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New Frontiers of the Automobile Industry

Exploring Geographies, Technology, and Institutional Challenges

Edited by Alex Covarrubias V.
Sigfrido M. Ramírez Perez

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For the stakeholders of the automobile industry worldwide, especially the workers.

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Introduction: Changing Geographies and Frontiers of the Automotive Industry

Alex Covarrubias V. and Sigfrido M. Ramírez Perez

The automotive industry (AI) shaped the industrial contours of the global economy in the twentieth century and continues to be a key player in the current vast socio-technical transition spurred by the digital revolution and the search for new mobility systems. While these processes evolve, there is a growing expectation that electrical and autonomous vehicles along with business and labor models based on online platforms and interconnected systems will come to transform the whole AI as we know it.

According to Sheller and Urry (2006) and Urry (2004), the AI created a powerful "system of automobility": that is, a powerful, car-dependent system that produced an archetypal manufactured object linked to the last century's iconic firms; a major item of individual consumption linked to images of social status and what constitutes "the good life"; an industrial

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complex linked to several other industries; and the predominant form of private mobility that subordinated other modes of mobility.

These features are still evident today, though they may adopt different expressions depending on economic, geographic, social, and technical borders. The fact remains that cars continue to be "freedom machines" for many: unique artifacts that provide solutions for the transportation of goods and people while encouraging personal expression. Indeed, few goods are as important for both people and society as cars are today. A 2015 study commissioned by the International Organization of Motor Vehicle Manufacturers (OICA) found that 57% of global consumers could not imagine living without a car and that cars are associated with unrivaled comfort, efficiency for daily travel, and a strong desire for ownership (TNS Sofres/OICA 2015).

The "system of automobility" rested on the powerful foundation of last century's industrial paradigm that shaped the productive, distributive, and institutional frameworks that regulated industrial society and that developed out of Henry Ford's assembly line. Based on this, the United States became the hegemonic center of the twentieth-century world economy, and mass production provided a technological and organizational template for other countries. Under the mass production paradigm, labor and management engaged in decisive battles and established collective bargaining agreements that both improved income distribution and were instrumental in unleashing the virtuous circle between production and consumption that lay behind the post-World War II economic boom. It was the golden age of capitalism, a period that extended to the first half of the 1970s (Piore and Sabel 1984; Field 2011).

This book recounts the frenetic state of transformation within which the global industry and automakers currently find themselves. For this purpose, a group of specialists from the sector's 18 large jurisdictions look at the processes, results, and tensions being experienced in the AI, a product of the interaction between emerging geographies (new countries, leaders, and institutional frameworks) and disruptive borders in transition (technological, organizational, institutional, business models, and labor relations).

This introduction presents the ideas and logic of these evolutions, our analytical framework and propositions to study them, the structure of the book, and each contributor's main findings. Before going to that, it is worth describing the prominence of the global automotive industry.

The Large Legacies of the AI

Many facts and data attest to the legacy and wealth of the sector.

Global auto industry revenues reached $3.8 trillion in 2018 after growing at an annual rate of 3.3% for the last five years. This means that if auto manufacturing were a country, it would be the fifth largest economy in the world, after the United States (with a GDP of $20.4 trillion), China (14), Japan (5.1), and Germany (4.2).[1]

The 11 largest auto makers (henceforth, OEMs)[2] appear in the top 100 of the 2018 *Fortune Global 500*, namely Toyota (ranked 6th), VW (7th), Daimler (16th), GM (21st), Ford (22nd), Honda (30th), SAIC (36th), BMW (51st), Nissan (54th), Dongfeng Motor (65th), and Hyundai (78th). Even the largest auto parts corporation, Bosch, is amongst the top 100 (ranked 75th). The sector, therefore, occupies a 12% share of the top 100 global corporations and 20% of the top 10 (Fortune 2018). These auto corporations manage more resources than most of the world's economies. Toyota's and VW's revenues are only next to the wealth of the world's top 16 economies. Put differently, their economic reach is greater than that of 169 nations.

The industry foments the image that it drives economic growth, competitiveness, and the catch-up effect, to the extent that each year, developing and emerging countries try to either make inroads into or consolidate a position in the sector. While one billion cars were manufactured in the twentieth century, largely in the United States, Western Europe, and Japan, in 2017 alone, 40 countries manufactured 97.3 million vehicles: 73.5 million cars and 23.8 million commercial vehicles. The auto industry's reputation is reinforced with well-known economic facts: for a typical, robust auto-producing country, the industry is the largest durable manufacturing activity, a net exporter, a major generator of international remittances, and an important source of research and development (R&D) as well as providing formal, skilled employment.

Spending on automobiles accounts for a large portion of the total consumer spending. In developed countries, this figure is around 10%; however, variations are sizeable. In the United States, spending on vehicles averaged $8427 in 2016, representing 14% of the total consumer spending.[3] In less developed countries, this can be much higher. For instance, in Mexico, spending on vehicles can be as much as a quarter of total personal spending (Covarrubias V. 2017).

In 2017, cars were the world's number one export product with a net value of $740.1 billion, up 9.2% from 2013 (Workman 2018). Ten countries accounted for more than three-quarters of all exports (Germany, Japan, United States, Canada, United Kingdom, Mexico, South Korea, Spain, Belgium, and France), with the European countries alone representing a 55% share of these. The automotive industry is a leader in R&D spending and numbers of engineers employed. According to the Center for Automotive Research (CAR), it accounts for 16% of the total R&D funding for all industries with a $100 billion annual budget: the five largest OEMs are among the top 20 corporate spenders on R&D worldwide, and the sector hires more engineers per 1000 jobs than any other industry (Center for Automotive Research (CAR) 2014: 1–2). Additionally, the industry maintains backward linkages with many other industries, such as steel, iron, aluminum, glass, plastics, carpeting, textiles, computer chips, and rubber, while its forward linkages connect to the powerful oil industry and such diverse service providers as financing, insurance, advertising, marketing, parking, repair shops, and aftermarket.

Just as it plays a key role in propelling countries to catch up and remain competitive in the global economy, the auto industry is also one of the major industrial employment providers. Around 5% of manufacturing jobs are direct auto jobs. Furthermore, when considering that for each direct job the sector impacts five indirect jobs, the auto industry is related to more than 50 million jobs. These correspond to both the different tiers of auto parts and component suppliers as well as to retailers and services.

Given its impact on labor markets, the automotive industry has been pivotal in defining the frontiers of the labor-management relationship along with the aspirations of thousands of workers, including skilled and technical labor, in acquiring higher incomes and moving up the social ladder. The fact that assembly plants were conceived as vertical industrial complexes, integrating all materials, processes, and technologies needed to engineer a car, meant that they were industrial settings operated by thousands of workers. Plants thus became ideal work places for union activity that ultimately had one of the highest rates of labor unionization in entire economies. By the second half of the last century, the auto industry was not only home to some of the most far-reaching battles between labor and management but also gradually became a trendsetter for collective bargaining. During the second half of the twentieth century, the United Autoworkers (UAW) and automakers in the United States crafted labor agreements that provided a role model at both the national and international levels. The main features of this labor model were mechanisms for improving compensation, benefits that protected employment, standardization of wages and work rules within and across firms, and job control unionism, including detailed job classifications, seniority rights, and work content conditions (Katz 1985).

The Industrial Union of Metalworkers (IG Metall) became the largest union in Germany and the largest industrial union in Europe. Once again, the collective bargaining agreements of its automotive branch, particularly those established in the car-making hub of Baden-Wuerttemberg—home to Daimler and Bosch—were trailblazers in the country. In Brazil, the Metalworkers union created the *Central Unica dos Trabalhadores* (CUT) in the ABC region of Sao Paulo, another car-making hub, from which emerged both templates for labor contracts for the rest of the country as well as the Workers' Party and Luis Ignacio Lula, a former metalworker, who would later run the country as president. Auto unions were even the first to build international networks to deal with corporate globalization. As early as 1966, the UAW created union networks at the Detroit Three. In summary, the combination of powerful unions and leading firms created a legacy of higher wages, better benefits, and greater labor security in the automotive industry.

This data tells the story of a centennial industry that holds enormous economic, technological, and labor importance and that continues to be a vibrant player in the global economy. Nevertheless, over the last four decades, the automotive industry has been experiencing profound transformations that are currently converging with changing environments and a myriad of institutional demands brought about by the digital revolution. As a result, the sector is transitioning and reshaping itself in the midst of the most disruptive environment it has ever experienced.

Changing the AI's Footprint

Evident today is a different and evolving industry geographical footprint. While shrinking in developed countries (DCs), automotive production centers and markets are skyrocketing in emerging countries (ECs). In fact, since 2009, ECs produce more and have a larger market share than DCs. China alone is manufacturing almost one-third of global vehicle output (more than 30 million units annually) and claims a similar portion of market share. Faced with this new geographical configuration, the classic concept of territorial distribution in TRIADs has become obsolete, that is, the notion that the industry is contained within regional production systems dominated by the United States in North America, the DCs of Western Europe, and Japan in East Asia (Dicken 2007). Specialists from the International Network of the Automotive Industry and its Employees (GERPISA) had called attention to the tensions in an industry established in a "world of regions," composed of regional economic spaces (EU, NAFTA, ASEAN, and Mercosur) in the midst of the era of globalization (Carrillo V. et al. 2004). Nevertheless, less than two decades later, none of these blocks are what they were envisaged to be and neither their members nor leadership remains the same. The epiphenomena of China in Asia, Brexit in Europe, and the new USMCA[4] in North America represent processes where governments and actors are intensely disputing the dominance of the industry in local and global markets. President Trump's rhetoric, on introducing the USMCA, will become a part of economic history for revealing how behind the search for new trade rules and regional investment lie unresolved reactions to the loss of leadership in strategic industries such as auto manufacturing.

Jullien and Pardi (2013) identified that these tendencies have created a double restructuring process of the old industry concentrated in the TRIADs and the structuring of a new upcoming industry in the ECs. As a result, new complexities have been added to business strategies, testing the goodness of fit between product strategies and a greater variety of markets as well as the organization of productive chains and governance commitments between actors. While the previous regional containment of the industry has cracked, the outcome of these tensions is currently unpredictable. What is the current state of the restructuring and structuring processes noted above? With what actors and via what logic do they dispute the dominance of the AI? This book seeks to answer these questions.

The technological frontiers of the industry are undergoing similarly profound changes. At the end of the twentieth century, warnings of climate change and greater governmental regulations for controlling emissions and pollution drove a search for alternative systems of engine propulsion and low carbon technologies. This was aggravated as ECs intensified environmental contamination problems from private automobiles based on internal combustion engines (ICEs). With growing public scrutiny and regulations for the control of contaminating emissions,[5] auto producers have accelerated experimentation with a range of alternative powertrains, mainly with electric vehicles (EVs) including electric batteries, fuel cells, hybrid-electric and plug-in hybrid vehicles, advanced ICEs, increasing the performance of combustibles and biofuels, and so on.

OEMs had only just begun accommodating to the previous regulations, when the progress toward highly interconnected production systems, artificial intelligence, and the Internet of Things (IoT)—the very strings of digital technologies—once again shook the industry. Two possibly disruptive events have been central to this: experimentation with driverless, autonomous vehicles (AVs) and new business and labor models based on online platforms and shared-mobility services. These possibilities are personified in new players such as America's Tesla and Uber, Asia's Ola and Didi Chuxing, and high-tech disruptors like Google-Waymo, all of which are making inroads into the sector. OEMs, while stating their readiness to respond to these and become the architects of an era of *new mobilities*, are frantically searching for alliances with new players and amongst each other. Once again, behind this lies a fierce battle for, if not for industry leadership, then at least for survival.

With changes at the top and the technological trajectory on its way, the final result is being processed and disputed on the local level. It is an environment in which government policies are becoming more important than ever. Contrasting priorities are evident in state policies aimed at saving its OEMs with the injection of historic levels of resources, versus the focus on dominating the emergent paradigm of AVs-EVs, versus attracting investment and employment with low salaries, versus those that bet on a new industry of sustainable mobility and integrated transportation services, versus policies aimed at fomenting innovation in the technological paradigm of the twentieth century in order to make ICEs more efficient and extend the life span of the oil era, and so on.

Hence, it is important to watch how the introduction of these new technological paradigms and business models in the main global jurisdictions of the industry evolves, as well as how the strategic interactions play out between *incumbents* and *newcomers, as well as between them* and their government institutions and policies. This book looks at this evolution in the 18 main countries in the sector, nine DCs and nine ECs.

The Machine That Changed the World of Womack et al. (1990) predicted that lean production would eventually triumph to become the standard in the industry, bringing about its "bundles" of human resource practices that harness organizational commitment while fulfilling a cooperative labor relations environment (MacDuffie 1995; Lincoln and Kalleberg 1990; Florida and Kenney 1996). The prediction failed miserably. The Japanese financial and monetary crisis of the 1990s uncovered the weaknesses of the lean system, and at the turn of the new century, even Toyota had discarded key traits of those practices, such as lifetime employment, promotion from within, and yearly wage hikes.

Automotive labor markets are growing rapidly in many ECs, challenging the capacity of existing institutional arrangements to train, hire, certify, and pay workers accordingly and to govern the labor-management relationship. In contrast, labor markets of the DCs, particularly the G7 countries—the United States, Canada, Japan, Italy, France, Germany, and the United Kingdom—have either shrunk or stagnated. The most visible impact of this has been on unionization rates and the rights and incomes of workers. The United States reflects one extreme of what has been defined as the race to the bottom. In 1978, the industry in Detroit had about 1.1 million jobs. Three decades later, this had been reduced to 945,000. Similarly, in 1987, membership of the United Automobile Workers (UAW) stood at around one million, and two decades later, it reached its lowest point at 355,000, while salaries declined by a third. The displacement of the industry toward ECs stimulated this race to the bottom, particularly in cases where the industry relocated to Mexico in the NAFTA region and toward Central Europe in the single European market. Many early studies argued that the real or threatened possibility of moving more production to these areas of cheap labor would provide management with greater leverage to call for wage freezes and labor concessions (amongst others, Charron and Stewart 2004; Jürgens and Krzywdzinski 2009; Cardoso and Covarrubias V. 2006).

Furthermore, the AI has not escaped from the global industry trend of the last 30 years that has seen a growing gap between productivity and salaries. This has meant that many of the jobs created both in ECs and DCs are precarious. After four decades of market and employment relations easing, and deregulation following the neoliberal credo, little remains of the era in which participation in the automobile industry was a guaranteed ticket to social advancement. This has tended to be replaced by low salaries and less social protection, especially for new workers. Nevertheless, these elements of labor relations are neither uniform nor universal (Pardi 2017). Variations are subject to the institutional legacy of each country as well as to the balance of power of the industrial relations system, and in particular, in the capacity and response strategies of organized labor. For example, in Germany, the system of co-determination and work councils as well as the rights of automobile workers have remained largely unchanged. Meanwhile, in such ECs as the BRICs (Brazil, Russia, India, and China), the boom of the industry has created an accelerated process of labor segmentation where a reduced core with better income and job security contrasts with the rest of the workers, subject to subcontracting, outsourcing, lower income, and no or limited rights (Jürgens and Krzywdzinski 2016).

Industry labor markets and employment relations have fabless companies/non-employment relationships on the horizon, as evident in mobility online platform business models such as Uber. These are two different labor markets—one representing formal employment and protected by traditional industrial social contracts, while the other represents the *gig economy* of flexible, part-time jobs undertaken by *freelance-independent contractors*. It is unclear at what point the 2.5 million drivers around the world that Uber, for example, has, offering ridesharing with their own cars and without any contractual relationship with the company could intersect with the established industry and directly affect its jobs.

Similarly, with the adoption of EVs, it is not clear how long it will be before the technology poised to displace the dominant paradigm of ICEs together with the introduction of autonomous vehicles (AVs) will in fact replace it. What is certain is that it is currently in an experimental phase in which its actors are yet to sit squarely with a profitable business that allows them to successfully navigate variables such as balance of costs and range and security of movement, as well as adjustments in government regulations (Covarrubias V. 2018). As such, companies such as Tesla and Uber continue to lose money while investors continue to bet on their future, elevating their market value above that of most OEMs.[6]

The Electric Vehicles Initiative, driven by the International Energy Agency, proposes in its *EV30@30 Scenario* the goal of reaching a 30% market share for EVs by 2030. By 2018, 5 million EVs were on the road globally, and sales hit 2 million, with more than half of these in China (Energy Agency (IEA) 2018). Nevertheless, EVs still represent no more than 2% of the market share. Regarding AVs, a prospective study (Arbib and Seba 2017) estimated that in the ten years following the approval of regulations for their circulation, the AVs-EVs combination will comprise as much as 60% of vehicle fleets, at least in the United States. Independent of the accuracy of this prognosis, the introduction of AVs-EVs will impact considerably the labor markets and employment relations in the industry. EVs have a sixth of the parts of a traditional ICE; its assembly takes 30% less time, and a battery plant requires a fifth of the workforce of an engine plant. One study commissioned by IG Metall found that of the current 840,000 jobs in the German auto industry, 75,000 gearbox jobs will be at risk by 2030 due to EVs. The same will occur with half of the 210,000 jobs tied to powertrain production,[7] while AVs will directly impact the three related areas of industry, namely transit, logistics, and trucking. It is also possible that AVs will impact driving habits and the demand for vehicles; however, evidence of this is still not conclusive.

Between the two extremes of the United States and Germany described above lies a gamut of labor reconfigurations in evolution. The same applies to gig jobs generated in new mobility services and the jobs that are, or will be, substituted with the advance of AVs and EVs in industrial settings.

Keeping track of these labor markets and industrial relations, reconfigurations is another research agenda to be pursued and to which this book will contribute.

Analytical Framework and Propositions

The automotive industry has been the center of scientific debates in analyzing the precipitous transformations seen in both countries and industries since the last quarter of the twentieth century. From a historical perspective, over the past 40 years, two main issues have occupied the attention of industrial development specialists: the crisis of Fordism and the crisis of the dominant industrial paradigm based on the dyad of ICEs-oil fuels as it confronts the digital revolution and the demand for alternative propulsion systems. While the former gave rise to the Post-Fordism debate, which took place from the 1980s to the first half of the new century, the latter has led to a debate around the transition or disruption of the old automotive paradigm and has intensified in the last decade. None of these two debates have been resolved satisfactorily, and their conceptual propositions have been either contradicted by reality or been unexplainable. Predictions from Post-Fordist theories have not materialized, while the ongoing debates are partial or inadequate for explaining the current transformations. This is in part because they are mistaken, at the moment, of defining the nature and the driving forces of the transformation. Their focus, which aims to understand the processes of industrial change that began with developed countries and their traditional OEMs, reveals their bias, which prevented them from understanding—as we show at the end of the book—that the axes of change are relocating to the emerging economies of Asia, where the actions of developing states are now exerting a greater influence on the course of the transition. There is a need to construct new analytical frameworks in order to problematize and propose approaches with greater explicative and predictive capacity.

In this section, we identify the conceptual parameters and realities that have enveloped these debates to date in order to identify the problems related to their internal logic and to outline the conceptual logic that is now needed.

The Post-Fordist Debate

The end of the post-World War II economic boom and the beginning of the era of stagflations in the 1970s are associated with the end of the manufacturing expansion of the American automotive industry. With the decline of manufacturing and jobs, the automotive industry was marked with the debate about the crisis in the Fordist model of mass production. As originally developed by William Abernathy, it entailed a productivity dilemma by which the high levels of capital required by mass production implied expanding markets in which to place standardized products at a large scale, blocking innovation and affecting the capacity to increase productivity. The Post-Fordist debate revolved around interpretations of how the dominant forms of industrial organization were being transformed as well as the industrial trends that would characterize new dominant paradigms.

The version popularly known as lean production legitimized intellectually the triumph of the Japanese production system as the new dominant paradigm. It argued that its socio-organizational advantages (Keiretsu, Kanban, and Kaizen systems, together with the development of work in social groupings, such as work teams and bundles of human resource practices, in order to attain high levels of labor commitment)[8] had sufficient conditions to transform industrial development and install a new world hegemony (Womack et al. 1990; Lincoln and Kalleberg 1990; Florida and Kenney 1996; MacDuffie 1995; MacDuffie and Helper 1997). Toyota—and later Toyotism—personified the great transformation that was taking place, being at the vanguard of lean production practices. Thus, an interpretation of socio-technical determinism was developed at a company level, but without sufficiently addressing the environmental, institutional, and market conditions in which firms operated. Neo-Schumpeterian economists like Perez and Freeman (1988) predicted the new hegemony of a Post-Fordist paradigm based on information and communication technologies (ICTs) that would underpin a new wave of industrial innovations. Their influence would extend into variations of the theory for national and sectorial systems of innovation. However, their greatest limitation lay in failing to consider how institutions and production systems could perform a function different from that of supporting an economic model dictated by technological developments.

As an alternative to the lean production as successor of Fordism, Piore and Sabel produced an elaborate work that was disseminated as flexible specialization theory. They showed that the major industrial divisions in history were resolved not only in the midst of technological tensions but also amidst complex conjunctions between these and the political battles to define new frontiers of industry and the institutions that would be needed to regulate it. The results were contingent configurations, highly dependent on strategic decisions by the actors. The Fordism crisis was the result of the saturation of standard markets and the move toward segmented markets, which could be imagined as the tension between the industrial organization of mass production and the evolution of old and emergent ways of craft production referred to as flexible specialization (Hirst and Jonathan 1991). They defined a move toward a second industrial divide where industrial organization around flexible specialization will replace the mass production paradigm, contrary to what had occurred in the first industrial divide.

Applying this to the automotive industry, Katz and Sabel (1985) envisaged that OEMs would have to embrace flexible specialization to produce specialized vehicles in order to meet the demands of particular groups. Then, they derived profound implications on an industrial and labor relations level. Instead of seeing labor as a cost, firms would invest in and equip workers with technical skills and job security to create a virtuous circle between new technologies, polyvalent and participative workers, and more specialized products (Amin 1994).[9]

The French Regulation School made a solid effort to escape the trap of technological overdetermination. The concepts of modes of production articulated by accumulation regimes that result from social and political battles to define the institutions that would mediate between social classes, contributes to avoiding explanations of historical determinism (Boyer 1986; Leborgne and Lipiets 1988). However, they did not escape the schematism of identifying phases of development that capital accumulation regimes would have to pass through. The notion that we would be faced with the transition from a Fordist regulation regime to a semi-flexible mode of regulation corresponding to Post-Fordism is born out of this schematism.

The greatest application of the theory of regulation was the study of the development of the productive models of automotive firms by Boyer and Freyssenet (2002, 2016). Their analysis emphasized that there is not a one best way but rather a plurality of productive models, which is articulated between firms' strategies (in particular, profit strategies) and modes of national production (specifically, growth model). They conceptualized the mediating mechanisms of this articulation in terms of governance compromises made up of product policy, productive organization, and employment relations. The assumption is that these mechanisms must make up a nexus of coherent responses to the requirements of profit strategies. Despite the empirical challenge of showing how OEMs can achieve such different levels of coherence, these authors were able to design a typology of the various profit strategies which had been successful historically for OEMs, including those from the same country and type of capitalism. Their merit lies in their ability to show that rather than one, there are multiple productive models that can be followed in order to achieve profitability.

When the economic conditions changed in the 1990s, and following the collapse of the asset price bubble, the Japanese stagnation period began that would last until 2010, heralding the collapse of lean production. At the start of the new century, the continued problems in Japan and Toyota's own adjustments to its traditional Keiretsu, Kanban, and Kaizen systems silenced those who had predicted a "lean" industrial future. The momentum of globalization and the visible contradictions of an industrial world organized in regional blocks likewise stalled the Post-Fordist debate as its propositions also failed to materialize. A new, extended wave of growth and innovation did not happen as the Post-Fordist paradigm had argued; a semi-flexible mode of regulation did not occur; and the industrial world was not divided between flexible specialization and mass production frontiers. The promoters of flexible specialization as well as the regulationists called for a neo-Keynesianism aimed at entities of international government, as a condition for a new era of prosperity. Instead, however, neoliberalism installed itself as the dominant public policy. In contrast to the predictions of the proponents of lean production and flexible specialization, instead of new labor relation regimes with more worker rights and in which workers would no longer be considered a cost, the growth model that emerged rewarded a type of consumption based on a regressive income redistribution that led to industrial job insecurity and attacked labor organizations. The mechanisms of global governance were weakened and an international division of labor was created that exacerbated the differences between rich and poor nations as well as between classes and social groups within countries. The automotive industry, in particular, following a shaky recovery in the 1990s, experienced further instability in the first decade of the twenty-first century.

The evident trend of automobile companies toward increasing financialization made them very fragile given their increasing dependence on financial markets and shareholder value (Froud et al. 2002). It is not surprising that the global financial crisis of 2008–2009 with the collapse of automobile market put OEMs on the verge of financial bankruptcy, in particular due to their financial subsidiaries, which had served to provide funding for maintaining consumption. The financialization facilitated and encouraged a wave of mega-fusions that further concentrated the platoon of leaders and drove the former American Big Three to bankruptcy and their ensuing bailout. Without the massive intervention of governments, automobile companies would have taken much more to recover even when they proceeded to carry out a strong restructuring of the whole supply chain and compress further wages of working conditions.

The Crisis of the Old Paradigm and the Move to Alternative Mobilities

The rebound of the industry—with global growth rates between 3% and 4% over the last ten years—was equally spectacular and has continued to date.[10] Nevertheless, a very different industry has emerged from the crisis and its recovery. First, China and a group of emerging countries have become the driving markets of the industry. Second, given environmental and institutional pressures to control polluting vehicle emissions, OEMs have begun to experiment with EVs and other drive systems. Third, in recent years, advances in the digital revolution, smart devices, connectivity, and online-based services are causing a major disruption in the industry with a range of newcomers and established high-tech companies and start-ups entering the industry and offering or experimenting with AVs, EVs/AVs, e-mobility services, and a growing spectrum of car-sharing and car-hailing alternatives. Fourth, the OEMs are faced with the dilemma of renewing or dying and consequently—supported by the bonanza of the past years and the dynamic of the world market for traditional cars that increased to 100 million units per year—have entered a frenetic state of strategic decision-making. Characteristic of this is the policy of alliances between themselves as well as with newcomers, and the continuous adjustments to their strategic plans.

Again, as at the end of last century, academic debates and interpretations have multiplied. Freyssenet (2009) spoke of the beginning of the *Second Automotive Revolution* in terms of a change in the technological paradigm: from the ICEs-oil fuels dyad to alternative environment-friendly drive systems, out of which two contrasting positions have emerged. The first stresses both the dynamics of continuity as well as the ability of OEMs to maintain their lead (MacDuffie and Fujimoto 2010; Jacobides et al. 2015). Within this, Smitka and Warrian (2017) emphasize that no disruption is on the horizon, neither technological nor in terms of business models. Others, advocating for a transition toward an ecosystem of new mobilities, suggest a shift aimed to disrupt the whole transportation sector that will be replaced by an ecosystem with new propulsion technologies (EVs/AVs based), urban planning, and business model propositions (Attias 2017; Donada 2013; Donada and Perez 2016; Codani et al. 2016; Attias and Mira-Bonnardel 2018). They argue for a new mobility paradigm based on "robomobiles" that will, in turn, be the basis of a new space-time relation encoded in smart cities that are sustainable, digital, connected, and innovative.

Between these two positions are various interpretations of the multiple stages through which the industrial transition is passing. One group is focused on explaining why the introduction of alternative automobiles and *the greening of the industry* are advancing slower than predicted and how this is affected by institutional factors (varieties of capitalism), path dependency (business models, markets), lock-in mechanisms, and socio-political constraints (Calabrese 2012; Mikler 2009; Clark-Sutton et al. 2016; Geels 2014; Covarrubias V. 2018; amongst others). Another group, particularly interested in the dissemination of EVs, has focused on the constraints to speeding up the transition by considering objective factors—that is, fuel prices, range and prices of batteries, alternative energies, and charging infrastructure—versus subjective ones—that is, consumer behavior, car-ownership orientations, cultural values, and so on (Pasaoglu et al. 2013; Shoemaker 2012; Liu et al. 2013; Whitmarsh and Köhler 2010; among others). A third group has looked at the supply-side variables—shares of car production, number of EV prototypes, and policy instruments such as grants, subsidies, and support for infrastructure and R&D—versus demand-side variables—EVs' share of sales, customer driving experience, and so on (Clark-Sutton et al. 2016; McKinsey and Company 2016).

These interpretations have various limitations. While they all agree that something big is underway, everything else is up for discussion: the nature of the change, its reach, its driving and restraining factors, its temporality, its probable outcome, and so on. Frequently, the issues under study are extremely different and thus it is impossible to establish either communication between schools and authors or the validity of the proposals. As we have seen, the central problem for some is the change of technological paradigm (Freyssenet 2009), and for others, it is the leadership of the industry (OEMs vs. high-tech or newcomers, Smitka and Warrian 2017, MacDuffie et al. above), or whether there has been disruption or a new business model (Christensen et al. 2015; Habtay and Holmén 2014; Chesbrough 2010; Markides 2006), while a fourth broad group attempts to document the factors that impede the transition (the EVs promoters above). The problem with these and similar interpretations is not that they are wrong about their particular issue—their arguments may be more or less correct and maintain a consistent logic with what they are attempting to show—but rather, the problem lies in that when looking at another dimension of the transformation, instead of acknowledging their limitations, what they can and cannot explain, they tend to provide a general overview of the industry. They commit the classic bias of confounding the particular—derived from isolated premises or evidence—with the universal.

One broad group aims to build a new narrative with performative ambitions about the prosperity that a paradigm of new mobilities may bring (Attias and others, above). They agree with the various international consulting agencies who would argue that the radical disruption of the industry is already evident (e.g. McKinsey and Company 2016; Forbes 2017; Berger 2017). According to these interpretations, the emergence of the EVs/AVs gives present value—that is, in the era of the digital revolution—to the promises of prosperity that promoters of lean production and flexible specialization had offered decades previously. The only difference is that instead of a new world of work nurturing a high-road strategy, the goal is now intelligent transportation: lower congestion, better safety, digital solutions, "multidimensionality," zero carbon society, car sharing, the circular economy, and responsible public policies committed to redesigning the urban landscape in which these can all flourish.

A widespread problem of these interpretations contains what we refer to as a Western bias, in the sense that they understand the processes of industrial change with a logic that focuses on advanced economies and their OEMs as the objects of change. Thus, in one of the mainstream frameworks—that of value chains—the destiny of emerging countries and their actors appears predetermined. They are defined as either living in the shadow of the DCs while waiting their turn in the stages of maturation and technological imitation or beginning catch-up and upgrading processes for the global value chains commanded by dominant corporations (Gereffi et al. 2011; Sturgeon et al. 2014; Gereffi 2018). For these interpretations, the strategic decisions that inaugurate or anticipate eras of change are taken at the firm level, while government institutions, in the midst of resistance and power struggles, end up providing the arrangements that will regulate or impose externalities on the productive, technological, and labor commitments of private actors. We will see that with the geographical weight and increasing leadership of the Asian ECs, these arguments do not hold.

Another Analytic Model to Study the Industry Transition

The path toward a comprehensive approach to the current transformation of the industry includes redefining its nature, its geographical relocation to the ECs, and the reconfiguration of the geometries of power, which adjust its technological, organizational, labor, and institutional boundaries and define its future. Furthermore, it is necessary to define the role of the state and its public policies, and their weight in the transformation vis-à-vis the positions of incumbent OEMs and newcomers as well as in terms of labor actors. This is due to the fact that the role of the state versus productive agents, firms, and labor is different in ECs than in mature economies: in ECs, the state has been a structuring agent of their productive and social life at key historical moments. The transition of the industrial regime of the sector will be decided by these three factors—geographical borders, geometries of power, and new configurations of agents and value propositions.

From the perspective of the sustainable transitions theory, we define the current industry transformation not as a change, but rather as a socio-technical transition. From a product life cycle viewpoint, the axes of the industry have moved to the ECs due to basic market reasons for a mature product such as traditional cars as well as for products in early stages of development and introduction, such as EVs and AVs. From the perspective of public value and public purpose theory, we contend that the state is now acting as the main agent affecting the developments of the sector. From a dialect issue life cycle view, we argue that the transition is currently in the stage prior to radical disruption, where agents experiment, refine alliances and prepare to define the direction of the changing industry.

A socio-technical transition occurs when what is at play is not only the change of the industry's technical-technological trajectory but all the deep structures of technical capabilities and routines, industry beliefs and mindsets, mission and identity (value propositions), as well as formal policies and regulations that integrate an industrial regime. These structures are embedded in an environmental landscape of economic and socio-political dimensions (Geels 2014; Geels and Penna 2015). Such is the nature of the epochal transformation currently occurring in the automotive industry.

The change is not one of sustaining innovations (Christensen et al. 2015), but a radical reorientation of the industry. As a result, and given that industrial regimes have structures anchored in production, policy, consumption, and cultural practices, the transition is a long-term process. In addition, incumbent OEMs have vested interests and are locked-in with investments in technologies, knowledge, and people that make them resistant to radical innovations.

In order for a radical reorientation or disruption of an industrial regime such as the automotive industry to occur, it needs to pass through various phases. The Geels (2014) and Geels and Penna's (2015) Dialectic Issue Life Cycle Model (DILC) identifies five phases that result from the interaction of socio-political, economic-market, and institutional pressures for change and incumbent strategic responses. In phases 1 and 2, incumbents stick to piecemeal changes and improvements; in phase 3, they move from hedging to exploring at R&D levels; in phase 4, they prepare for strategic diversification (changing and increasing technological capabilities); and finally, in phase 5, they begin a radical regime reorientation (changing beliefs and mindsets and embracing the innovation race). That is, the first three phases are characterized by firms' defensiveness and reluctance to make substantial changes, while in the latter two, they transition to proactive and radical stances.

Covarrubias V. (2018) has identified that the AI is currently between the third and fourth phase of this transition, defined by intense exploration of alternatives and mechanisms to adjust its industrial regime. It is also defined by a moment of strategic diversification in which, while fighting to prolong the validity of its old technological trajectory, the industry is constructing strategic alliances to introduce new vehicles (EVs/AVs), business models (e-mobility services), and organizational structures. A crucial aspect of this redefinition is the reconfiguration of its value propositions—what, how much, how, when, and where to produce. The author also emphasizes that until now, the only radical reorientation undertaken by incumbent OEMs is on the level of its industrial mindsets. Thus, currently, all claim to be manufacturers of "mobility solutions" and not just producers of vehicles. It is suggested that only when consumer preferences change, and the demand for alternative vehicles exceeds that of traditional vehicles, will the industry transition to a complete replacement of its still-valid current industrial regime.

Our fundamental assumption is that in order for this to occur, a push from outside the established industry is needed, rather than from within its geographies or its techno-organizational borders. The push will come from an entrepreneurial state (Mazzucato 2013), situated in the geographies of the

ECs, and in particular, from the governments of China, Korea, and India, who are taking the lead in this aspect. That is, the phenomenon is already underway. On one hand, markets and car manufacturing centers have relocated to ECs, with the Asian ECs at the forefront and China alone accounting for a third of the supply and demand of vehicles worldwide. From the product life cycle viewpoint (Levitt 1965; Anderson and Zeithaml 1984), these tendencies are not only predictable but also irreversible. After a century of industry, demand for cars is declining in the markets in which they were born. Meanwhile, the cycle is restarting in the ECs—where markets are virgin—or being reinvigorated. Chinese, Indian, and Korean firms already account for nearly a fifth of traditional vehicle production and more than half of alternative vehicles, such as EVs and others. Furthermore, half of the market for these emerging technology vehicles is already in China. These factors interact to create a new geometry of power in the industry.

The essence of these geometries lies in who takes leadership and can make a difference to the course of the industry. We will show that the actors from the West are losing while those in the East are winning. Through the lens of public value perspective and public purpose theory (Mazzucato 2013, 2018), the most impactful variable for explaining changes in the geometries of power is the performance of the entrepreneurial state in these nations, to the degree that the disruptive force of the industry does not originate in private firms, but rather in governments that pull firms forward in a strategy orchestrated to take control of the industry.

The South Korean state embarked on this path in the final third of the last century when it forged its own industry through a go-it-alone strategy. It prompted OEMs to license their technologies, and selected and forced domestic actors—through R&D programs, financing, and regulations—to develop their own vehicles. It did this with such entrepreneurship and leadership ability that at the beginning of the twenty-first century, its emblematic firm, Hyundai-Kia, was one of the top ten global OEMs. It followed a similar path with other strategic industries (such as heavy equipment, shipping, electronics, and petrochemicals), building other emblematic leaders such as Samsung, LG, SK, and KT in the then-emerging ICTs. The result is well known: South Korea became the only country able to migrate from EC to DC and locate a group of its own companies amongst industry leaders in high technology.

Both the Chinese and Indian governments are following this path with such force that the processes of reconstruction of the old industry and the structuring of the new, identified by Jullien and Pardi (2013), are now largely influenced by these countries and their internal markets. As a result, and keeping in mind their increasing impact on global demand with the growth and consolidation of their internal markets, they are changing the architecture of value chains and demanding a regional focus in the industry.

From a theoretical-practical perspective, the cases of Korea, China, and India reflect the fallibility of the theory of global value chains (GVCs) (Gereffi et al. 2011; Sturgeon et al. 2014) that world governance organizations such as the OECD and the World Bank had adopted to further promote their neoliberal credo. This is the one-way path in which ECs experience processes of upgrading and catching up through the GVCs by accelerating the implementation of structural reforms that attract growing flows of Foreign Direct Investment (FDI). Mexico is a case in point, with results that are contrary to what is postulated by the theory. After half a century of attracting FDI flows and becoming one of the three hotspots in the global automotive industry for OEMs, Mexico has been unable to advance in upgrading and catching up, other than in processes—not in terms of products and even less so in design. Furthermore, it does not have its own industry and largely depends on cheap labor to preserve its competitiveness. In comparison with the Asian entrepreneurial state, what we refer to here as the *Mexican Syndrome* represents the unintentional effects of being inundated by GVCs and FDI flows.

The new geometry of power will generate a tipping point that might break the industrial regime based on ICEs, threatening the leadership and industrial mainframes of the West. This will occur when their markets begin to produce and consume mainly EVs/AVs, causing a ripple effect that will definitively alter the global value chains of the industry. This shift in markets, with an epicenter in Asia, will accelerate to the degree that Japan, spurred by the need to end its external dependence on fossil energies, begins to manufacture and demand EVs/AVs as well as various modalities of e-mobility services and car sharing that will also be useful given the shortage of space in the country. Other Asian countries, such as Pakistan, Thailand, Malaysia, and Vietnam are likely to join the momentum as they begin to explore their own paths in the industry.

This will not occur without a geopolitical conflict. Geographically, the western powers with the strongest interests in the established industry will react with force. The protectionist and nationalist tendencies personified by the Trump administration in the United States and by Brexit in the United Kingdom, as well as the US-China trade war, are part of the tension and conflict that could intensify in future in the dispute for the industry's geometries of power. It is predicted that, given these tendencies, the legacy OEMs, with the support of their governments, will strive to prolong as long as possible the old industrial regime in their home countries, while creating equations for new business models that will allow them to provide a growing selection of EVs/AVs and car sharing.

In the latter scenario, they will need to deterritorialize completely, relocating their entire production of traditional vehicles to export platforms based on cheap labor, such as Mexico. This will allow them to experiment with business models connected with design and provision of e-mobility and connectivity services—the direction that the value architecture of the industry will increasingly take—while the production and value of ICEs will commoditize in the opposite direction.

This is a story without the happy ending predicted by the theories of lean production, flexible specialization and Post-Fordism, bringing with it, in the immediate term, a more conflictual labor-management relationship. It will depend on the capacity of organized labor to negotiate, frontier after frontier, a destiny other than labor precariousness and to shape a new industrial regime with better working conditions. It is not a coincidence that in most cases the most relevant trade unions of the metal sector are at the forefront of sponsoring industrial policies which would guide this transformation in an orderly manner trying to preserve not just current employment but also the future of employment and also of work.

Book Structure and Authors Proposals

This book is the product of an invitation to specialists from the most important countries in the industry to analyze the transformations, tendencies, and challenges of the main issues we have identified: new geographies; new technological, organizational, and socio-technical frontiers;

new government policies and institutions; and new business and labor configurations. The authors were all asked to address the same questions: How are the automobile sector and its main players presently faring in their countries as to those challenges? What are the most important institutional, technological, and industrial relations and organizational environment legacies of the country and how do such legacies condition the responses of the main actors to the challenges posed by industry transition? Are there special public or private programs that foster the transition or promote alternative drive systems and/or new mobilities?

While these issues were proposed as referents for each author, they were not established as obligatory. Rather, given that the contributors are among the most qualified specialists in the study of the industry in their countries of origin, each was entrusted with following their own criteria in focusing on what they consider to be most relevant in the evolution of the automotive industry. As such, the book presents a single subject dealt with by a great diversity of disciplines, approaches, emphases, and interpretations. All the authors are part of the GERPISA network. We thank each one for their contribution as well as GERPISA itself. Still, this is not a GERPISA book, nor it is intended to represent its view. Each author is responsible for her/his own chapter's content.

The text is divided into four parts. Part I covers the G7 countries, with one chapter dedicated to each country. Part II looks at the contrasting cases of Australia, a country that has lost the industry, and Korea, which has risen to the category of DC, developing its own strategic industries such as automobile manufacturing. Part III deals with the cases of the ECs that are making a difference in the industry, namely China, India, Mexico, Brazil, and the cases of Poland, Hungary, the Czech Republic, and Slovakia in East-Central Europe. Part IV comprises two chapters that deal with a particularly critical problem faced by ECs in upgrading the industry, namely the deficits and tensions regarding their education and training systems in order to have the skilled workers required for OEMs. These are comparative studies of Turkey–Mexico and the Czech Republic, Hungary and Slovakia. In total, the authors detail 18 countries, nine DCs and nine ECs and their productive companies, particularly the automakers. Some authors make reference to auto parts companies and supplier chains, while others make these a central part of their study.

Other countries, such as Spain, Russia, Thailand, Iran, Slovenia, and Romania, are referenced in a secondary role by some authors and in the concluding chapter. A proper account of them and of other emerging jurisdictions making inroads in the industry such as Pakistan, Vietnam, and Malaysia will need another book.

In total, the countries that are the focus of this book produce 84.5 million vehicles, accounting for 87% of global auto production. They include 33 automakers, employing around 11 million people (Table 1.1).

In Part I, Chap. 2, Thomas Klier and James Rubenstein provide an overview of the US auto industry. Their study shows that while in 1950, more than half of the world's vehicles were registered and more than three-quarters were produced in the United States, in the twenty-first century, it is no longer the world's leading producer of vehicles, although it continues to be home to the largest number of them by far. Contextualizing the major disruptive forces currently facing the industry, they focus on critical aspects of the market and production of vehicles in the United States as well as on the role of the government.

In Chap. 3, Brendan Sweeney analyzes how shifts in the competitive advantages of Canada's automotive industry, namely innovative trade policies, labor costs, and productivity advantages vis-à-vis the United States, have affected production and employment. He examines the country's current industrial restructuring in the context of its shifting role in the global automotive industry. The author then assesses changes to industry structure, international trade, employment relations, and public policies implemented by the government to support the industry and concludes with a discussion of future prospects.

In Chap. 4, Ludger Pries and Nils Wäcken use the case of "VW Dieselgate" to analyze the tendencies and technological, social, and regulatory forces impacting OEMs in the search for a model for "greening the industry." With a focus on Germany and the VW case, the author shows that most OEMs have altered information regarding contaminating emissions, while pursuing an approach of incremental innovation. From an organizational theory perspective, Pries establishes that the direction and leadership of the industry will be defined by the management of factors such as path dependency in engineering, strategies impeding disruptive innovation, organizational culture, and contingent action dynamics.

Table 1.1 Countries and industrial settings under study

		Output			Jobs	
Region/countries		1999	2017	% change	2016–2017	Firms
G7	United States	13,024,978	11,189,985	–14	945,000	GM, Ford
	Canada	3,058,813	2,199,789	–28	125,000	
	Japan	9,895,476	9,693,746	–2	814,000	Toyota, Nissan, Honda, Suzuki, Mazda, Daihatsu, Subaru
	United Kingdom	1,973,519	1,749,385	–11	169,000	
	Germany	5,687,692	5,645,581	–1	857,000	VW, Mercedes Benz, Daimler AG, BMW
	France	3,180,193	2,227,000	–30	216,000	Renault-Nissan-Mitsubishi Alliance, PSA
	Italy	1,701,256	1,142,210	–33	166,000	FCA
Ascending/ descending	South Korea	2,843,114	4,114,913	45	321,000	Hyundai-Kia
	Australia	302,925	98,632	–67	27,000	
Emerging countries	China	1,829,953	29,015,434	1486	3,400,000	Geely, SAIC, ChangAn, Dongfeng, BAIC, SAIC-GM-Wling, Great Wall, Chery, GAC, Sac
	India	818,193	4,782,896	485	1,100,000	Maruti Suzuki, Tata, Mahindra & Mahindra
	Mexico	1,549,925	4,068,415	162	800,000	
	Brazil	1,350,828	2,699,672	100	12,222	
	Turkey	297,862	1,695,731	469	190,000	
	Poland	574,834	689,729	20	187,000	
	Czech Republic	376,261	1,419,993	277	168,000	
	Slovakia	126,831	1,001,520	690	72,000	
	Hungary	128,186	505,400	294	93,000	
	Slovenia	118,132	189,852	61	12,000	
	Romania	106,897	359,250	236	174,000	

(continued)

Table 1.1 (continued)

Region/countries		Output 1999	2017	% change	Jobs 2016–2017	Firms
	Subtotal	48,945,868	84,489,133	73		
Others		7,313,024	12,813,401	75		
	Total	56,258,892	97,302,534	73	11,056,000	

Source: Author's elaboration based on Statista, https://www.statista.com/statistics/620767/number-of-employees-in-the-automotive-industry-in-brazil/, and OICA data. Japan data, Japan Automobile Manufacturer Association, 2017, http://www.jama-english.jp/publications/MIJ2017.pdf. European countries, 2016 data, ACEA, https://www.acea.be/statistics/article/employment

European countries, 2016 data, ACEA, https://www.acea.be/statistics/article/employment

Australia, http://www.manmonthly.com.au/news/australian-automotive-sector-provide-35000-jobs-2018/

In Chap. 5, Tommaso Pardi analyzes the decline of the French AI. He shows that while most of the ad hoc measures taken during the crisis to prevent the collapse of the industry have proven successful, the attempts to address the structural causes of the decline and restore the long-term competitiveness of the sector have failed. He discusses its future prospects in the light of two ongoing major transformations: the shift toward electro-mobility mainly driven by new post-"Dieselgate" (emission scandal) EU regulations and the longer-term transition toward autonomous driving pushed by the entry of Silicon Valley's companies.

In Chap. 6, Dan Coffey and Carole Thornley study the current state and global positioning of Britain's car industry, distinguished by the loss of its own automakers, high levels of foreign ownership, an export-oriented production sector, and an import-oriented domestic market. The authors appraise the multiple government and policy efforts in the current disruptive transitions of the industry of working on reducing carbon emissions and planning for connected and autonomous vehicles. They highlight how the uncertainties resulting from Brexit have made the struggle to achieve sustainability and find the proper industrial strategy and business model to navigate the current disruptions more challenging.

Guiseppe Giulio Calabrese highlights the particular characteristics of the Italian automotive industry based on one corporation and one of the most important European supply chains, Fiat Chrysler Automobile (FCA), in Chap. 7. Calabrese analyzes the internationalization of FCA as a strategy for survival and for eventually competing at a global level as well as the way that main actors have been struggling with declining auto outputs. He underscores the battles and difficulties between management and labor in the search for a new system of industrial relations that balances union competitiveness with FCA standards needed to compete internationally. He argues that Italy is lagging behind due to its lack of an industrial policy for promoting sustainable mobilities.

Stéphane Heim, in Chap. 8, develops an all-encompassing overview of the Japanese automotive industry. After being celebrated in the late 1980s as the industrial model to follow, the Japanese automotive industry has significantly evolved its productive organization, employment relations, and interfirm relations since the mid-1990s. The author shows how the financial crisis, the regionalization of the Asian automotive industries, the profitability of new energy vehicles, changing consumer behavior, industrial policies, and the growth of ECs (especially that of China) have modified its sources of profits. These have also reshaped the industrial compromises that framed the labor and management relationship and created a well-balanced division of labor, and a product mix of internal combustion engines and alternative powertrains.

In Part II, Professor young-suk Hyun looks at the case of Korean Hyundai Motor, and its affiliate Kia, and analyzes the unique mix of factors that took it from struggling to catching up during the 1970s and then, two decades later, made it into one of the leading auto corporations worldwide. The dynamics of corporate strategy and technology learning, multinationals' involvement and knowledge base, government policy, and entrepreneurship were, and continue to be, the factors accounting for such an exemplary achievement. The author reflects on the lessons from the Korean industry for other ECs looking to leapfrog into the files of industrialized nations. He also reflects on the challenges ahead for the Korean players as the industry moves toward a new paradigm based on AVs/EVs and new business models.

In contrast to the Korean case, Australia is an example of an industrialized country in the process of losing its automotive industry altogether. Stephen Clibborn, Russell D. Lansbury, and Chris F. Wright explain the factors driving Ford, General Motors, and Toyota to cease production in the country. In this case, the end of government support for the industry, exchange rate volatility, and global strategic decisions by the parent companies to shift production to expanding markets in Asia, created an unfavorable confluence of factors that led automakers to that decision. They argue that while official discourse blames the system of industrial relations and labor unions, these in fact, made no difference.

Part III relates to ECs and is made up of five Chaps. 11, 12, 13, 14 and 15. Frido Wenten traces the emergence, expansion, and diversification of the automotive industry in China through the lens of changing industrial policy priorities and explores their implications for innovation and employment relations. Limitations of a joint-venture-centered model in developing domestic brands and EVs have led to recent policy shifts in favor of private domestic manufacturers, thereby increasing the pressure to innovate on global OEMs. Wenten argues that despite increasing labor costs, employment relations continue to be characterized by segmented labor markets, precarious employment, and conflict, while China's push for EVs development has a ripple effect on global markets and the innovative capacity of the industry as a whole.

India is studied by Biswajit Nag and Debdeep De. The country is now the fourth largest auto market, and the authors analyze how its position hinges upon established domestic firms and OEMs and a strong market in terms of both the domestic demand and exports. Against this backdrop, the study examines how the adoption of emerging technologies among the companies is facilitating the Indian automotive industry to grow and remain competitive. To this end, the authors discuss the enablers of changing competitive landscape in the industry and analyze the Indian government's strategies and policies to facilitate the navigation on it of domestic players.

The boom of the Mexican automotive industry (MAI) and the negotiations to sign NAFTA 2.0 are studied by Alex Covarrubias V. The MAI boom, which began in the last decade and parallels that of China and India, is founded on its nearshoring status, free trade frameworks led by NAFTA, and cheap labor. The country is capturing most factory openings, and auto jobs have doubled, reshaping the geography of labor in the region. American decision-makers were responsible for creating this model and designed NAFTA as a way of ensuring that Mexico would remain the Detroit Three's backyard while also keeping out Asian and European automakers. The author argues that not only did NAFTA fail to accomplish that goal but that the USMCA, crafted by Trump as a replacement, will also eventually fall short of correcting the US deficit and regaining the initiative over MAI for US firms.

Roberto Marx, Adriana Marotti de Mello, and Felipe Ferreira de Lara analyze the Brazilian case, another core industry location, one of the world's ten largest producers and the only Latin American market in the top ten list. Through a historic perspective, the authors show that the Brazilian automotive industry has evolved from importer to local producer with a limited degree of autonomy. They contend that Brazilian market attractiveness, government regulations, and manufacturers' "global" strategy underpin this evolution. The country is attempting to reduce its carbon footprint first through the introduction of ethanol technology and now through *InovarAuto*, a strategy to densify the value chain.

Robert Guzik, Bolesław Domański, and Krzysztof Gwosdz shed light on the development and current position of Central Europe in the European automotive production networks in the context of industrial upgrading and territorial embeddedness of transnational corporations, with particular emphasis on Poland. Special attention is given to the emergence of non-productive functions, especially R&D centers and design capabilities. In addition, the role of local (domestic) producers is explored. Prospects and determinants for further development and upgrading of the automotive sector in Central Europe are discussed, including the ability of domestic suppliers to build a stronger position in the value chain and the functional upgrading of foreign subsidiaries.

Part IV, comprising of Chaps. 16 and 17, contain comparative studies of vocational education and training systems (VET) of ECs. *Vera Šćepanović* explores the Czech Republic, Hungary, and Slovakia and focuses on their policies aimed at improving the supply of skilled labor that developed as a result of the growing concern caused by its scarcity. Labor shortage and lack of needed skills have pushed wages up, resulting in a growing sentiment that the region will be priced out of competition without being able to move toward more skill-intensive production. Government policies have unsuccessfully tried to engage industry participation in vocational training. Nevertheless, a combination of strong market performance, transnational support, and local policy experimentation has helped these countries to overcome their weaknesses and create an incipient form of dual training.

Merve Sancak extends the analysis to look at how local Mexican and Turkish firms producing auto parts found workers with the necessary skills. The comparison is plausible as both countries specialize in medium value-added goods and require workers with medium-level technical skills. The article shows that the institutional environment in which firms are embedded is a vital determinant of their manner of finding skilled workers. The scarcity of public VET programs in Mexico aggravates scarcity of workers with technical training and forces firms to craft their own solutions. In contrast, Turkish firms have taken advantage of the creation of an initial VET system to skill and certify operators.

Notes

1. GDP 2018 data from IMF (2018).
2. Original equipment manufacturers.
3. Defined as total cost of ownership, which includes spending on buying a new or used car, gasoline, motor oil, insurance, maintenance, and licensing. Data from BLS (2016).
4. European Union (EU), North American Free Trade Agreement (NAFTA), Association of Southeast Asian Nations (ASIAN), Southern Common Market (Mercosur), United States-Mexico-Canada Agreement (USMCA, meant to replace NAFTA).
5. According to the Union of Concerned Scientists (2018), ICE vehicles contributed more than half of the carbon monoxide and nitrogen oxides, and almost a quarter of the hydrocarbons emitted into the air.
6. By 2017, Didi Chuxing, Tesla, and Uber had surpassed the market value of all automotive corporations except Toyota and VW.
7. Estimations based on the premise that by 2030, 25% of cars will be EVs. U.S. News (2018, June 5).
8. Keiretsu are Japanese business clusters composed of manufacturers, suppliers, financiers, and dealers who work closely to ensure the success of the group. Kanban: a scheduling system to achieve Just-in-Time and reduce inventories. Kaizen: the Japanese approach for continuous improvement and worker involvement.
9. Hirst and Jonathan (1991) provide a detailed criticism of these formulations in their discussion of flexible specialization versus Post-Fordism.
10. The expansive cycle of the industry after 2009 has been one of the longest in history. At the end of 2018, the market and investment indicators began to announce the coming end to this cycle.

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Part I

Developed Countries: Old Geographies and New Frontiers

2

Overview of the U.S. Automobile Industry

Thomas Klier and James Rubenstein

Introduction

The car was not invented in the United States, but it was there that nearly universal ownership of vehicles was first embraced. The United States is also the first country to adopt mass production of cars. As recently as 1950, more than one-half of the world's vehicles were registered in the United States, and more than three-fourths of the world's vehicles were produced in the United States that year. Into the twenty-first century, the United States is no longer the world's leading producer of vehicles, but, with 21 percent of the world's vehicles in use in 2015 (International Organization of Motor Vehicle Manufacturers 2018), it remains one of the largest markets.

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This chapter provides an overview of the U.S. auto industry. We start by discussing the major disruptive forces currently facing the industry. In the second and third sections, we focus on the market for vehicles as well as different aspects of the production of vehicles. Section four briefly discusses the role of the government. We conclude with providing a brief outlook for the industry.

Three Disruptions

The U.S. (as well as the entire world) auto industry is likely to be sharply altered by three major disruptions: electrification, autonomy, and sharing.[1] These trends present significant challenges for the current producers of vehicles and vehicle parts and have encouraged new entrants to vehicle production. Yet, given the complexity and need for coordination in designing and producing a car, MacDuffie and Fujimoto (2010) conclude, "[the established companies] that can successfully wage war on complexity are positioned to beat new challengers for at least the next few decades" (MacDuffie and Fujimoto 2010).[2]

Electrification

The United States was the world's first leading market for electric vehicles, with annual sales of around 200,000 in 2017 and around 765,000 on the road, one-fourth of the worldwide total (Cobb 2015; Lutsey 2015; "Monthly Plug-in Sales Scorecard" 2018; Vaughan 2017). This figure includes plug-in electrics (PEVs), such as the Nissan Leaf, and plug-in hybrids (PHEVs), such as the Chevrolet Volt, but excludes hybrid electrics (HEVs) that cannot be plugged and recharged from an off-vehicle electric energy source (U.S. EIA 2018). The United States is also the location of Tesla Motors, which has been the world's leading carmaker devoted to making and selling only electric vehicles. Nonetheless, in 2017, plug-in electrics accounted for only 1.2 percent of U.S. vehicle sales and 0.2 percent of vehicles of the U.S. vehicle stock ("Monthly Plug-in Sales Scorecard" 2018; Vaughan 2017). In 2016, China passed the United States as the country with the largest number of electric vehicles on the road (Hertzke et al. 2017).

Most efforts by U.S. carmakers to increase fuel economy have been directed at improving conventional internal combustion engines. The most common alternative fuel vehicles are ethanol-powered and HEVs. In 2017, 8 percent of U.S. vehicles were ethanol-powered and 2 percent were HEV, according to the U.S. Department of Energy's Energy Information Agency (EIA) (U.S. EIA 2018).

Several carmakers are banking on hydrogen fuel cells rather than lithium-ion batteries to provide electricity for vehicles in the future. Honda, for example, expects to meet regulatory standards by electrifying two-thirds of its U.S. vehicles by 2030, with electricity to be generated primarily through fuel cells (Undercoffler 2016: 33).

The number of plug-in EV models available in the market was expected to increase from 49 in 2017 to 258 by 2025, according to London-based information provider (IHS) Markit (Karkaria 2018). Still, the EIA forecasts that in 2050, only 8 percent of U.S. vehicles will be plug-in electrics (U.S. EIA 2018). Low petroleum prices have kept consumer interest modest; it would probably take a sustained increase in fuel prices for PEVs and PHEVs to capture significantly higher market shares in the United States. One factor that will likely shape the pace of electrification in the U.S. vehicle market is government regulation regarding vehicle fuel economy (see section four of this paper).

Autonomy

The Society of Automotive Engineers (SAE), which is based in the United States, distinguishes six levels of autonomous vehicles, ranging from Level 0 (no automation) to Level 5 (full automation with no driver controls). Technology permitting Level 1 autonomy, such as cruise control, has long been standard in U.S. vehicles, as in the rest of the world, and Level 2 technology, such as automated emergency braking, has been added at a rapid pace to vehicles produced and sold in the United States.

The "legacy" carmakers, including Ford and General Motors (GM) (the two with U.S. headquarters), have added Level 2 autonomy in order to make driver-operated vehicles safer, thereby reducing the number of accidents and fatalities. Vehicle-to-vehicle and vehicle-to-infrastructure communications are designed to intervene when a vehicle is in danger of hitting something, drifting out of a lane, or otherwise endangers the driver and passengers. The approach is being called a “war on traffic deaths” (Guilford 2016: 52). Secondary benefits of partial autonomy include finding parking places, maneuvering in tight spots, and avoiding traffic jams. Carmakers are prioritizing driver assistance based on affordability and consumer acceptance (Sedgwick 2016). To achieve higher levels of autonomy, Ford and GM have acquired tech companies. GM bought self-driving start-up Cruise Automation in 2016, and Ford bought artificial intelligence company Argo AI in 2018 (Walker 2018). Driverless vehicles may be especially attractive in the emerging sharing economy (see below); GM has acquired a stake in the carsharing company Lyft. In addition, autonomous class 8 trucks are expected by the mid-2020s (Sedgwick 2016).

Meanwhile, U.S. technology companies based in Silicon Valley Apple and Waymo (a subsidiary of Alphabet, formerly Google) have taken a different approach in trying to develop highly autonomous Level 4 and fully autonomous Level 5 driverless vehicles. Eschewing the continuous marginal improvement approach to autonomy embraced by the “legacy” carmakers, the tech upstarts have been testing fully autonomous technology in production vehicles of established carmakers. Waymo’s business model intends to “build the world’s most experienced driver” by way of artificial intelligence.

The two tech companies, as well as GM, have been the early leaders in testing Level 4 and Level 5 vehicles on the streets of several urban areas. Most U.S. states have enacted or at least considered legislation to legalize autonomous vehicles. At the national level, the National Highway and Transportation Safety Administration (NHTSA) has released several sets of guidelines for automated driving systems.

Formidable short- and medium-term obstacles hinder the operation of driverless vehicles on U.S. roads. Even if introduced in large numbers, driverless vehicles would have to share the road with drivers for many decades. Ultimately, consumer acceptance is likely to be the most critical factor in the pace of the introduction of fully autonomous vehicles.

Sharing

Two approaches to the sharing economy have become important for the U.S. auto industry: carsharing and ridesharing.

- Carsharing is the short-term rental of a vehicle, typically by the hour. Zipcar, a subsidiary of Avis Budget Group, is by far the leading carsharing company based in the United States.[3] It is differentiated from longer-term rental car services that have existed for more than a century. Carsharing is especially attractive for younger people ("millennials") living in urban neighborhoods who don't own a car because they rarely need one.
- Ridesharing connects an individual who needs a ride with a driver who has a car and is willing, for a fee, to take passengers to their desired destination. The United States is home to two of the leading ridesharing companies—Uber and Lyft. These two companies consider themselves to be providers of online transportation network services rather than transportation services. Their business is based on a mobile app, which allows an individual to submit a trip request and to pay for it, and allows a driver to find riders. Ridesharing services have proved controversial in the United States, as elsewhere. Principal concerns are directed at insufficient insurance and screening of participants. "Legacy" services such as taxicab companies have criticized sharing services for alleged lack of oversight and training.

U.S. carmakers are monitoring the sharing economy closely. They are finding that millennials are postponing vehicle purchases, but not giving up vehicle ownership altogether. Starting a family is found to be the key trigger in the decision to purchase the first vehicle (Naughton 2014). GM has invested in Lyft in part to induce Lyft drivers to buy or lease GM vehicles (Colias 2016).

U.S. Sales

More vehicles were sold in the United States than in any other country every year through the twentieth century and into the first decade of the twenty-first century. Sales in China exceeded those in the United States beginning in 2009. In 2017, the United States accounted for just over 18 percent of the world's new vehicle sales (International Organization of Motor Vehicle Manufacturers 2018).

Annual sales of new vehicles in the United States first exceeded 100,000 in 1909, 1 million in 1916, 2 million in 1919, 3 million in 1924, 4 million in 1929, 5 million in 1949, 10 million in 1965, 15 million in 1985, and 17 million in 2000 (*The 100-Year Almanac* 1996). The upward long-term trend masks short-term cyclical variations, which are prominent as vehicles represent durable consumer goods, the purchase of which can be put off during hard economic times. Sales tend to increase with the introduction of popular new models and during economic expansions and decline during economic slowdowns. Annual percentage increases and decreases in sales in excess of 20 percent are common in this industry.

Between 1984 and 2007, the United States witnessed much lower annual percentage changes in new vehicle sales. During that period, sales of light vehicles (i.e. cars and light trucks) averaged around 15 million, ranging between 12.3 million in 1991 and 17.3 million in 2000. The severe recession of 2008–09 was especially disruptive, when after a quarter-century of stability, sales plummeted to 10.4 million in 2009. Sales then increased steadily every year thereafter, until reaching an historic high of 17.4 million vehicles in 2015, declining somewhat since to 17.1 million in 2017 (WardsAuto Infobank).

Market Share

The U.S. market is highly competitive. Seven companies held between 7 percent and 18 percent of the market in 2017. The two carmakers with U.S. headquarters held the top two spots, General Motors (GM) with

17.5 percent of the market and Ford with 14.7 percent (Fig. 2.1). They were followed by Toyota with 14.2 percent, Fiat Chrysler (FCA) with 11.9 percent, Honda and Nissan with 9.6 and 9.3 percent, respectively, and Hyundai/Kia with 7.4 percent. Europe-based carmakers (other than FCA) had 8 percent of the market, and other, mostly Asia-based, carmakers had 7.5 percent (WardsAuto Infobank).

Automotive News identified around 100 companies with annual sales of at least 1000 vehicles during the first two decades of the twentieth century. However, the leading carmakers in the United States have remained remarkably stable through the entire century and a quarter of commercial production. Either Ford Motor Company or General Motors (including companies acquired by GM) has been the top-selling company in the United States every year since 1903 (*The 100-Year Almanac* 1996). Furthermore, throughout the twentieth century, either Ford or GM was also the world's best-selling company. Ford was the leader during the first quarter-century. GM first passed Ford in 1927 and was the world's leading seller through the remainder of the twentieth century. During the

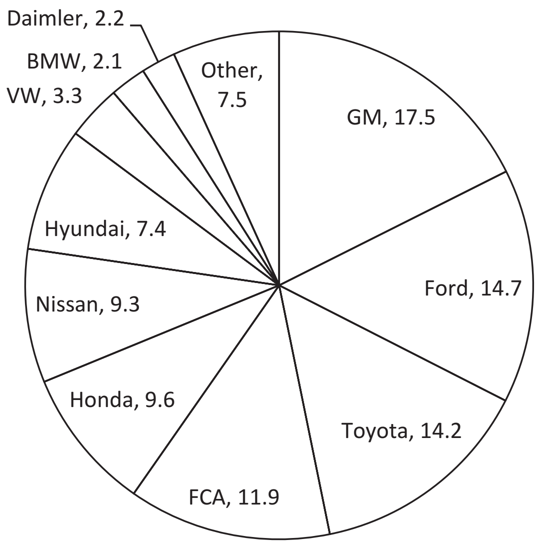

Fig. 2.1 U.S. light vehicle market share, 2017. Source: WardsAuto Infobank

first eighteen years of the twenty-first century, GM has shared the top three positions with Toyota and VW. Ford has generally fallen to the sixth place.

Ford Motor Company—Henry Ford's third attempt at establishing an automobile company—was incorporated in 1903 and passed Cadillac as the leading producer in 1906. Ford remained the leading producer every year until 1927. It averaged around 45 percent of sales during the 1910s and 1920s, and in its peak year of 1921, it accounted for 61 percent of all U.S. sales (*The 100-Year Almanac* 1996).

William C. Durant incorporated General Motors in 1908 as a consolidation of several existing carmakers, including Oldsmobile (the top-selling company in 1903 and 1904), Cadillac (the top seller in 1905), and Buick (the top seller in 1909). Durant was forced out of GM in 1910, incorporated Republic Motors in 1911, acquired Chevrolet in 1912, regained control of GM in 1916, and consolidated Chevrolet and other Republic holdings into GM in 1918 (Rubenstein 1992). GM supplanted Ford as the top-selling carmaker in the United States in 1927 and 1928, was second to Ford in 1929 and 1930, returned to the top in 1931, and has remained there every year since.

Walter P. Chrysler, a former GM executive, founded Chrysler in 1924 through the reorganization of Maxwell and acquired Dodge two years later. Chrysler prospered during the 1930s and passed Ford into second place in U.S. sales in 1936, 1938–41, and 1946 [no civilian production or sales occurred during World War II, 1942–45]. Ford returned to second place behind GM in 1947 and has held it every year since then. Chrysler was in third place every year from 1947 until it was passed by Toyota in 2006.

The 1929 stock market crash and subsequent Great Depression sealed the long-term dominance of the Detroit 3 carmakers. The combined market share of the three increased from 64 percent in 1927 to 90 percent in 1933 (*The 100-Year Almanac* 1996).[4]

At their peak of dominance in the 1950s, the Detroit 3 held as much as 95 percent of the U.S. market. The Detroit 3 market share declined to 84 percent in 1960, 83 percent in 1970, 74 percent in 1980, 72 percent in 1990, 64 percent in 2000, and 45 percent in 2010 (Automotive News Data Center). In 1960, the remaining 16 percent was divided among American Motors (AMC) with 6 percent, Studebaker-Packard and VW with 2 percent each, other European imports with 5 percent, and other U.S. companies with 1 percent.

Over the years, the industry became increasingly international, going back to the mid-1950s, when the VW Beetle became the first vehicle model imported to the United States in large numbers. In 1980, most of the 26 percent market share not held by the Detroit 3 went to Japan-based companies including Toyota and Nissan, with 6 percent each, and Honda and other Japan-based companies, with 3 percent each. VW had 3 percent of the U.S. market in 1980, and AMC and other Europe-based companies had 2 percent each.

Asia-based companies have made further inroads into the U.S. market during the twenty-first century. Between 2000 and 2017, Toyota increased its share of the U.S. market from 9 to 14 percent, Honda from 6 to 10 percent, Nissan from 4 to 9 percent, and Hyundai from 2 to 7 percent. Toyota passed Chrysler in the third place in 2006.

Product Segments

The U.S. market is distinctive among the world's major markets because of the high share of trucks rather than cars. Vehicles classified as light trucks accounted for 64.5 percent of U.S. light vehicle sales in 2017. Trucks had previously accounted for 10 percent of U.S. light vehicle sales in the 1920s, 15 percent in the 1930s, 10 percent in the 1950s, 15 percent in the 1960s, 20 percent in the 1970s, 30 percent in the 1980s, and 40 percent in the 1990s. Trucks first outsold cars in 2002 and have accounted for more than one-half of sales nearly every year since then.

Light trucks sold in the United States can be grouped into four categories: crossover utility vehicles (CUVs), pickups, sport utility vehicles (SUVs), and vans. The two best-selling models in the United States most years have been the full-size pickup trucks sold by Ford and GM. However, as a group, CUVs accounted for the largest share of U.S. sales, 34.9 percent in 2017, compared with 16.1 percent for pickups, 8.1 percent for SUVs, and 5.4 percent for vans (WardsAuto Infobank).

A CUV is built on a car platform while incorporating features of a truck-like SUV, such as high ground clearance and large interior space.

The segment incorporates a variety of individual products ranging widely in price, size, and degree of luxury. Classifying a vehicle as a truck rather than a car has been important for U.S. carmakers because for several decades trucks had been subject to less stringent fuel economy standards.

The two leading car segments are midsize and compact; they accounted for 12.8 percent and 12.4 percent of the total U.S. light vehicle sales in 2017, respectively. Luxury cars accounted for 6.1 percent of sales, subcompacts for 2.8 percent, and large cars for 1.5 percent (Fig. 2.2).

U.S. Production

Annual light vehicle production in the United States first exceeded 100,000 in 1909, 1 million in 1916, 2 million in 1919, 3 million in 1924, and 4 million in 1929. Following an extended period of limited production during the Great Depression and World War II, U.S.

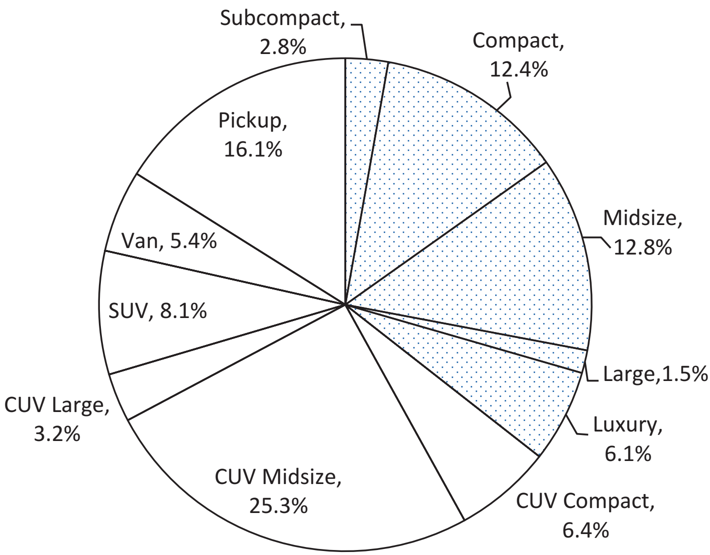

Fig. 2.2 U.S. light vehicle market segments, 2017. Source: WardsAuto Infobank

production exceeded 5 million in 1949, 8 million in 1950, 9 million in 1955, and 11 million in 1965.

The United States dominated the global production of vehicles during the first half of the twentieth century. As recently as 1950, 76 percent of the world's vehicles were produced in the United States. The U.S. share has dropped steadily since then to 70 percent of the world production in 1955, 48 percent in 1960, 28 percent in 1970, and 21 percent in 1980. In 2017, 18 percent of the world's vehicles were produced in the United States. More vehicles were produced in Japan than in the United States between 1980 and 1993 and between 2006 and 2010. In 2009, China passed both Japan and the United States to become the leading producer. The United States has become a distant second in production to China since 2011 (*The 100-Year Almanac* 1996).

Since the mid-1960s, U.S. production has averaged around 11 million light vehicles per year. In the 36 years between 1971 and 2007, annual production came to between 10 million and 12 million units 21 times, dipped below 10 million units 6 times, and exceeded 12 million units 9 times. As a result of this long-term stability, the severe recession of 2008–09 came as an especially sharp blow to the U.S. auto industry. Production declined to 5.8 million in 2009, the lowest level since 1958. Production returned to the long-term average of 11 million in 2013, averaging 11.5 million in the four years from 2014 through 2017 (WardsAuto Infobank).

Starting in the late 1970s, foreign-headquartered producers entered the U.S. market as producers (Table 2.1). VW was first; it started producing vehicles at a former Chrysler plant in Westmoreland, Pennsylvania, in 1978. Honda, the first of the Asian-based producers, arrived in 1982. The two German premium brand producers BMW and Mercedes opened their first plants in the 1990s; Korean producer Hyundai arrived in the first decade of the twenty-first century. In 2017, 12 carmakers produced at least 100,000 light vehicles in the United States. The share of U.S. production accounted for by the Detroit 3 carmakers declined from 87 percent in 1990 to 78 percent in 2000, 55 percent in 2010, and 52 percent in 2017.

Table 2.1 Foreign-headquartered light vehicle producers in the United States by year of the first assembly plant

VW[a]	1978
Honda	1982
Nissan	1983
Toyota	1984
Mitsubishi[b]	1987
Mazda[c]	1987
Subaru	1989
BMW	1994
Mercedes-Benz	1997
Hyundai/Kia	2005

[a]Closed in 1989, the new plant opened in 2011
[b]Closed in 2015
[c]Ended U.S. production in 2012, the new plant opened in Mexico in 2013. U.S. plant continues as Ford plant

Geography of Production

The U.S. auto industry is highly clustered in an area known as auto alley, a north-south corridor between Michigan and Alabama, roughly 800 miles long and 250 miles wide. The spine of the auto alley is formed by the north-south interstate highways I-65 and I-75 (Klier and Rubenstein 2008; Klier and McMillen 2006, 2008; and Rubenstein 1992). Within the United States, auto alley accounted for 85 percent of light vehicle production in 2017 (authors' calculations based on data from WardsAuto Infobank).

In 2018, the United States had 43 assembly plants that could produce at least 100,000 vehicles per year. General Motors operated 11 of them; Ford 9; FCA 6; Honda and Toyota 4 each; Hyundai and Nissan 2 each; and BMW, Daimler, Subaru, Tesla, and VW 1 each. All but 6 of the 43 were in the auto alley. Of the 37 in the auto alley, 11 were in Michigan; 6 in Ohio; 4 in Indiana; 3 each in Alabama, Kentucky, and Tennessee; 2 each in Illinois and Mississippi; and 1 each in Georgia, Missouri, and South Carolina. The six outside auto alley included 2 each in Missouri and Texas and 1 each in California and Kansas (Fig. 2.3).

The auto alley is divided along the east-west route U.S. 30 into northern and southern sections. Eighteen of the 37 assembly plants in the auto

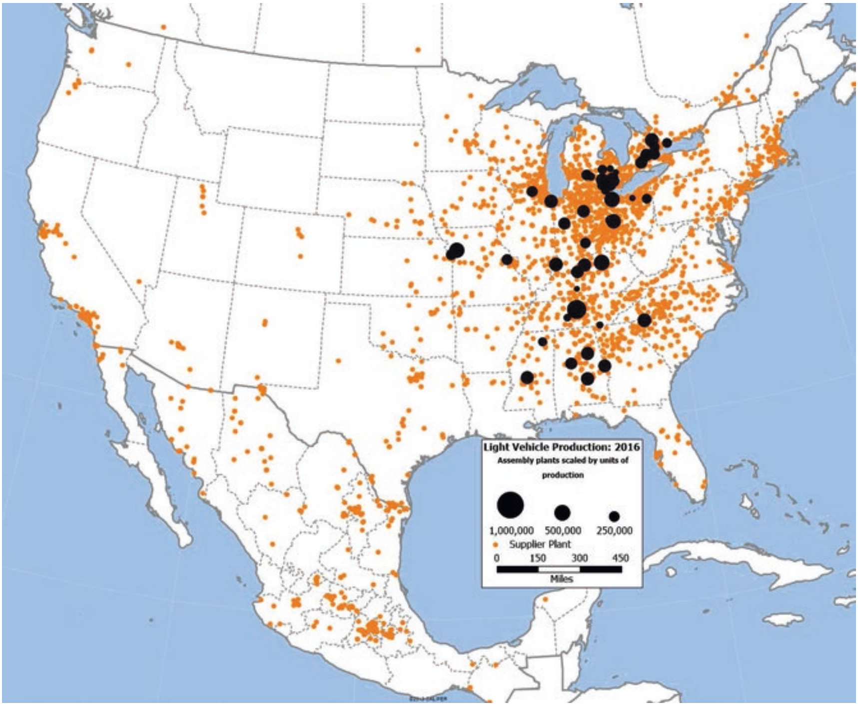

Fig. 2.3 Light vehicle assembly plants and parts supplier plants in North America, 2016. Source: Authors' adaptation of data from Wards Autoinfobank, Elm, and Maptitude

alley are in the northern section and 19 in the south of U.S. 30. All 18 of the northern assembly plants are owned by the Detroit 3 carmakers, whereas 15 of the 19 southern assembly plants are operated by foreign-based carmakers.

The north-south division within the auto alley is related to rates of unionization. The United Auto Workers union represents workers in all of the assembly plants owned by the Detroit 3 but in none of the assembly plants owned by other carmakers. International carmakers have selected assembly plant sites in the southern portion of an auto alley in part to avoid the northern area that has historically been associated with relatively high rates of unionization in the auto industry (Fig. 2.4).

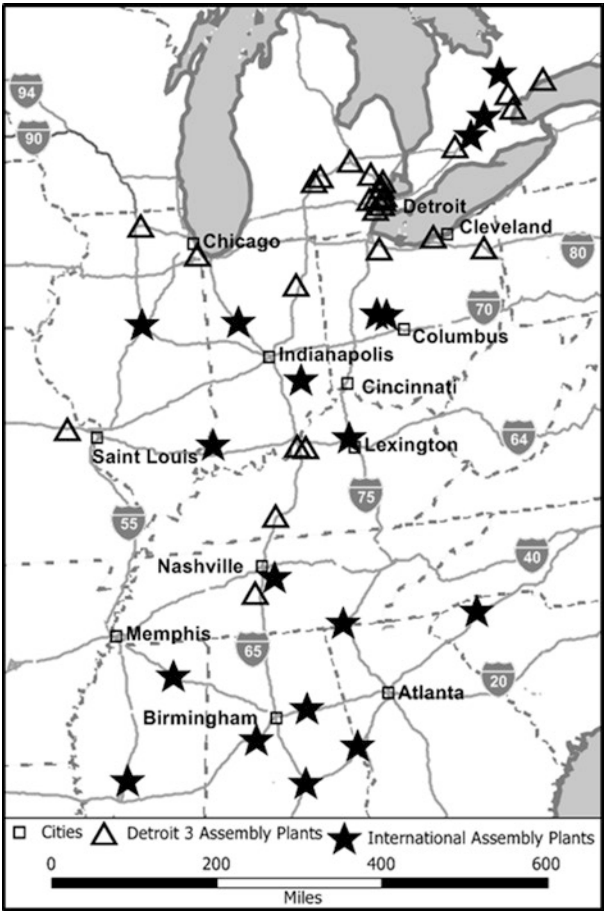

Fig. 2.4 Light vehicle assembly plants by nationality, 2016. Source: Authors' adaptation of data from Wards Autoinfobank, Elm, and Maptitude

Parts Suppliers

Most parts used to assemble vehicles in the United States are made in North America. Employment in the production of motor vehicle parts represents about three-quarters of overall industry employment (see Klier and Rubenstein 2008, for a comprehensive treatment of that part of the industry). The industry geography is characterized by pronounced co-location of vehicle assembly and vehicle parts production (see Fig. 2.3).

According to *Automotive News*, 11 suppliers had North American sales exceeding $5 billion in 2017: Magna International, ZF, Denso International, Continental Automotive Systems, Lear, Robert Bosch, Flex-N-Gate, Aisin World, Adient, American Axle & Manufacturing, and Hyundai Mobis. Only two of the ten largest suppliers in 2017 were among the ten largest in 1994: Lear and Adient (spun off from Johnson Controls in 2016). Only five were among the top ten in 2004: Adient, Lear, Magna International, Robert Bosch Corp., and Denso International (known as Nippondenso until 1996).

Only four of the ten largest suppliers in 2017 were based in the United States; three were headquartered in Germany, two in Japan, and one in Canada. By comparison, all ten of the leading suppliers in 1994 and six of the ten in 2004 were U.S. companies (two were German and one each Canadian and Japanese in 2004) (Table 2.2).

Trade

With U.S. sales averaging 15 million light vehicles per year and production averaging 11 million, the gap is being covered through imports. These imports may be originating from elsewhere in North America (i.e.

Table 2.2 Top auto parts suppliers in North America, 1994, 2004, and 2017

1994	2004	2017
GM ACG (Delphi)	Delphi	Magna International
Ford ACD (Visteon)	Visteon	ZF North America
Delco Electronics	Magna International	Denso International America
Inland Steel	Johnson Controls	Continental Automotive Systems
Dana Corp.	Lear Corp.	Lear
TRW Inc.	Robert Bosch Corp.	Robert Bosch
Lear (Seating) Corp.	Dana Corp.	Flex-N-Gate
Johnson Controls	Nippondenso	Aisin World
DuPont Automotive	TRW Inc.	Adient
ITT Automotive	ThyssenKrupp Automotive	American Axle & Manufacturing

Source: Automotive News Supplement, various years

Canada and Mexico) or from other regions of the world (Asia and Europe). The North American Free Trade Agreement (NAFTA) as originally negotiated permitted light vehicles to be shipped tariff-free within North America as long as their North American content was at least 62.5 percent (for vehicle parts, the requirement was at least 60 percent).[5] Light vehicles imported to the United States from elsewhere in the world have been subject to the World Trade Organization (WTO) tariff of 2.5 percent with the exception of pickup trucks and cargo vans, which have faced a tariff of 25 percent (the so-called chicken tax, which goes back to a trade dispute between Germany/France and the United States in 1964; see e.g. Hoffman 2018).

Imports first appeared in the United States in significant numbers in the late 1950s. Imports from outside of North America accounted for 7 percent of U.S. sales in 1960, 13 percent in 1970, and 24 percent in 1980. The figure declined to 22 percent in 1990, primarily because of the construction of assembly plants in North America by several Asian carmakers during the 1980s. Voluntary export restraints adhered to by Japanese carmakers also contributed to the decline during the 1980s.

In 2014,[6] 11.4 million vehicles were produced in the United States; 9.0 million of these vehicles were sold in the United States and 2.4 million were exported, including 1 million to Canada, 247,000 to Mexico, and 1.2 million to the rest of the world. U.S. sales amounted to 16.5 million in 2014; 9.0 million of these sales were vehicles produced in the United States, 1.7 million were imported from Mexico, 1.9 million were imported from Canada, and 3.9 million were imported from elsewhere in the world. Figure 2.5 displays the flow of vehicles in the United States from production to sales in 2014.

Otherwise stated in 2014, 55 percent of the vehicles sold in the United States were produced in the United States, 10 percent were imported from Mexico, 12 percent were imported from Canada, and 24 percent were imported from elsewhere in the world. Meanwhile, 79 percent of the vehicles produced in the United States in 2014 were sold in the United States, 9 percent were exported to Canada, 2 percent were exported to Mexico, and 11 percent were exported to the rest of the world (see Fig. 2.5).

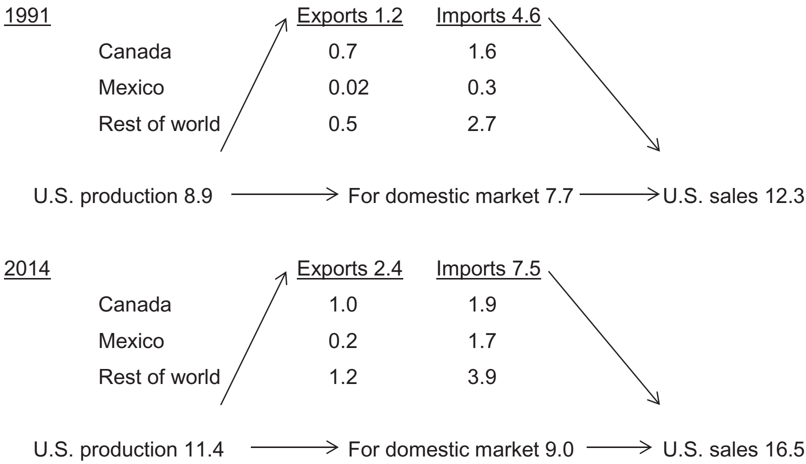

Fig. 2.5 U.S. production, sales, and trade flows, 1991 and 2014. Sources: Estimated by authors from IHS Markit and Automotive News Data Center

In comparison, in 1991, approximately 63 percent of the 12.3 million vehicles sold in the United States were produced in the United States, 13 percent were imported from Canada, 2 percent were imported from Mexico, and 22 percent are imported from elsewhere in the world. Approximately 87 percent of the 8.9 million vehicles produced in the United States were sold in the United States, 8 percent were exported to Canada, and 6 percent were exported to the rest of the world (exports to Mexico accounted for only 0.2 percent of U.S. production in 1991).

Thus, the overall role of trade in U.S. production and sales has changed during the past several decades, primarily through an increase in the share of imports from Mexico from 2 percent to 10 percent of U.S. sales. Sales of light vehicles in the United States were approximately 4 million higher in 2014 than in 1991; U.S. production accounted for around 2.5 million of the growth of 4 million units and net imports from Mexico for most of the remaining 1.5 million units.

Nearly all of the early imports were small cars from Europe. European carmakers accounted for 64 percent of imports into the 1970s. Renault was the leading importer into the United States in 1959, and VW was the leading importer between 1960 and 1974. Japan rapidly replaced Europe as the principal source of imports into the United States during the late 1970s. Japanese carmakers comprised 77 percent of imports in 1980 and 85 percent in 1990; Toyota had passed VW as the leading importer in 1975.

Today, reliance on imports into the United States varies by the nationality of the carmaker. Japan-based carmakers imported from Japan 25 percent of the vehicles they sold in the United States in 2017. Conversely, in 2017, Europe-based carmakers imported 59 percent of their U.S. sales from Europe, and Korea-based carmakers imported 48 percent of their U.S. sales from Korea. U.S.-based carmakers produced 95 percent of their U.S. sales in North America.

The U.S. auto industry is closely integrated with the auto industries of its neighboring countries Canada and Mexico. In 2014, the United States exported 1 million vehicles to Canada and imported 1.9 million from there. The United States exported 247,000 vehicles to Mexico and imported 1.7 million from its neighbor to the south.

The U.S. and Canadian motor vehicle industries became highly integrated during the 1960s (Anastakis 2005). Prior to that time, high tariffs limited the movement of vehicles and parts between the United States and Canada. To serve the relatively small Canadian market, assembly plants in Canada had to produce small batches of a wide variety of models, an inefficient arrangement. The elimination of trade barriers induced U.S.-owned carmakers and parts suppliers to view the United States and Canada as a single area for the production of vehicles and parts. Subsequently, vehicles produced in Canada increased from approximately 0.1 percent of U.S. sales in 1963, 2 percent in 1966, and 5 percent in 1969. Canada exported 4 percent of its vehicle production to the United States in 1963, 45 percent in 1966, and 72 percent in 1969. In the other direction, 4 percent of vehicles produced in the United States were sold in Canada in 1963, 6 percent in 1966, and 12 percent in 1969. Vehicles produced in the United States accounted for 57 percent of vehicles sold in Canada in 1963, 71 percent in 1966, and 85 percent in 1969 (Holmes 1983 in Rubenstein 1992: 226).

Mexico started becoming integrated into the North American auto industry geography through a series of automotive decrees during the 1970s and 1980s. The implementation of NAFTA in 1994 removed most of Mexico's lingering trade restrictions (Brincks et al. 2018: 9). A number of provisions of the NAFTA agreement were phased in over its first ten years. In light of the uncertainty over the future of NAFTA following the election of Donald Trump as U.S. President in 2016, several vehicle producers made changes to their product planning for North America: Ford canceled a new assembly plant to be built in Mexico (Naughton 2017), FiatChrysler decided to move production of its full-size pickups from Mexico to the United States (Dawson and Stoll 2018), and Toyota shifted the production of its Corolla from a plant under construction in Mexico to a plant being built in the United States (Iliff 2018).

According to the U.S. Department of Commerce International Trade Administration Office of Transportation and Machinery, the United States imported $143 billion worth of parts in 2017, including $53 billion from Mexico, $17 billion from China, $16 billion from Canada, $15 billion from Japan, $10 billion from Germany, $9 billion from the rest of Europe, $8 billion from South Korea, and $15 billion from the rest of the world. The United States exported $86 billion worth of parts in 2017, including $31 billion to Canada, $30 billion to Mexico, $8 billion to Europe, and $17 billion to the rest of the world (U.S. Department of Commerce 2018).

Government Role

The U.S. government has played an increasingly important role in regulating the motor vehicle industry. Regulation has been especially important in three areas: emissions, fuel economy, and safety.

The federal initiative to control pollutants initiated with the 1970 Clean Air Act, which called for the U.S. Environmental Protection Agency (EPA) to issue national air quality standards and specify required emission reductions. A year later, the EPA called for 90 percent cuts in emissions for carbon monoxide and hydrocarbons by 1975 and for nitrogen oxides by 1976. Goals were later pushed back to 1981. Carmakers met the standards primarily by introducing catalytic converters in newly produced cars. Nitrogen oxide and hydrocarbon emissions in the United States declined by more than 95 percent between 1970 and 2000, and carbon monoxide emissions decreased by more than 75 percent (Rechtin 1993: 152, in Rubenstein 2001: 245–246).

The first U.S. legislation designed to conserve petroleum was the 1975 Energy Policy and Conservation Act. All manufacturers selling more than 10,000 cars a year in the United States had to meet the corporate average fuel economy (CAFE) standard set by the U.S. Department of Transportation. The first CAFE standard, issued in 1975, required manufacturers to achieve a fleet average for passenger cars of 18 miles per gallon (mpg) in 1978, 20 mpg in 1980, and 27.5 mpg in 1985. Separate CAFE standards were set for trucks (Korylko 1996: 136, in Rubenstein 2001: 242). The Energy Independence and Security Act of 2007 set targets of 30.2 mpg for cars and 24.1 mpg for light trucks in 2011. A 2011 agreement among President Barack Obama, 13 carmakers, the United Auto Workers union, and the State of California set overall targets for light vehicles of 37 mpg in 2021 and 54.5 mpg in 2025 (Klier and Linn 2011, 2016).[7] Future fuel efficiency standards were thrown into uncertainty in 2018 when the Trump Administration proposed freezing CAFE at the 2021 level of 37 mpg, whereas the State of California called for honoring the 2011 agreement to achieve 54.5 mpg in 2025.

Federal regulation of vehicle safety can be traced to the National Traffic and Motor Vehicle Safety Act and the Highway Safety Act, both enacted in 1966. The National Highway Safety Bureau (since 1970, the National Highway Traffic Safety Administration) was empowered to set standards for automotive safety and order recalls of vehicles with safety-related defects. One of NHTSA's first initiatives, under the 1972 Motor Vehicle Information and Cost Saving Act, set and enforced standards for bumpers to withstand low-speed accidents.

Aside from legislative and regulatory updates for emissions, fuel economy, and safety, the most important federal involvement in the U.S. auto industry came during the severe recession of 2008–09. Faced with the prospect of General Motors and Chrysler running out of money in the final weeks of his presidency, President George W. Bush in December 2008 issued an executive order authorizing emergency loans to be made to the two carmakers under the Troubled Asset Relief Program (TARP). Shortly after taking office, President Barack Obama established an Auto Industry Task Force in February 2009 to deal with the financial crisis. After finding that the companies' plans for restoring financial solvency

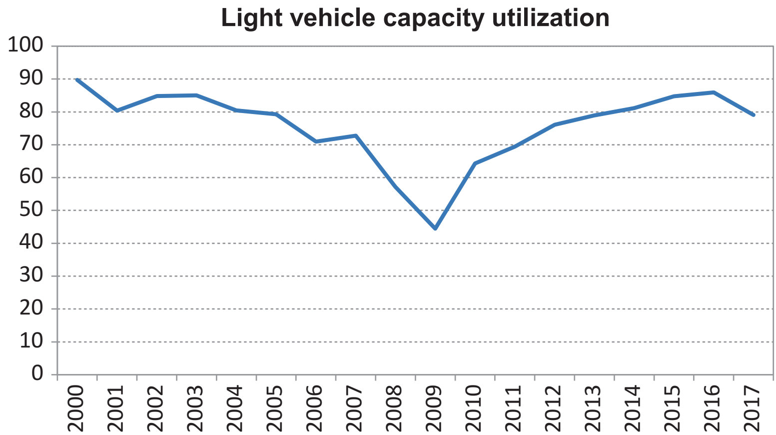

Fig. 2.6 Capacity utilization for the U.S. auto industry, 2000–17. Source: Federal Reserve Board, Haver Analytics

were inadequate, the Task Force managed the restructuring of GM and Chrysler in 2009 under the U.S. Bankruptcy Code. The U.S. government held shares in the restructured Chrysler until 2011 and in the restructured GM until 2013 (Klier and Rubenstein 2013).

During the severe recession and restructuring period, 15 U.S. assembly plants were closed. As a result, the capacity utilization of U.S. assembly plants—a key indicator of the health of the industry—rose from 44 percent in 2009 to 79 percent in 2017 (Fig. 2.6).

Future Prospects

Long-term prospects remain strong for both the sales and production of vehicles in the United States as the country remains a large and wealthy market for vehicles, and the nation's relatively low density and dispersed population distribution point to continued dependence on vehicles for transportation. Yet the vehicle industry is experiencing significant change at many levels. Below are our suggestions regarding the way the three disruptions discussed at the beginning of the chapter might impact the structure of the industry in the United States.

Vehicles represent the textbook case of a weight-gaining good. Motor vehicle production remains a highly agglomerated industry, and assembly plants are situated to minimize the costs of shipping finished vehicles to dealerships (Klier and Rubenstein 2011, 2012, 2015). Neither a move from vehicles powered by internal combustion engines to those powered by electricity nor increased usage of autonomous vehicles seems to change the robustness of this industry characteristic: most vehicles sold in the United States are expected to be built in the United States.

To the extent that changes to trade agreements introduce sharp barriers to trade, one would expect a re-optimization of the footprint of production of the vehicles and parts to the extent it involves different countries.

Finally, to the extent that the new technology, for example electric motors and related capabilities as well as software engineering related to autonomous vehicles, commonly referred to as AI, draws on centers of excellence that are not part of the current automotive R&D cluster in southeast Michigan (see e.g. Klier et al. 2014), one has to wonder if R&D activities in this industry going forward will continue to take place in a highly spatially concentrated fashion or if they will be separable along particular core technologies.

Notes

1. For a critical view on some of the changes, see Gladwell (2017).
2. "Compared with car design's advanced calculus of millions of simultaneous complex equations, the iPad's design is basic arithmetic" (MacDuffie and Fujimoto 2010).
3. The world's leading carsharing company cargo is not a major player in the U.S. market as of 2018.
4. Between 1927 and 1933, GM's market share increased from 42 percent to 44 percent, Ford's from 17 percent to 22 percent, and Chrysler's from 5 percent to 24 percent.
5. See Canis et al. (2017). Note that these requirements are specified in the original NAFTA treaty and are currently being re-negotiated.

6. We have data that link the country of production to the country of sale for North American production; that data ends in 2014.
7. Compliance with the 54.5 mpg target is based on laboratory tests conducted by the U.S. Environmental Protection Agency.

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3

Canada's Automotive Industry: Recession, Restructuring, and Future Prospects

Brendan Sweeney

Introduction

For much of the twentieth century, Canada was unique in that it consistently ranked among the world's top vehicle-producing nations despite not having an indigenous original equipment manufacturer (OEM). In Canada, the automotive industry is geographically concentrated in Southern Ontario, the nation's most populous region, where virtually all vehicle production and the majority of parts and component manufacturing take place. Canada's automotive industry is also highly integrated with the automotive industry of the US Great Lakes states, notably with Michigan, Ohio, and Indiana. In fact, partly due to this high level of industry integration, academics, beginning with Garreau (1982), and policy-makers alike characterize Southern Ontario and the US Great Lakes states as a cross-border region (see also Holmes and Kumar 1995; Courchene 2001; Brunet-Jailly 2006; Rutherford and Holmes 2013).

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Canada's automotive industry grew between the early 1960s and the late 1990s. This was the result of several factors. First, the 1965 Canada-US Automotive Products Trade Agreement (better known as the Auto Pact) required US-based automakers to maintain specific Canadian sales-to-production ratios and value-added levels in exchange for duty-free trade in vehicles and automotive parts (Anastakis 2005). This provided the basis for integrated cross-border production networks and industry growth until the late 1970s. Industry growth slowed beginning in the late 1970s due to the growing competition from Asian and European imports and the recession of the early 1980s. However, Canada's automotive industry grew rapidly in the late 1980s following the implementation of public policies to incent the construction of new vehicle assembly plants by Honda, Toyota, Hyundai, and AMC-Renault and by a joint venture between General Motors and Suzuki (Mordue 2010; Anastakis 2013). Industry growth continued throughout the 1990s, as investment increased due to high demand for vehicles in the US, Canadian labor cost and productivity advantages, and the low value of Canadian currency relative to the US dollar. Toyota and Honda built additional assembly plants in the late 1990s, and annual vehicle production exceeded three million units at its peak in 1999 (OICA 2018).

Canada's automotive industry began to contract in the early 2000s. This occurred as a result of a World Trade Organization (WTO) ruling that struck down the Auto Pact in 2001 on the grounds that it favored US-based OEMs over Toyota and Honda, the appreciation of the Canadian dollar, increased competition for automotive investment from lower wage regions (namely the southern US and Mexico), and the diffusion of high-performance work systems to those regions, all of which undermined the Canadian competitive advantages (Mordue and Sweeney 2017a). GM, DaimlerChrysler, and Ford each closed a Canadian assembly plant between 2002 and 2004. Canadian vehicle production, automotive parts manufacturing, and automotive industry employment contracted substantially prior to, during, and immediately following the recession of 2008–2009 (despite Toyota building a new assembly plant that came online in 2008). GM and Ford each closed an additional assembly plant and several large powertrain and parts manufacturing facilities during this time. Furthermore, over 200 independent automotive parts manufacturing establishments were closed, a disproportionate amount of which belonged to the large US-owned suppliers (Sweeney and Mordue 2017). In response to these challenges, the governments of Canada and Ontario provided funding through several programs in order to assist GM and Chrysler through bankruptcy and to incentivize capital expenditures in the existing facilities by OEMs and parts makers alike.

Canada's automotive industry experienced a modest recovery following the recession of 2008–2009. Annual vehicle production stabilized at over 2.3 million units between 2012 and 2016, although it fell below 2.1 million units in 2017. While no OEM has closed a Canadian assembly plant since 2011, and each has invested in their existing facilities, most often with the support of government incentives, Canada has received virtually no Greenfield investment since prior to the recession and capital expenditures, which averaged over C$3.5 billion annually between the mid-1990s and mid-2000s and averaged less than C$2 billion annually since 2008. Moreover, GM decreased production across their Canadian assembly plants in 2017; in that year, the company's Oshawa, Ontario assembly complex, which produced nearly one million vehicles in 1999, assembled fewer than 90,000 vehicles. There are also concerns that new (e.g. Comprehensive and Progressive Agreement for Trans-Pacific Partnership [CPTPP]) and revised (e.g. North American Free Trade Agreement [NAFTA]) trade agreements could potentially reduce the economic contributions of the industry and exacerbate a growing trade deficit (see Stanford 2014; Holmes 2015; Carey and Holmes 2017; Sweeney and Holmes 2017).

The remainder of this chapter explores the restructuring of Canada's automotive industry in more detail. The first section examines production, employment, and industry structure. The second section examines Canada's trade in automotive products and its changing position within North America and the global automotive industry. The third section examines employment relations and collective bargaining. The fourth section examines the role of public policy in supporting Canada's automotive industry. This is followed by a conclusion that comments on the future prospects for Canada's automotive industry.

Production, Employment, and Industry Structure

After several decades of consistent growth, Canadian vehicle production eclipsed three million units in 1999 (Fig. 3.1). At this time, six OEMs (DaimlerChrysler, Ford, GM, Honda, Suzuki, and Toyota) employed nearly 59,000 people in fourteen vehicle assembly plants and fourteen parts and components manufacturing facilities (Table 3.1). All of these facilities were located in Southern Ontario save for a GM assembly plant in Québec and a Toyota wheel manufacturing facility in British Columbia. At this time, GM employed over 20,000 people, Ford employed over 15,000, and DaimlerChrysler employed over 13,000, while Honda and Toyota each employed fewer than 4000.

Over the next decade, Canadian vehicle production decreased nearly every year, reaching a 25-year low of fewer than 1.5 million units in 2009. Between 1999 and 2012, Toyota built an additional assembly plant and Honda built an engine manufacturing facility; however, GM and Ford each closed two assembly plants and DaimlerChrysler closed one.

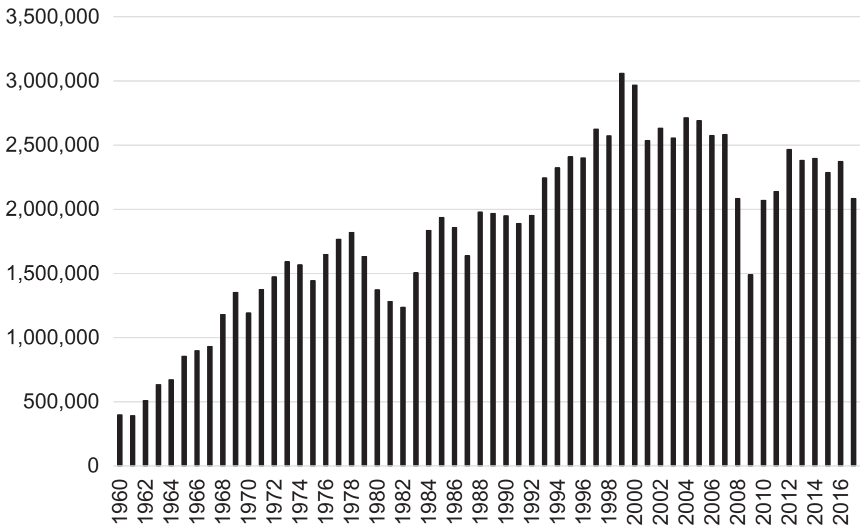

Fig. 3.1 Canadian motor vehicle production, 1960–2017

Table 3.1 OEM plants and employment, 1999, 2009, and 2016

	1999			2009			2016		
	Assembly plants	Parts plants	Employees	Assembly plants	Parts plants	Employees	Assembly plants	Parts plants	Employees
GM[a]	5	6	20,624	3	3	9834	3	1	7819
Ford	3	6	15,282	2	2	6104	1	2	6891
FCA	3	1	13,750	2	1	7550	2	1	8928
Toyota	2	1	3692	3	1	6209	3	1	8654
Honda	2	0	3500	2	1	3800	2	1	4200
Total	15	14	58,847	12	8	33,497	11	6	36,492

[a]Includes CAMI Assembly, which was once a GM-Suzuki joint venture (now wholly owned by GM)

Moreover, GM and Ford each closed or divested several powertrain and parts manufacturing facilities. Currently, five OEMs (Fiat-Chrysler, Ford, GM, Honda, and Toyota) operate eleven assembly plants and six parts and components manufacturing facilities in Canada. In 2017, these plants built over two million vehicles—over two-thirds of which were SUVs or minivans—and employed over 37,000 people.

Canada has a well-established independent automotive parts and components manufacturing industry, most of which is located in close proximity to the Canadian assembly plants and to the Ontario-Michigan border. Over 900 establishments supply OEMs or higher tier suppliers with parts, components, and value-added services (e.g. sub-assembly, metal treating). Together, these establishments employ over 100,000 people (Sweeney and Mordue 2017). The majority of these establishments are concentrated in several medium-sized Ontario cities (e.g. Windsor, London, Kitchener-Waterloo, Cambridge, Guelph), in Toronto's western and northern suburbs, and in the Eastern Townships region of Québec. Figure 3.2 illustrates automotive industry employment and the location of OEM production facilities in Southern Ontario.

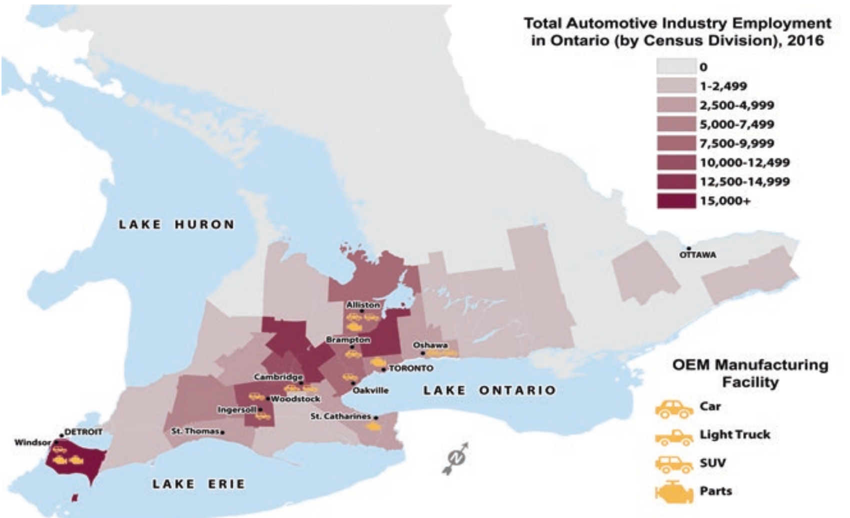

Fig. 3.2 Ontario automotive industry employment and assembly plants, 2016. Reproduced with permission from APRC Inc

The composition of independent automotive parts, components, and value-added service suppliers is diverse. Magna, which is headquartered in Toronto's northern suburbs, is Canada's largest independent parts and components manufacturer, employing more people than the next two largest automotive employers (Fiat-Chrysler and Toyota, respectively) combined. Magna's Canadian production facilities are engaged in several segments of the automotive supply chain, including seating, metal stampings, bodies and frames, closures, engine and powertrain components, and plastics. Other large Canadian-owned suppliers include Linamar, which produces engine and powertrain components; Martinrea, which produces metal stampings, fluid handling components, and welded assemblies; Woodbridge Foam, which produces seating and interior foam parts; and Multimatic, which produces closures, metal stampings, and suspension components. Multimatic also assembles the Ford GT near its Toronto area headquarters. In total, these and other Canadian-owned suppliers employ just over half of the Canadian independent automotive parts and component manufacturing workforce (Sweeney and Mordue 2017).

Canada is also home to the networks of foreign-owned independent automotive parts and component manufacturers. Historically, large US-owned firms played an important role in the Canadian automotive supply chain. These firms provided parts and components primarily to the assembly plants in Canada and the US Great Lakes states, and helped US-owned OEMs satisfy Canadian value-added production requirements stipulated by the Auto Pact (Anastakis 2005). Prior to the economic crisis of 2008–2009, US-owned firms employed over a third of Canada's independent automotive parts manufacturing workforce. However, the economic contributions of US-owned automotive parts and components suppliers diminished due to a series of bankruptcies (e.g. Collins and Aikman, Oxford Automotive), acquisitions by European or Asian firms (e.g. TRW, Johnson Controls), the end of the Auto Pact, and the closure of several GM and Ford assembly plants in Canada. While some large globally competitive US-owned suppliers (e.g. Flex-n-Gate, Cooper-Standard) maintain a large production footprint in Canada, others (e.g. Dana, Lear) closed their largest Canadian production facilities and employed only a fraction of the people than they did in the early 2000s. Currently, US-owned suppliers employ less than fifteen percent of the Canadian independent automotive parts and components manufacturing workforce (Sweeney and Mordue 2017).

Japanese-owned automotive parts and components suppliers have increased their production and employment in nominal and proportional terms since the late 1990s (Mordue and Sweeney 2017b). These firms, which supply Toyota and Honda primarily, include Toyoda Gosei, Toyota Boshoku, Denso, Aisin Seiki, and TS Tech. Together they employ approximately twenty percent of Canada's independent automotive parts manufacturing workforce. The increasingly prominent position of Japanese-owned suppliers relative to US-owned suppliers is indicative of broader shifts in the composition of Canada's automotive industry.

The majority of the remainder of Canada's independent automotive parts and components manufacturing suppliers are German- (e.g. ZF Friedrichshafen, Brose), French- (e.g. Valeo, Faurecia), Swedish- (e.g. Autoliv), and Chinese-owned (e.g. Stackpole, Yanfeng, Meridian). Chinese-owned automotive parts and components suppliers—all of which became Chinese-owned as the result of mergers and acquisitions—employ over 3000 people in Canada, and constitute a group of firms that were non-existent prior to the recession of 2008–2009 (Sweeney and Mordue 2017).

Trade Patterns and Canada's Role in the Global Automotive Industry

Despite its lack of a domestic automaker, Canada produces more vehicles than it consumes. This has been the case since the mid-1960s, when Canada and the US ratified the Auto Pact (Anastakis 2005). The Auto Pact led to high levels of automotive industry integration in North America, much of which was, and still is, concentrated in Southern Ontario and the Great Lakes states. It also cemented Canada's reliance on the US as the primary market for Canadian-made vehicles. In this sense, little has changed. In 2017, over ninety-six percent of Canadian vehicle exports were destined for the US (ISED 2018; author's calculations).

However, and while the US remains the primary source of automotive imports to Canada, imports from other countries and regions (notably Japan, Korea, China, Mexico, and the EU) have more than doubled since the 1990s. For example, countries other than the US accounted for less than eighteen percent of Canadian automotive product imports in 1999, but over thirty-seven percent in 2017 (ISED 2018; author's calculations). This trend is part of broader concerns regarding Canada's trade in automotive products in the context of a growing trade deficit and the consequences of new trade agreements with North American, EU, and Pacific Rim nations (see Carey and Holmes 2017; Sweeney and Holmes 2017).

Canada's balance of trade in automotive products shifted from a surplus to a deficit in the mid-2000s (Holmes 2015). After nearly two decades of growth, Canada's automotive trade surplus peaked at over C$15.1 billion in 1999, coinciding with Canada's peak in vehicle production. Canada's trade surplus shrank in all but one year between 2000 and 2006, and went into deficit in 2007. This deficit increased to C$11.8 billion by 2008 and to over C$24.5 billion in 2017 (ISED 2018; Fig. 3.3).

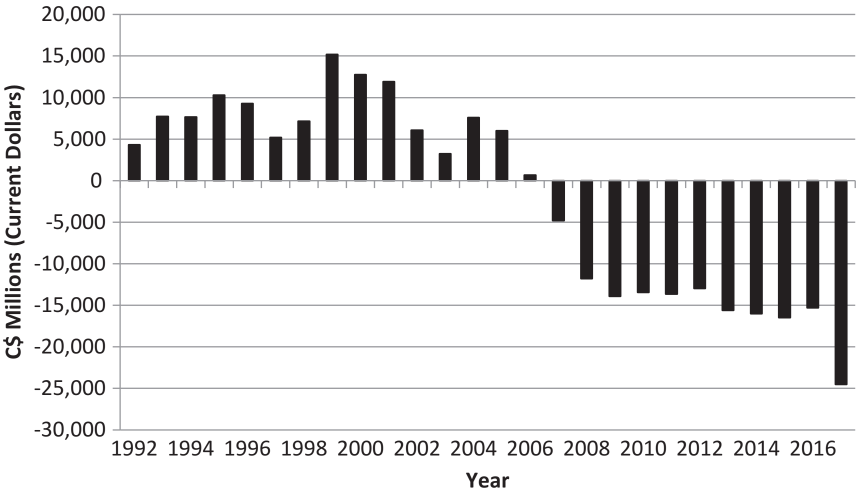

Fig. 3.3 Canada's automotive trade balance (NAICS 3361 and 3363), 1999–2017. Source: ISED 2018; author's calculations

Canada maintains a surplus in the trade of automotive products with the US. This surplus reached C$23.9 billion in 2017. This surplus was C$9.3 billion in 2017 (although this was nearly C$6 billion less than in 2016). This reflects a surplus in the trade of vehicles with the US (C$23.9 billion in 2017) and a deficit in the trade of automotive parts (C$14.6 billion). However, Canada has a deficit in the trade of vehicles and automotive parts with its major trading partners outside the US. Taken together, Canada's combined automotive products trade deficit with the EU, Japan, Korea, and China was over C$18.7 billion in 2017. Also of consequence is Canada's deficit in the trade of automotive products with Mexico, which grew from approximately C$2 billion in 1993—the year prior to NAFTA taking force—to over C$13.8 billion in 2017. This is due to the substantial imports of Mexican-made vehicles and automotive parts, a result of the growth of the export-oriented automotive industry and its supply chain in Mexico over the past twenty years and the loss of Canadian vehicle assembly and parts-making capacity since the early 2000s. The shift from being a net exporter of automotive products to a net importer is a concern for Canadian policy-makers and industry stakeholders.

Canada has recently entered into several trade agreements with Pacific Rim nations, the EU, and, at the time of writing, is in the process of re-negotiating a free trade agreement with the US and Mexico. The consequences of these new trade agreements are a significant concern for policy-makers, industry stakeholders, and the general public. Over the past several years, there has been a considerable debate regarding the potential impacts on the automotive industry of the Canada-EU Comprehensive Economic and Trade Agreement (CETA), the Canada-Korea Free Trade Agreement (CKFTA), and the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), which includes Canada, Mexico, and nine other Pacific Rim nations, and its failed predecessor, the Trans-Pacific Partnership (TPP), which included the US. Unifor, the union representing the majority of unionized Canadian autoworkers, has been particularly vocal in its opposition to these trade agreements and predicts that they will exacerbate Canada's existing automotive trade deficit and lead to job loss (Stanford 2014). The CEOs for Ford and Fiat-Chrysler's Canadian operations have been equally critical, going so far as to comment that 'there will be no positive outcome for Canadian manufacturing' (Craig in Posadzki 2016). Furthermore, Holmes and Carey (2016) (see also Carey and Holmes 2017) conclude that a trade agreement with Pacific Rim nations is likely to have negative impacts on production and employment in Canada's automotive industry.

In the context of the automotive industry, the election of Donald Trump as the President of the US in 2016 and his subsequent positions on trade and, more specifically, on NAFTA have dwarfed policy-makers' and industry stakeholders' concerns about other trade agreements. While the impacts and consequences of the revised North American trade agreement are yet to be determined, these concerns are closely related to Canada's uncertain role in the contemporary global automotive industry. Canada served as a lower cost option for vehicle assembly and automotive parts manufacturing vis-à-vis the US until as recently as the late 1990s (Sturgeon and Florida 2000), although for much of this time, automakers' conception of the North American automotive supply chain did not extend far into Mexico. As Japanese, German, and Korean automakers invested in the southeastern US, and then as automakers of all nationalities invested heavily into Mexico, Canada's competitive advantages eroded. In light of these eroding competitive advantages, ensuring that trade agreements provide Canada with some advantages in the North American or global automotive production networks is increasingly important to maintaining production and employment in Canada's automotive industry.

Employment Relations and Collective Bargaining

Employment relations in Canada's automotive industry were similar to those in the US for much of the 1960s and 1970s. Production and trade workers employed by OEMs were unionized almost exclusively, as were a majority of those employed by independent automotive parts manufacturers. The Canadian division of the United Automobile Workers

(UAW)—the same union that represents autoworkers in the US—represented most unionized autoworkers in Canada until the mid-1980s. Canadian autoworkers' collective agreements closely followed those negotiated in the US. Most collective agreements were three years in length and used formulaic mechanisms linked to productivity gains and inflation to determine wage and benefit increases (Katz et al. 2013). These collective agreements established the basic terms and conditions for not only the automotive industry, but for other manufacturing industries throughout Canada and the US. Strikes and lockouts were common during bargaining impasses, particularly during the 1970s.

The strategies of unionized autoworkers in Canada and the US diverged in the early 1980s. The relative bargaining power of the UAW diminished as a result of increased imports, US-based automakers' loss of market share, and excess capacity at US plants—many of which were antiquated—following the recession of the early 1980s, all of which reduced the effectiveness of strikes as a tactic to gain leverage during negotiations (Katz et al. 2013). As a result, and partly due to efforts to help Chrysler avoid bankruptcy in 1979, the UAW departed from traditional bargaining practices in the US and instead accepted lump sum payment and profit-sharing schemes in lieu of annual base wage and benefit increases. Unionized Canadian autoworkers, however, retained substantial bargaining power due to the production and value-added provisions of the Auto Pact and lower relative labor costs. They continued to pursue traditional collective bargaining and refused to accept profit-sharing schemes in lieu of annual base wage increases. This divergence in strategy eventually led to the breakup of the UAW along international lines and the creation of the Canadian Auto Workers (CAW) in 1985. This breakup and the divergence of once-similar collective bargaining systems is the subject of a large body of employment relations and labor geography literature (see Holmes and Rusonik 1991; Kumar 1993; Yates 1993; Kumar and Holmes 1996).

The CAW leveraged the bargaining power afforded to them by relatively low Canadian labor costs, higher rates of productivity, and the production and value-added stipulations of the Auto Pact to make significant wage and benefit gains throughout the late 1980s until the mid-2000s. In addition to wage and benefit gains, the CAW negotiated successorship and work ownership provisions in the mid-1990s that provided for union certification and job security in the event that work was outsourced from OEMs to independent parts suppliers (Holmes 2004). The CAW also successfully negotiated above-average wages and benefits at a network of independent automotive parts and components suppliers, many of which were US-owned.

The bargaining power of the CAW (renamed Unifor in 2013 as a result of a merger) vis-à-vis automakers has eroded since the mid-2000s. This is the result of several factors. Not least of these are the nominal and proportional increases in employment at Toyota and Honda and the growth of Canadian-owned suppliers Magna and Linamar. The CAW and Unifor have had little success organizing workers at Toyota, Honda, and Linamar and only limited success organizing workers at Magna (Lewchuk and Wells 2006; Malin 2010). The growth of these firms, the simultaneous decrease in the unionized employment at GM and Ford, and the closure of over 100 unionized independent automotive parts and component manufacturing facilities (many of which belonged to US-owned firms) between 2005 and 2015 led to steep decreases in union density in both the vehicle assembly and automotive parts manufacturing industries.

The recession of 2008–2009 and the subsequent government funding packages designed to assist GM and Chrysler emerge from bankruptcy eroded the CAW's bargaining power further. They also led to distinct changes in bargaining strategies. The CAW avoided concessions during negotiations with GM, Ford, and Chrysler on the eve of the recession in 2008. However, they departed from their more than two-decade-old no-concessions policy during negotiations in Spring 2009 and accepted substantial wage and benefit concessions so that GM and Chrysler could receive government funding for restructuring. The concessions included wage and cost-of-living adjustment freezes, the elimination or reduction of several fringe benefits, and a decrease in entry-level wages and simultaneous extension of the amount of time before entry-level workers reach the full base wage (CAW 2009). The CAW did, however, avoid the much-maligned two-tier wage structure that unionized US autoworkers accepted in 2007 (and subsequently eliminated in 2015). These concessionary agreements were extended to Ford later that year.

Critics argue that the CAW's willingness to accept concessions represents a tacit acceptance of neo-liberalism (Fowler 2012; Siemiatycki 2012). Others, however, interpret this shift in bargaining strategy as a 'recalibration' of employment relations in the context of declining union density and the need to be competitive for capital investment with the US Great Lakes states and with lower cost jurisdictions such as Mexico (Wheaton 2015; Rutherford and Holmes 2013). Moreover, and as is evident in the collective agreements negotiated by Unifor and the US-based automakers in 2016, collective bargaining has become just as much a medium to discuss the conditions under which OEMs will make the capital investments necessary to produce vehicles and automotive parts and components in Canada as it is a mechanism to establish the terms and conditions under which people will be employed to do so. While the four-year collective agreements that govern GM, Ford, and Fiat-Chrysler's Canadian employees include wage increases in the first and fourth years and lump sum bonuses in the second and third years, the most important aspect of these negotiations was GM's commitment to maintain at least some production at their Oshawa assembly complex for the life of the agreement, a re-affirmation of Fiat-Chrysler's commitment (originally made in 2011) to modernize an antiquated paint shop at their Brampton assembly plant, and Ford's commitment to new production mandates at their engine plants in Windsor.

Earnings in vehicle assembly plants and automotive parts and components manufacturing facilities are both much higher than average earnings in Canada (Table 3.2). It is partly for this reason that the automotive industry receives so much attention from policy-makers. However, over the past decade, the wage premium enjoyed by Canada's automotive workers has decreased. While the average weekly earnings of all Canadian

Table 3.2 Average weekly wages, 2008 and 2017

	2008	2017	Percent change
All industries	$810.20	$976.14	20
Manufacturing	$951.00	$1096.65	15
Vehicle assembly	$1394.59	$1379.90	−1
Automotive parts	$1026.49	$1129.55	10

Source: Statistics Canada 2018

workers increased by twenty percent and of all Canadian manufacturing workers increased by fifteen percent, the average weekly earnings of automotive parts and component manufacturing workers increased by only ten percent and the average weekly earnings of vehicle assembly workers *decreased* by one percent. The diminished wage premium of Canadian autoworkers is related to the negotiated wage freezes, decreased entry-level wages, the widespread closure of unionized automotive parts and components manufacturing facilities, and the relatively low wages paid by many non-unionized automotive parts manufacturers.

Public Policy and Investment Incentives

Canadian policy-makers have actively used financial incentives and tax credits to incent automotive manufacturing and R&D investments since the late 1970s. These incentives have come primarily in the form of low-interest loans and direct contributions from federal and provincial governments to support capital investments. Most government programs are available to all firms in a certain industry (e.g. automotive, aerospace) or entire sector (e.g. manufacturing) so long as the investment meets certain criteria (e.g. value, number of jobs created or sustained). Unlike the US, municipal governments do not offer incentives for manufacturing investments due to legislation that prohibits them from providing cash, land, or tax exemptions (Yates and Lewchuk 2017). Moreover, and again unlike the US, Canadian governments avoid including the value of upgrades to or investment to transportation, communication, utilities, or educational infrastructure in announced incentive packages. This is because the costs of such investments are both politically contentious and because such investments benefit not only firms, but the public generally. The true value of financial incentives offered to manufacturers in Canada is therefore often much higher than the publicly announced value (Yates and Lewchuk 2017).

The earliest government incentives for automotive investment in Canada occurred in the late 1970s. In an attempt to remain competitive with the US for investment during a period of industry restructuring, Canadian policy-makers provided C$68 million toward the construction of a new Ford engine manufacturing facility in Windsor in 1978 (Anastakis 2013). Since the late 1970s, most subsequent Greenfield investments by automotive OEMs (and several by large upper-tier parts suppliers) have received financial support from the Governments of Canada and Ontario. However, no automotive OEM has announced a Greenfield investment in Canada in over a decade. The Governments of Canada and Ontario also partnered with the US government to provide loan guarantees to help Chrysler avoid bankruptcy in 1980 in exchange for production and employment commitments (Anastakis 2007). They also provided over C$13 billion in financial support to Chrysler and GM in 2009 to assist them as they emerged from bankruptcy.

As the prospect of receiving Greenfield investment decreased in the early 2000s, Canadian policy-makers began providing incentives for periodic capital investments in the existing vehicle assembly plants and in large powertrain and parts manufacturing facilities (Van Biesebroeck 2010). While such incentives were uncommon prior to the mid-2000s, Canadian governments had in the past provided automakers that were not facing bankruptcy with low-interest loans for investment in the existing production facilities. The most notable of these was a C$220 million loan provided to GM by the Government of Canada and the Gouvernement de Québec in 1987 in exchange for a commitment to keeping an assembly plant near Montréal open for several more years (the plant closed in 2002; see Marrotte 2002).

Incentives for periodic capital investments in the existing assembly plants and powertrain and parts manufacturing facilities are now commonplace in Canada. Since 2013, the Government of Ontario has provided cash incentives of approximately ten percent of the value of manufacturing investments of C$10 million and above through their Jobs and Prosperity Fund (JPF). Between 2004 and 2013, the Government of Ontario provided similar incentives through the Ontario Automotive Investment Strategy (OAIS). The Government of Ontario also provides cash incentives for lower value manufacturing investments through the Automotive Suppliers Competitiveness Improvement Program (ASCIP), the Southwestern Ontario Development Fund (SWODF), and the Eastern Ontario Development Fund (EODF). The primary condition of these incentives is that the investing firm maintains certain levels of employment over a defined period of time (usually ten years). Other provinces, notably Québec, provide automotive parts suppliers with investment incentives through programs that provide low-interest loans (e.g. programs administered by Investissement Québec) or other discrete programs that provide cash incentives (e.g. the Québec Aluminum Development Strategy).

The Government of Canada provided financial incentives in the form of low-interest loans with long amortization periods of up to fifteen percent of the total investment to automakers and upper-tier parts manufacturers through the Automotive Innovation Fund (AIF) between 2008 and 2015 and through the Program for Strategic Industrial Projects (PSIP) between 2005 and 2008. The AIF's successor, the Strategic Investment Fund (SIF), was implemented in 2016 following the criticism of the tax implications of the former program (CAPC 2013; Yates and Lewchuk 2017). The SIF provides cash incentives and low-interest loans to firms (both automotive and non-automotive) making large-scale capital investments in manufacturing facilities. The Government of Canada also provides funding for smaller scale investments by automotive parts suppliers (and to non-automotive manufacturers) through its Federal Economic Development Agency and other discrete programs (e.g. the Automotive Supplier Innovation Program).

Since the early 2000s, Canadian governments have increasingly focused on using public policy to incent investments in automotive R&D. This is due to Canada's desire to improve upon historically low levels of automotive R&D spending (see Rutherford and Holmes 2007). It is also done partly out of necessity; as Canada became less competitive for traditional manufacturing investments, it sought to capture a greater share of higher value automotive industry activities, such as R&D. To do so, Canadian governments use a combination of tax credits and financial incentives. The Governments of Canada and Ontario both offer tax credits for R&D activities. While these are helpful, they are also criticized in that they are more beneficial to large and profitable firms and less beneficial to smaller firms in the early stages of commercialization that may not have significant revenues or profits. The Governments of Canada and Ontario also offer financial incentives for automotive R&D through the programs mentioned above (e.g. SIF, although the vast majority of these programs' funds are directed toward capital expenditures), through research partnerships between private sector firms and publicly funded universities, and through discrete programs focused on the development of environmentally friendly technologies (e.g. Sustainable Development Technology Canada). While policy-makers are optimistic about Canada's future as a location for automotive R&D investment, and despite the availability of highly trained engineers and research professionals, studies suggest that Canada's automotive R&D performance continues to lag behind other automotive-producing nations (Mordue and Sweeney forthcoming). This is due to the lack of a homegrown automaker and to the propensity for upper-tier automotive parts and components suppliers to located R&D facilities near their customers' headquarters in Michigan, Germany, and Japan.

Future Prospects for Canada's Automotive Industry

Following decades of growth and the development of competitive advantages, Canada's automotive industry underwent a period of profound restructuring beginning in the early 2000s. This was due to the diminishing competitive advantages vis-à-vis the US, the emergence of Mexico as a location for automotive investment, the recession of 2008–2009, and new trade patterns and agreements. Despite a modest recovery following the recession of 2008–2009, Canada has struggled to develop new competitive advantages. In fact, what were once Canada's structural strengths—a well-developed network of assembly plants and automotive parts manufacturing facilities—might ultimately limit Canada's ability to shift toward higher value-added segments of the industry (e.g. R&D, niche vehicle production) that are generally thought to be more suitable for high-wage economies.

Canada is engaged in some automotive R&D activities (especially related to software) and in some niche vehicle production (e.g. the Ford GT). Governments and policy-makers have recently placed an increasing emphasis on Canada as a location for automotive R&D. Some

OEMs, namely GM and Ford, recently established automotive software development facilities in Canada. There is also a burgeoning network of smaller software firms that are developing products for the automotive industry, many of which are located in the Kitchener-Waterloo region just west of Toronto. However, the actual extent and economic impact of R&D activities related to traditional or emerging automotive technologies are unclear, and several studies express skepticism regarding the amount of automotive R&D spending, output, and employment that is actually taking place in Canada (see Mordue and Sweeney forthcoming). There is also little evidence that these activities will ever be able to make economic contributions that resemble those made by large-scale vehicle assembly and automotive parts manufacturing facilities. All that said, Canada continues to produce over two million vehicles annually, making it the ninth largest vehicle producer in the world, and Southern Ontario, the location of the vast majority of Canada's automotive industry, is undoubtedly geographically well-situated relative to Detroit.

At the time of writing, uncertainty around the long-term future of several assembly plants, the potential success and economic contributions of policies designed to incent investments in higher value-added segments of the industry, including those related to emerging connected, autonomous, and electrified technologies, and around trade agreements within and beyond North America are some of the major concerns for policy-makers and industry stakeholders alike. These concerns are themselves related to the broader questions regarding Canada's role in an increasingly 'commoditized' global automotive industry (Mordue and Sweeney 2017a). The emergence of China, and to a lesser extent, India, as major automotive-producing nations and as the sources of foreign direct investment may present opportunities for Canada. In fact, between three and four percent of Canada's automotive parts and components manufacturing industry is currently controlled by Chinese-owned firms (Sweeney and Mordue 2017). Other yet-to-be-conceived changes to the structure and organization of the industry may also very well be on the horizon. Yet, for Canadian policy-makers and industry stakeholders, the broader question remains: what role(s) will Canada play in the North American and global automotive industry production network? Only time will tell.

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4

The 2015 Volkswagen 'Diesel-Gate' and Its Impact on German Carmakers

Ludger Pries and Nils Wäcken

Introduction

Since the development of the Internal Combustion Engine (ICE) more than 100 years ago, there have been remarkable steps forward in the industry in the development of more fuel-saving, powerful, large, long-lasting and safe technologies to burn fossil fuels. The Holy Grail *individual mobility for everyone* has been a core phenomenon of modern societies since Henry Ford developed the assembly line for his Model-T. The revolutionary concept of standardization of the production process, the integration of the whole value chain and later on the subcontracting of important parts as well as high volumes of production (and sales) has rapidly become the foundation of all original equipment manufacturers (OEMs) ever since (Teuber 2009: 57 ff.). In the following decades, when the global automotive markets grew, many innovations were made, but the "[…] establishment of ICE dominance, the mass

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production of ICE engines, and the formation of socio-economic-political coalitions around the value-chain that fostered the petrol technology" (Amatucci 2015: 45) was an unalterable entity. The incremental introduction of digital technologies (e.g. in the product as electronic injection control and in production by robotization mainly in the body shop) differentiated but did not change substantially the established business model.

Since then, three main events in the new millennium had substantial influence on the international automobile industry and especially on the German Big Three (GBT), that is, BMW, Daimler and Volkswagen. *First*, the financial crisis of 2008 shook the worldwide economies (Horn et al. 2009) and therefore also the German automotive industry (Pries and Seeliger 2012, 2014). The slow but constant decline of flowing oil in the decades to come combined with new regulatory frameworks focusing on greening and exhaust/pollution-minimizing in most countries (Mohr et al. 2013: 6; Ganser 2014) is the *second* externally given challenge and certainly the most substantial one. A *third* challenge has recently occurred in revealing one of the largest scandals in automobile history that will be the connecting factor of this chapter: the emissions scandal at Volkswagen and its impact on the international automobile industry.

In September 2015, Volkswagen was forced to admit that "[…] 11 million of its diesel cars were equipped with software that could be used to cheat on emissions tests."[1] Since 2008, the Volkswagen Diesel engine TDI EA 189 with manipulated software was assembled in the models of Volkswagen (New Beetle, Golf VI, Jetta, Passat VII, Polo, Scirocco and Tiguan), Audi (A1, A3, A4, A5, A6, Q3, Q5 and TT), Skoda (Fabia, Roomster, Octavia and Superb) and Seat (Leon). Recent studies reveal how far the actual nitrogen oxide (NOx) emissions of the models mentioned before went beyond US legal requirements. For example, the 2011 Jetta blew out almost 30 times as much nitrogen oxide as allowed in a mix of highway, urban and rural driving. Other models of the company (also of Audi and Porsche models, as they are part of Volkswagen's multiple brands including the same or similar Diesel engines) are nothing much better.[2] In the USA, the national Environmental Protection Agency (EPA) declared on 28 June 2016 that "in two related settlements, one with the United States and the State of California, and one with the

U.S. Federal Trade Commission (FTC), German automaker Volkswagen AG and related entities have agreed to spend up to $14.7 billion to settle allegations of cheating emissions tests and deceiving customers."[3]

Not only in the USA did the emissions scandal created disturbances and had massive consequences for Volkswagen—and later on for many of the world's most renowned carmakers. In Europe, the most important market for Volkswagen and its 12 brands, action was taken to investigate the manipulated Diesel engines by authorities of the European Union (EU) and also by the German *Kraftfahrt-Bundesamt* (KBA, trans. in English: Federal Motor Transport Authority). On 16 October 2015, the KBA announced that Volkswagen would have to recall 2.4 million vehicles only in Germany. Affected vehicles were those with engines falling under the EURO 5-norm and sizes of 2, 1.6 and 1.2 litres engine displacement.[4] About one month later, the extent of the scandal enlarged, when it became obvious that not only engines of Model EA 189 were affected by manipulations: The latest generation of Volkswagen's engines (EA 288) met the legal requirements for NOx-exhaust, but CO_2-pollution rates were deliberately amended (see KBA 2015). When the KBA in 2016 checked car models of many international companies, almost all of them went out of the established maximum values of NOx-exhaust and CO_2-pollution (BMVi 2016). For the times to come, this will lead to substantial and extensive research and debates.

In autumn 2016, the German carmakers association *Verein der deutschen Automobilindustrie* (VDA, trans. in English: Association of German Automobile Industry) claimed that there were two main topics influencing the German automotive sector and therefore the GBT. *First*, the "Brexit" decision from 23 June[5] will have remarkable consequences for both, continental companies from the automotive industry and for businesses from the UK. Due to closely interwoven business relationships in exports and imports, it will be inevitable to maintain the lowest level of taxation and tariffs to keep the flow of goods vital to such an extent as today. *Second*, the Diesel-topic, initially occurred on 18 September 2015 (see BMVi 2016: 4), affects the GBT and the automotive industry as well as legislative bodies around the world since then. According to VDA, the main target has to be to restore *trust* in the whole automotive sector in Germany. Therefore, several steps are mentioned. For instance, the industry supports new exhaust testing-schemes such as

Worldwide Light Vehicle Test Procedure (WLTP) (test bench) and Real Driving Emissions (RDE), where a mobile device is mounted to the exhaust system, to measure fumes while actually driving on the road. Furthermore, in the future, companies will have to reveal the software for motor management, as an integral part of a reformed type admission procedure. It is also planned to extend and improve compliance and control as well as communication with customers, clients, politics and interest groups at all levels.

There are three main topics to treat in the following sections. In a first section, the market performance and strategic answers of the GBT after the ‘Diesel-Gate’ of 2015 will be sketched out: To what extent were sales, shares, employment and production affected? Concluding this section by stating an astonishing stability in the development of the GBT, the next section then analyses the main reasons for this constancy: Is it just ‘the calm before the storm’? Was Volkswagen an exceptional case of cheating emission standards? Are all GBT or perhaps all major global carmakers affected? It is argued that groups in Volkswagen obviously manipulated with criminal energy while following an incremental strategy of innovation, but that—as developed in section three—almost the whole automobile industry failed to comply with the standards of fuel consumption and emissions established, for example, the EU and Germany. This leads to finally, in a fourth section, a discussion on some future trends and challenges for all car producers.

Volkswagen Since the ‘Diesel-Gate’: Same Procedure as Every Year?

This section will give a brief overview of general developments and then concentrate on the trajectory of Volkswagen. How was the company affected by the ‘Diesel-gate’ until 2018? What kind of strategies did it develop and present? Considering national market conditions in Germany for all car-producing companies, there could be stated a generally quite positive and stable economic environment until 2018, maintaining monthly production at about 450,000–480,000 units and exports at about 360,000 units per month. In the following, differentiated data for

Volkswagen will relate to the consolidated year 2015 and part of 2016. During the first half of 2016, the development of the three most important car markets of the GBT was quite positive. In Western Europe, sales increased by 9%; in the USA, by 1% and in China, by 12%. In Europe, especially the Italian (+12%), Spanish (+11%) and German (+8%) automobile markets recorded positive growth rates. Also, smaller markets in Europe followed this trend, such as Finland (+20%), Sweden (+13%) and Ireland (+12%).[6] Against this background of generally positive market conditions, how did Volkswagen perform? Was the company directly affected by the 'Diesel-gate'? As announced by many analysts and politicians, the 'Diesel-gate' could or would damage the reputation not only of Volkswagen but of all German brands or even the whole industry. Do the numbers of sales and of share value reflect this challenge?

Taking into consideration the annual report of the Volkswagen Group for 2015, no strong indicators can be found for the emissions scandal to have had an influence on the overall sales of the company. While Europe/remaining markets remained the most important market for Volkswagen (4.006 Mio units, +2.9%), within this region, developments were quite distinct: Western Europe performed well (3.062 Mio units, +5.1%) while Central/Eastern Europe had to deal with losses (0.556 Mio units, −7.7%). Northern America also showed an overall positive development (0.932 Mio units, +4.3%). The most remarkable losses are perceptible for South America (0.490 Mio units, −29.0%) and Asia-Pacific (3.902 Mio units, −3.0%; VW-AG 2016a: 97). Losses in respective regions are not, as expectable, explained by the Diesel scandal or a massive decline of trustworthiness, but rather as consequences of political and economic turbulences in Brazil, Russia and China (ibid.: 94–95).

More detailed figures and explanations might give additional information about consequences of the emissions scandal. During the first days, weeks and first quarter after EPA made the scandal public, the figures of worldwide sales rose: In Q4, the production did rise by 21.4% and vehicle sales climbed by 9.4% compared to Q3 of 2015. In Q4, Europe/remaining markets as well as Asia-Pacific delivered the best figures, while in South America, there was a sharp decline of nearly 50% compared to 2014. The explanations mentioned before, namely economic and political instabilities, are also here a main factor (ibid.; VW-AG 2016b).

Recent developments in sales and production also hint at the fact that "diesel dupe's"[7] negative effects on sales were not as severe as might have been expected. In Volkswagen's report on the first half year of 2016 compared to 2015, a slight positive development of overall sales (4.788 Mio units, +1.2%) can be identified (VW-AG 2016c). At the same time, differing growth rates could be observed for the regions already mentioned for the year 2015. In *Western Europe* (+2.5%), growth rates cooled down and the market share of Volkswagen Group declined gently from 23.4% to 22.1%. *Central and Eastern Europe's* sales figures are in a relatively better shape, as deliveries to customers improved into an overall positive result of +6.0%, though large Russian market still shows a negative development due to economically and politically tense circumstances. *Northern America* is, according to Volkswagen, the only region deeply affected by the emissions scandal. Compared to first half of 2015, 7.2% less units were delivered to customers, while overall market developments show a growth for this region (+1.5%). Sales in Southern America suffer from deep economic uncertainties and intense competition, which lead again to a drop in market shares as well as sales (−26.8%). As Brazil is the major market for Volkswagen in this region, the recession the state is in at the moment[8] intensifies the problems for Volkswagen mentioned above. Finally, the *Asia-Pacific* region showed in the period under review progressivity of 5.2%. What is more, China was once again an important pillar of Volkswagens overall sales with a growth of 6.9% (1.859 Mio. Units; VW-AG 2016c: 11–13).

Another means to evaluate possible consequences for Volkswagen resulting from the emissions scandal is to take a closer look at financial key figures. Here, some substantial impacts could be observed. The price per share was, before false emissions were uncovered, around €160–170. Within days after the official statement by EPA,[9] the price dropped down to €95. After that, the value per share bounced back slowly up to about €130 in the middle of August 2016. During 2015, Volkswagen shares lost almost one-fifth.[10] In the first half of 2016, share price went down to almost two-thirds of the value in December 2014 (VW-AG 2016c: 9). Some shareholder groups already raised complaints or are considering to do that against Volkswagen for not having informed at time about the risks of the ongoing emission investigations in the USA.[11]

In sum, until autumn of 2016, there is a certain paradox of the impact of the 'Diesel-gate' in the company Volkswagen itself. Until mid of 2016, there was still continuing growth and positive dynamics of sales. Positive dynamics show up also for new models: "In 2015, the Volkswagen Group implemented a total of 59 vehicle production starts in 27 locations across 14 countries" (VW-AG 2016a: 146). This is also true for production: In fiscal year 2015, the Volkswagen Group's global production volume passed the 10 million mark again. Productivity increased by 3.5% year-on-year despite the continuing difficult conditions in many markets. "The rising unit sales figures in Germany and Western Europe and the systematic implementation of the Group production system compensated for the decreasing volumes in the South American and Russian markets" (VW-AG 2016a: 145). During the overall period, employment also kept quite stabile; until the end of 2015, workforce went up by some 17,500 workers compared to 2014, then during the first half of 2016, workforce shrank more or less to the level of 2014 (VW-AG 2016a: 159, c: 17).

This development of Volkswagen could be interpreted in different ways. One assumption could be that long-term effects of the 'Diesel-gate' are still to come. For the years to come, there will be billions of losses for shareholders, employment challenges and pressures for restraining costs and wages; scepticism or distrust of clients and stakeholders could deeply damage the image and success of the company. Another hypothesis is that Volkswagen has the opportunity to shift faster and more radically towards new, more sustainable business models with electric driven cars and own battery production; the company could send the message: "we understood" and really change things, meanwhile almost all other international car producers will get their problems with legitimizing emission manipulations. There are some indicators for both future ways.[12]

Volkswagen as a Scapegoat or Criminal Actor?

The 'Diesel-gate' was not just a short story of autumn 2015 but the peak of a decades-long discourse on voluntary and compulsory emission rules, in the USA as well as in the EU. Already since the 1980s, there were debates on how to control and reduce car emissions. In order to prevent direct legal regulations of maximum values for specific cars, the European automobile industry committed itself to voluntarily reducing the emissions of their corresponding floats (taking into account the total of all types of cars produced and averaging the different volumes of emissions, mainly of carbon dioxide and nitrogen oxide). For instance, the German carmakers promised to reduce carbon dioxide emissions from 1990 to 2006 by a quarter. Actually, reduction was only by 2% (UPI 2007/2008). In a similar way, during the 2000s, there were defined strong emission rules in the USA (e.g. Bin-5 Lev II) that were even stronger than in the EU, where the so-called Euro Norm 1–6 were defined from 1993 up to 2014. In Europe, mainly German and French carmakers (BMW, Daimler, Peugeot, Renault and Volkswagen) relied heavily on equipping their passenger cars with Diesel engines. They lobbied in the EU to focus mainly on carbon dioxide emissions and more or less neglect the nitrogen oxide problems (of probably influencing on the probability of generating cancers).[13]

Concerning the US market, since 2005, all GBT and its brands—Audi, BMW, Mercedes-Benz, Porsche and Volkswagen—focused on expanding their market share by a strategy of 'clean Diesel' or 'blue efficiency'. According to internal revision in Volkswagen, the decision to manipulate control software was taken in 2005 already in the engine development centre in Wolfsburg. In 2007, the new engine EA 189 was presented as 'cleanest Diesel of the world' (16 valves, exhaust gases recirculation, special cold start control and so on). Bosch had developed the Diesel injection bomb and corresponding software; in a letter to Volkswagen, Bosch pointed to possibilities of manipulating the software (mainly in the way that it could detect test stand situations and then increase emission cleaning that was put on in normal run).

Since 2008, the Diesel engine EA 189 with manipulated software was assembled in millions of selected models of Volkswagen (New Beetle, Golf VI, Jetta, Passat VII, Polo, Scirocco and Tiguan), Audi (A1, A3, A4, A5, A6, Q3, Q5 and TT), Skoda (Fabia, Roomster, Octavia and Superb) and Seat (Leon). Already, in 2008, the California Air Resources Board (CARB) claimed Volkswagen to explicitly declare that no 'defeat device' was installed in engine control. Volkswagen always denied to have manipulated the emission control software. In spring 2014, the International Council on Clean Transportation (in the USA and Germany) and the West Virginia University tested Volkswagen Jetta and Passat. The result was that nitrogen oxides were 5–35 times higher than the legal limit; in the same test, BMW model X 5 almost fulfilled the emission rules. Then, in December 2014, Volkswagen declared to have found an error and updated their software in almost half million cars in the USA. Since spring 2015, CARB began checking the updated cars under real conditions, and no emission reduction was found.

Therefore, in May 2015, CARB informed the EPA and Volkswagen. Based on these findings, US agencies refused to admit new 2016-models of Volkswagen to enter the US market. Based on this strong pressure until then, Volkswagen admitted to have installed a 'defeat device' that simply put off emission reduction under real conditions and puts it on only under test conditions. As of third of September 2015, Volkswagen admitted to CARB and EPA manipulations of software. Two weeks later, EPA informed openly in Washington about manipulated software—until then Volkswagen confessed the manipulations publicly.

Volkswagen shares lost €12 billion in one week. US-American, French, Spanish and other prosecutors began to investigate against Volkswagen. Complaints were calculated to cost about €20–50 billion for Volkswagen. Some 8 million cars were affected only in the EU, in total almost 11 million cars worldwide. Volkswagen tried to slow down the scandal arguing that it is just a small reconfiguration of the software and an additional plastic part that has to be put in all cars. Checking and changing engine control in car repair shops began, which will last years. Car owners eventually will have to pay higher taxes due to more carbon dioxide emissions. Volkswagen declared that since 2013, all cars are equipped with the new Modular Transverse Matrix MQB and the new engine EA 288—that works without manipulated software. Analysing the Volkswagen 'Diesel-Gate' in a broader perspective of social sciences, this emission affair was the culmination of at least four influencing factors: (1) engineering path dependency of Diesel-engine tradition and incremental innovation, (2) divergent internal and external expectations and legitimation strategies impeding disruptive innovation, (3) specific organizational culture and tradition that frustrated disruptive innovation and (4) contingent action dynamics.

Concerning the first element, engineering path dependency, it has to be underlined, that since the 1980s at the latest Volkswagen, in a similar way than the other German and French carmakers mentioned before, had focused extremely on Diesel-engine technology. It was considered as being more efficient than gasoline traction and thereby reducing carbon dioxide emissions. Other types of emissions like sooty and microparticles or nitrogen oxides were simply marginalized. Generations of engineers were socialized with the Diesel technology in universities and in the car companies. They were fascinated for incrementally improving this technology and thereby have a comparative advantage compared to US-American or Japanese companies. When, for example, Toyota decided to develop hybrid cars, mainly its Prius model, German engineers were sceptical due to the increasing weight of the car that definitely compensated for most of the combustible saving by the hybrid technology. Although the disadvantages of Diesel engines, mainly their environmental problems, found more attention, due to the path dependency, there was a certain blindness for thinking in the alternative traction.

The second argument that helps to explain the 'Diesel-gate' is strongly related to the first one. There existed—raised up and strengthened by Diesel carmakers themselves—the expectations of customers to get cars that are increasingly dynamic, powerful, more comfortable and more ecological. The external expectations—stabilized by the legitimation strategies of the carmakers themselves—impeded some sort of disruptive innovation, of not just following the old trail of improving existing technologies but of changing the path and investing in alternative traction technologies. Those engineers convinced of Diesel traction had good arguments to show that hybrid cars were heavy weighted, battery production and quality was not sufficient, and range and infrastructure were strong limitations. Especially with the boom of Sport Utility Vehicles (SUVs) since the 1990s, expectations of clients and legitimation strategies of GBT went to 'more power *and* more comfort *and* more ecology'. The promise was that only the Diesel technology was able to comply with these somehow contradicting requirements.

A third aspect that helps to explain the 'Diesel-gate' refers to the specific organizational culture and tradition of Volkswagen. The company is characterized by extremely hierarchized structures. This refers to both sides, capital and labour. Founded during the Nazi-regime and then refounded as an independent company after British administration, the headquarters and all German subsidiaries until 1990 concentrated in the state of Lower Saxony. And Wolfsburg was the unquestioned headquarters—in terms of production volume and employment, of Research and Development (R&D), and also concerning power at the company level (Volkswagen) and consortium level (including brands like Skoda, Audi and Porsche). The top management and the CEOs always concentrated in Wolfsburg. The powerful works council at company and consortium level always was presided by the head of the works council of Wolfsburg. This is important because the works council has a decisive saying in assigning top managers and CEOs. So the high concentration of production and power in Wolfsburg provides the basis for a centralistic culture of management and control. Given that there was no really big city around (the state capital Hannover has just half a million of inhabitants), there developed a certain autism of a centralized company with headquarters in a rural area and monopolar position in the region and the state of Lower Saxony. This situation contrasts totally with the Silicon Valley environment where employees of different small, medium and big companies meet and interchange frequently. The hermetic company location of Volkswagen made substantial shift of the trail of development more difficult and less likely.

A fourth and final argument that strengthens the path dependency thesis refers to the quite contingent action dynamics where a cumulative causation made the action groups immune to leave the Diesel (fraud) trail: Due to the centralistic management style, there prevailed fear in engineering and management circles and, at the same time, a high level of arrogance. Especially the Volkswagen specialists working in the USA in preparing the Diesel launch and emission controls experienced very high pressure to be successful no matter what the cost. At the same time, according to reports, they showed an extreme arrogance and thought to be able to cheat all US-American official bodies.[14] After all the aggressive promotion of the allegedly clean Diesel in the USA, the corresponding Volkswagen teams found no way to comply with the high expectations, which the company itself and others like Mercedes had created, than manipulating the software control of the Diesel engines.

The four factors sketched out could explain why—once on the trail of 'clean Diesel'—the Volkswagen company was unable to shift from the strategy of incremental innovation of Diesel technology towards a disruptive innovation path of alternative power units. But was Volkswagen the only company fascinated and captivated by traditional gasoline and Diesel ICE? Were the other big car producers of the world committed to the goal of emission reduction? Did they comply with the standards defined at the national or the European level?

Almost All International Carmakers Faked Emission Information

Without relativizing the criminal and long-lasting energy of groups inside the Volkswagen consortium to allegedly manipulate the emission control systems, the matter of fact is that quite all companies were cheating their clients by officially announcing emission data that never corresponded with real everyday pollution discharge. The overwhelming and shared ideology in the automobile industry was expressed by Bosch CEO Volkmar Denner when he stated that if "emission norms are reduced in a non-realistic way, that is no favour, neither for clients nor for the industry".[15] There was a broad consensus of carmakers' executives that clients always wanted more powerful and higher, SUV-styled cars and, at the same time, the governments imposed 'unrealistic' emission standards. In this dilemma—this is the hidden message of Bosch CEO's statement—there are no remedy but cheating. And, as it turned out since autumn 2016, it seems that the company Bosch was an active part in this milieu.

But it was not only the GBT or Bosch that were tricking and swindling concerning the emissions of their cars. Between 2000 and 2015, according to the official information of the companies of all new passenger cars, the formal consumption of CO_2 went down for more than 25%, but the actual consumption measured by the New European Drive Cycle (NEDC) standard rose up for more than 30%. In the same period, the engine performance grew more than 20%, the weight of cars (mainly due to the share of SUVs) increased by more than 10% and the maximum speed also increased (Teufel et al. 2015).

A report on the development of the formal carbon dioxide emission indicated by the carmakers, the maximum speed, average weight, engine performance and real fuel consumption according to the NEDC of all newly accepted cars in the German car market between 2000 and 2014 reveals that the delta between theoretical CO_2 emissions as announced by the carmakers themselves and all other characteristics is opening in a continuous way. Especially the difference between theoretical CO_2 emissions and actual fuel consumption increases from zero (coherence between both values) to some 60%. This means the carmakers, state authorities and also clients (could) know that cars' engines are getting more powerful, that cars' weight is increasing, that the maximum speed (as indicator of driving dynamics) is going up—but companies went on cheating about the actual emissions.

In a similar way, the average fuel consumption of different brands (of German and non-German carmakers) as announced by the companies was compared with the actual average consumption that hundreds of thousands of clients voluntarily registered. The difference between fuel consumption as declared by the companies and as measured by drivers increases from some 10% in 2001 up to almost 40% in 2014. In spite of fulfilling with their own compromises and promises to reduce fuel consumption—and therewith emissions—carmakers simply hold down their announced theoretic measured value while, at the same time, producing new models with pronouncedly higher real fuel consumption than indicated. This holds for German companies like Audi, BMW, Mercedes and Volkswagen as well as for other carmakers like Opel, Toyota and Volvo.

Substantial empirical evidence proving that almost all carmakers are cheating the official standards could be derived from a study of the KBA of spring 2016 (KBA 2016). For the KBA—and the lobby of the German car industry—it probably was coherent to demonstrate that it is not only Volkswagen and not only the GBT that are failing, but almost all global carmakers. The KBA tested more than 50 models of the following brands: Audi, BMW, Chevrolet, Dacia, Fiat, Ford, Honda, Hyundai, Jaguar, Jeep, Land Rover, Mazda, Mercedes, Mitsubishi, Opel, Peugeot, Porsche, Renault, Smart, Suzuki, Toyota, Volvo and Volkswagen. The cars were first grouped according to their accepted Euro Norm, that is, the classification from Euro Norm 1–6 according to emissions related to car specificities. The KBA then tested all engines empirically according to the NEDC test standard in warm conditions and in real street conditions. Additionally, the KBA tested according to the newly established RDE, which is a European standard for measuring car emissions in real street and operating conditions.

The results of this extensive testing were disappointing. Only about half of all models tested had more or less acceptable nitrogen oxide emissions and revealed no suspicious engine behaviour (in the sense of manipulations of software control). But even in this group of cars more or less complying with the nitrogen oxide emission standards, only 4 models out of 27 (Audi A3, Mercedes C220 Bluetec, VW Passat and VW Touran) met the standards of carbon dioxide emissions according to their corresponding Euro Norm (i.e. according to the norm with which the car was registered in the market). Most cars emitted up to five times more carbon dioxide than indicated according to their official market registry. KBA listed all those models in a second group of 22 cars that showed up very high nitrogen oxide emissions (2.1–3 times exceeding the official limit) that were not explicable. All these cars had also very high carbon dioxide emissions surpassing the allowed limits up to ten times or more. In a third group, the four VW vehicles with Diesel engines EA1 89 were listed which had been proven to have illegal manipulations.

All in all, if the 'Diesel-gate' is a considerable scandal due to the frivolity and criminal energy of groups inside the Volkswagen consortium, an equally shame and outrage cause the results of the KBA study. All companies and brands included in the tests surpassed—at least with some of their models—by hundreds of percent the officially established and theoretically accepted European and Germans norms. As emission standards, for example, in the USA in some aspects are even more restrictive, corresponding tests in other countries should challenge the ongoing practice of emission standards, announcements and controls as well. The Diesel strategy resulted in a one-way road. But the classic ICE, be it Diesel- or gasoline-driven engines, also turned out to completely neglect the established standards of carbon dioxide emissions. It seems that all traditional global carmakers are trapped in the ICE path dependency. Is electric traction a real alternative and solution?

Future Trends and Challenges

When considering the future of the automobile industry for the decades to come, according to several global studies, there are some crucial worldwide trends that have to be taken into account. Three general tendencies were identified: *ecological and environmental requirements, (further) individualization* of mobility and (further) *increase in mobility* (Winterhoff et al. 2009: 3). In a similar vein, Ebel and Hofer (2014) identified as long-term trends: rising ecological awareness, worldwide demographic growth, as well as a cultural change. The last change is particularly dependent on the two mentioned before, as it includes the desire of the older generations to stay mobile and the development of new mobility concepts by younger people (ibid.: 76).

The European Automobile Manufacturers Association (ACEA) mentions three challenges for the automotive sector that mainly require investments and R&D-efforts: (1) *sustainable propulsion* where "collaborative automotive R&I towards propulsion systems which are clean and energy efficient over the full life-cycle, with cost-effective technologies, while maintaining customer priorities" (ACEA 2015: 8; see also EUCAR 2014: 1; TAB 2012: 6) are needed; (2) *safe and integrated mobility* in the sense of "smart and safe vehicles for all purposes, integrated into a secure and intelligent transport system, progressing towards seamless mobility for all, maximum efficiency and ever-fewer accidents" (ACEA 2015: 8; see also EUCAR 2009: 2, 2014: 1; VDA 2014: 3); and as a third test is mentioned *affordability and competitiveness* given the competition of new automobile regions in Asia and the Americas that require a "new sustainable approach for developing and producing affordable and competitive vehicles in Europe" (ibid.).

Due to the sales growth of above average consuming SUVs and because of the decline in sales of Diesel engine-driven cars in Europe in the context of the Diesel-gate, in 2017, the average CO_2 emission values in the EU fall short of the proclaimed reduction goals. Since 2015, the average CO_2 emission values in the EU almost stagnated—in spite of decreasing. Therefore, mainly for the companies with a high share of SUVs and powerful engines, there is a high pressure to increase the share of electric driven cars.[16] For Germany, the CO_2 emission goals probably will not be reached without compulsory assembly of catalytic converters in all fuel-driven cars (including Diesel and gasoline fuel). But the carmakers resist to additional technical backfitting because legal questions of guarantee and accountability are unclear. Additionally, such measures would either reduce engine power or lead to higher consumption and emissions.

In this context, the electrification of the power unit seems to be a major challenge (Günther et al. 2015: 220; Spiegelberg 2014: 58–80). Electro mobility can be efficient, as electric motors themselves reach energy conversion efficiencies of more than 95%. Traditional combustion engines in contrast only reach combustion efficiency of around 30%. Also, looking at the efficiency from a Well-to-Wheel-perspective (ibid: 60), electric vehicles perform at a 70% level, while fossil fuel-burning engines reach almost 20%. But electro mobility is not without problems to resolve. One challenge is the infrastructure of loading stations for batteries: The red of charging opportunities has to be dense enough, and the energy grid has to be able to manage the high volume of power (ibid.: 62ff; Teufel et al. 2015: 2). Another task relates to producing batteries, at affordable economic and sustainable environmental costs (Spiegelberg 2014: 69ff; Teufel et al. 2015; Golembiewski et al. 2015); batteries will account for 30–40% of production costs of electric vehicle (NPE 2016: 5; Spiegelberg 2014: 76; ISI 2014: 3).

Looking at the international scenery for battery production, Germany is clearly not a leading market, but until 2015, Japan and the USA had the leadership (ISI 2014: 3). Japan still was the leading seller of battery packs. Its largest customer is the USA. But this began to change since 2016 when China and the USA began to develop strongly this industry. Tesla plans to produce battery packs for about half a million electric cars in its *Gigafactory* from 2020 onwards (ISI 2014: 3). The future is open, as Chinese independent carmakers already have a lot of experience in electric cars. The European Union and the GBT are trying to catch up. The "the European manufacturers have been forced to speed up their R&D work" (Ebel and Hofer 2014: 139). The German automobile industry increased its domestic R&D expenditures from 2014 to 2015 by 5% to €20.6 billion. Two-thirds of the expenditures are invested directly by the OEMS, one-third by suppliers. The automotive industry as a whole is the main investor of R&D in Germany. More than 100,000 employees are engaged in R&D—the number is expected to increase.[17] In worldwide comparison, the "EU is by far the world's largest investor in automotive R&D" (ACEA 2016: 67). Within the EU, "the automotive sector is the […] number one investor in R&D, with €44.7 billion invested per year" (ibid.: 69). The importance of R&D for an economic sector can be analysed by comparing the number of patents granted. In 2015, German OEMs and suppliers accounted for 34% of all patents granted in the worldwide automobile industry, followed by Japan with 22% (ibid.: 70).

Volkswagen is especially engaged in changing course. In 2015, the company spent €18.3 billion on R&D. The fields of research were "the electrification of our vehicle portfolio, a more efficient range of engines, lightweight construction, digitalization and the development of toolkits" (VW-AG 2016d: 64). In 2015, in the Volkswagen Group, some 49,000 employees worked in R&D, representing 8% of total headcount (ibid). In San Francisco, researchers co-operate with start-up *QuantumScape* in order to develop new generations of solid batteries for more range and less weight. A more application-oriented research is conducted at the headquarters of Volkswagen within project *V-Charge*. It combines the search for autonomous parking-schemes in parking garages and simultaneous battery-charging via induction. Volkswagen's technology-centre *electric traction* is located in the small town of Isenbüttel. Apart from electric powertrains, highly efficient fuel-cells are developed (VW-AG 2016d: 26–31). In the context of the company strategy *Together—Strategy 2025* (VW-AG 2016e), it planned to roll out 20 additional e-models up to 2020, to be developed on a completely new Modular Transverse Matrix MQB for electric cars (ibid.: 25).

For all German Big Three, in 2018, the fundamental shift towards alternative traction was done at least at the strategic level. All companies announced electric cars, SUVs and light trucks for 2019 or 2020. In Volkswagen, 50 new electric cars and 30 plugin-hybrid models were announced to be introduced until 2025. Daimler presented its EQC-model and BMW expands its electric car models as well. A pending question is battery production in Europe. Volkswagen plans to produce solid battery cells in one of its already existing plants in Germany. In any case, the shift from fuel-driven cars to electric vehicles will reduce employment. Metalworkers Union IG Metall and the Workers' Councils are negotiating with management conditions for saving employment.

An interesting case is Volkswagen, where since 2004 IG Metall negotiated a 'collective agreement for the future' with management guaranteeing employment stability. The agreement was renegotiated in 2009 and 2011 introducing a so-called innovation-fund. This fund awards innovation proposals of workers and employees in Volkswagen by about €20 million per year. So there is a more than ten years tradition of workers' innovation proposals, where much of them are oriented towards alternative products and alternative driving systems. This strategy of the metalworkers' union and the Company Workers' Council is based on the idea that employment has to be saved by innovation and not just by resistance to change.

The same basic orientation can be found at current times when products and production change towards alternative power units. According to CEO Herbert Diess of Volkswagen, shifting towards electric car production will reduce almost a third of added value in the value chain of a car. This will have radical consequences for employment. Nevertheless, union and workers' councils' representatives strongly support the company strategy of changing towards e-mobility. They claim that battery production should be located in Germany in order not to depend completely from other countries like China. In this context, the Company Workers' Council negotiated and signed a new 'collective agreement for the future' in autumn 2018 including a guarantee that no workers will be dismissed for reasons of the shift to electric car production until 2028. This is the first time that a collective agreement includes a commitment of the management to employment stability for such a long time of a decade. The head of the Company Workers' Council, Bernd Osterloh, expressed, "I am especially proud that we were able to locate the electric mobility to a great part in our existing plants in Germany."

To sum up, the 'Diesel-gate' hit the Volkswagen consortium in a substantial way. In the following debates and studies, it came out that almost all global carmakers still were in the trail of incremental innovation of the classic ICE. Instead of actually reducing substantially fuel consumption and emissions, they just drove down their announced theoretical indices. Customers and governments began to put pressure on the automobile industry to really comply with environmental goals; governmental bodies began to change norms and control mechanisms in order to better follow up real emissions. The future of the global automobile industry will be turbulent. Although challenged substantially by newcomers in car production and by expanding car production in new regions, the GBT are trying to catch up time and capacities they lost by following incremental innovation. The next decade will be a bumpy road for all carmakers.

Notes

1. http://www.nytimes.com/2015/09/23/business/international/volkswagen-diesel-car-scandal.html, last checked: 16/08/16, 18:01.
2. http://www.nytimes.com/interactive/2015/business/international/vw-diesel-emissions-scandal-explained.html?_r=0, last checked: 17/08/16, 11:23.
3. https://www.epa.gov/newsreleases/volkswagen-spend-147-billion-settle-allegations-cheating-emissions-tests-and-deceiving, last checked: 20/09/16, 12:39.
4. http://www.kba.de/DE/Home/infotext_startseite_VW_komplett.html, last checked: 17/08/16, 15:30.
5. http://www.spiegel.de/thema/brexit/, last checked: 09/08/16, 15:11.
6. https://www.vda.de/de/presse/Pressemeldungen/20160715-pkw-m-rkte-in-westeuropa-usa-und-china-im-ersten-halbjahr-im-plus.html, last checked: 10.08.16, 17:33.
7. http://www.bbc.com/news/business-34324772, last checked: 23/08/16, 13:56.
8. http://www.auswaertiges-amt.de/DE/Aussenpolitik/Laender/Laenderinfos/Brasilien/Wirtschaft_node.html, last checked: 23/08/16, 14:58.
9. https://www.epa.gov/newsreleases/volkswagen-spend-147-billion-settle-allegations-cheating-emissions-tests-and-deceiving, last checked: 23/08/16, 17:20.
10. VW-AG 1916b: 102; http://kurse.boerse.ard.de/ard/kurse_einzelkurs_uebersicht.htn?sektion=portrait&i=110056&seite=aktien&chartzeitraum=10000, last checked: 23/08/16, 17:26.
11. For the state of Bavaria, see http://www.zeit.de/wirtschaft/2016-08/dieselskandal-bayern-verklagt-volkswagen; for the company Deutsche, see http://www.spiegel.de/wirtschaft/unternehmen/volkswagen-deutsche-see-erwaegt-klage-wegen-vw-abgasskandal-a-1096760.html.

12. See VW-AG 2016a: 7: "It all comes down to trust"; BMW 2016; for Volkswagen's announcement of June 2016 to produce batteries in Germany, see https://global.handelsblatt.com/breaking/exclusive-vw-considers-building-own-battery-factory and https://www.bloomberg.com/gadfly/articles/2016-06-21/volkswagen-should-be-wary-on-electric-battery-factory, accessed 14.09.2016.
13. Despite the deficiencies of the website, for a first glimpse, see https://en.wikipedia.org/wiki/European_emission_standards#Obligatory_vehicle_CO2_emission_limits.
14. See, for example, the TV-report http://www.zdf.de/ZDFmediathek/kanaluebersicht/aktuellste/228#/beitrag/video/2751706/Die-Akte-VW%2D%2D-Geschichte-eines-Skandals with interviews of local and federal authorities of CARB and so on.
15. Volkmar Denner in an interview available at http://www.schwaebische.de/wirtschaft/aktuelle-nachrichten_artikel,-Bosch-Chef-Denner-warnt-vor-zu-strengen-Auto-Abgastests-_arid,10322684.html; meanwhile a criminal complaint was raised against Bosch CEO Denner: http://www.faz.net/aktuell/wirtschaft/vw-abgasskandal/strafanzeige-gegen-bosch-chef-volkmar-denner-im-vw-abgasskandal-14427197.html
16. See ICCT, https://www.theicct.org/publications/co2-emissions-new-passenger-cars-eu-car-manufacturers-performance-2017.
17. https://www.vda.de/de/presse/Pressemeldungen/20160101-deutsche-a...investiert-34-milliarden-euro-in-forschung-und-entwicklung0.html, last checked: 06/09/16, 11:04.

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5

Searching for Industrial Policy: The Long Decline of the French Automotive Industry

Tommaso Pardi

Introduction

Starting from the second half of the 2000s, the French automotive industry has fallen into a spiral of decline. Production volumes have dropped from 3.7 million light-vehicles to 1.7 million at the bottom of the crisis in 2013, and they have only moderately recovered to 2.2 million in 2017 when the European market was finally back to pre-crisis levels (see Table 5.1). During this period the French trade balance for automotive products has gone from a healthy surplus of €11.8 billion to an alarming deficit of €9.7 billion, highlighting the loss of competitiveness of the French production sites (see Table 5.1). While only one carmaker factory (PSA Aulnay) and just few more amongst first-tier suppliers have been closed down during the crisis, overall around 130,000 jobs have been lost in the industry since 2004 (−40%). As a result, the relative weight of the

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Table 5.1 French automotive industry main indicators (2004–2017)

	2004	2008	2009	2010	2013	2015	2017
Domestic production (light-vehicles)—millions	3.67	2.57	2.05	2.22	1.74	1.97	2.22
Domestic sales (light-vehicles)—millions	2.47	2.57	2.51	2.7	2.28	2.3	2.55
Domestic production/domestic sales	149%	100%	82%	82%	76%	86%	87%
French production/German production	66%	43%	39%	38%	27%	33%	39%
Trade balance automotive (billions €)	11.8	−3.2	−4.4	−3.3	−5.6	−6.4	−9.7
Carmakers	7.5	−7	−8.4	−8.4		−9.8	−11.3
Suppliers	4.3	4	3.9	5.1		3.4	1.6
Personnel	313	270	246	225	200	191	183
Carmakers	183	163	149	137	124	118	112
Suppliers (INSEE)	92	69	58	60	53	82	79
Suppliers (FIEV)	130	107	97	88	76	73	71
Market shares French carmakers							
France	58%	55%	59%	60%	55%	56%	56%
EU 17	24%	23%	24%	25%	22%	22%	24%

Sources: OICA, CCFA (author treatment)

French automotive industry in the European landscape has dropped significantly from 18% (2004) to 11% (2017) of the total production of European light-vehicles (sources: OICA).

In the first part of the chapter, we will analyse the main causes of this prolonged structural decline. We will particularly focus on two causes: the growing hegemony of premium German carmakers over the European market, which has squeezed the profit margins of the French generalist carmakers; and the enlargement of the European Union (EU) towards the East that has provided French carmakers with the opportunity of relocating production to low-cost countries as a way to deal with the effects of growing competition.

In the second part of the chapter, we will analyse the different measures taken by the French state to try to offset the industrial decline in car manufacturing. We will see that while most of the ad-hoc measures taken during the crisis to prevent the collapse of the industry have proven successful, the attempts to address the structural causes of the decline and restore the long-term competitiveness of the French automotive industry have failed to produce positive results. In explaining the reasons of these difficulties, we will emphasize three complementary factors: the lack of a shared strategic vision amongst the main players of the industry; the incapacity of the State to impose one; and the impossibility of contesting the German hegemony over the European institutions that govern the automotive sector under these conditions.

Finally, in the third part of the chapter, we will discuss the future prospects for the French automotive industry in the light of the following two ongoing or possible major transformations: the shift towards electromobility, mainly driven by new post-"Dieselgate" (emission scandal) EU regulations; and the long-term transition towards autonomous driving pushed by the entry of companies from Silicon Valley. Further, we will discuss whether these trends can be considered as opportunities or threats for the future development of the French automotive industry, and what kind of impacts they could have on work and employment.

The Decline of the French Automotive Industry: Causes and Consequences

Between 2004 and 2008, French production of light-vehicles decreased by 30% in a favourable domestic market environment (+4%) in which the market shares of French carmakers remained stable both in France (from 58% to 55% of the market) and in Europe (from 24% and 23% of the market). However, during this period, the ratio of domestic production on domestic registrations fell from 149% (2004) to 100% (2008) and the trade balance of the sector went from a surplus of €11.8 billion to a deficit of €3.2 billion. In terms of employment, the sector lost 44,000 jobs, of which 20,000 out of 183,000 for manufacturers' staff (−11%) and 23,000 out of 130,000 for suppliers' staff (−18%)—see Table 5.1.

The phenomenon of deindustrialization in the sector, therefore, precedes the crisis of 2008 and is essentially due to the relocation of the production of vehicles with lower added value (segments B1 and B2) to the Eastern European and Turkish sites of PSA (Czech Republic, Slovakia) and Renault (Slovenia, Turkey, Romania). This implicit trend in the development of the European internationalization of French manufacturers

(Charron 2004; Jullien et al. 2014) was further reinforced by three additional destabilizing factors linked to the evolution of the configuration of the European markets and the structure of competition.

First Factor of Destabilization: The Hegemony of the Premium

Throughout the 1990s and early 2000s, competition had grown fiercer as a result of the growing internationalization of European manufacturers. This has led to a sharp increase in the number of models supplied to the market, to their quicker renewal, and to the steady introduction of new technologies to both seduce consumers and respond to the regulatory constraints in the areas of fuel consumption, pollution and road safety. An increase in costs and prices ensued, which also reflected the move towards heavier and more powerful vehicles. In France, the number of months of average pay required to buy an average car increased from 8.5 months between 1968 and 1983 to 10 months between 1989 and 1999, and to 11.6 months in 2003 (Jullien and Pardi 2011). Similarly, the ratio between the sale of new cars and second-hand cars, which was more or less stable at around one new car for one second-hand car until the end of the 1980s, increased to one new car for two second-hand cars at the end of the 1990s—and then, very rapidly, from one new car for every three second-hand cars from 2004 onwards.

This trend was similar at the European level. International Council on Clean Transportation (ICCT) data notably show a steady increase in the weight and engine power of vehicles, accompanied by a price increase that is common to all brands[1]: the average sales price increased by 20% in Europe between 2000 and 2007, relative to an inflation rate of 14.8%, to 35% between 2000 and 2014, relative to an inflation rate of 27.6%.

Because cars were becoming more expensive and their purchase was increasingly restricted to the richest households, it was the German brands—traditionally the market leaders in the medium and upmarket range—which best succeeded in holding their own. Their share of the market, particularly for the premium brands, sharply increased between

2001 and 2017 (BMW +55%, Audi +52% and Mercedes-Benz +20%), while the market shares of French carmakers, as well as of Fiat and the subsidiaries of Ford and GM specialized in the production of low-range cars, dropped considerably (Ford −21%, Peugeot −30%, Renault −30%, Fiat −33%, Citroën −36% and Opel −41%).[2]

If the French carmakers were still, at the beginning of the decade, represented in the more lucrative segments with some successful models, they started to be increasingly marginalized by the German brands (see Fig. 5.1) in both the high-end segment (M2) and the mid- to high-end segment (M1).

This dynamic made it increasingly difficult for French carmakers to maintain their profitability margins. Their quest for "competitiveness" consisted in cutting costs, particularly labour and supply costs. The enlargement of the

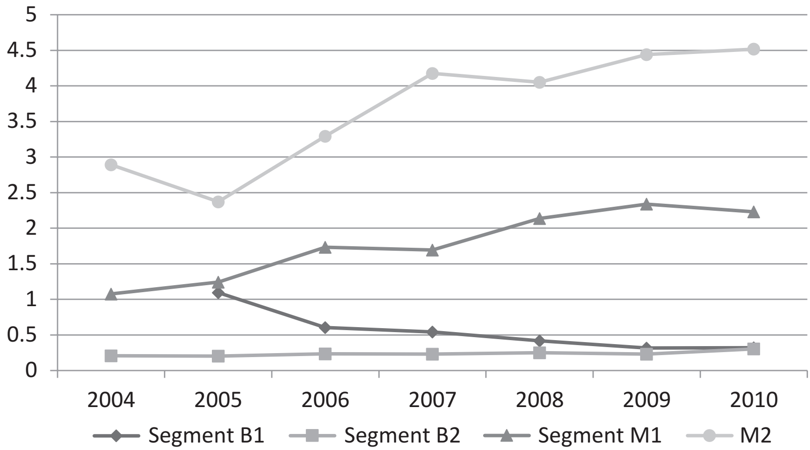

Fig. 5.1 Ratio between the European sales of VW, Audi, BMW and Mercedes models and Peugeot, Citroën and Renault models (2004–2010). Source: CCFA, AutoActu (treatment by Bernard Jullien). Notes: Segment B1 corresponds to the sales of «mini-city cars» (VW Fox, Smart Fortwo, Peugeot 107, Citroën C1 and Twingo); Segment B2 to the sales of "city cars" (Polo, Peugeot 206/207, Citroën C2/C3, Renault Clio and Modus); Segment M1 to the sales of compact cars and minivans (VW Golf and Touran, BMW Mini, Audi A and B, Peugeot 307/308; Citroën Xsara/C4, Renault Mégane and Scenic); the M2 to the sales of family saloon cars (VW Passat, Audi A4, BMW 3 Series, Mercedes C-Class, Peugeot 407, Citroën C5 and Renault Laguna)

EU in 2004 and 2007 to integrate new Member States from Central and Eastern Europe provided Renault and PSA with the opportunity to relocate their production to countries with low wage costs, within the Single Market itself.

Second Factor of Destabilization: The Integration of Central and Eastern European Countries

The first wave of foreign direct investment in the automotive sector in Central and Eastern European Countries (CEECs) during the 1990s and in the first half of the 2000s focused, at least in the early days, on the growth of local markets, which, according to most experts, was expected to reach 2 million vehicles at the end of the decade and 4 million during the next (Pardi 2018). Further, this expectation justified the availability of generous EU subsidies to support the creation of this new capacity (Nicolini et al. 2013). However, contrary to these forecasts, the markets of the CEECs did not develop at all, mainly on account of the massive imports of second-hand vehicles from Western markets, and particularly from Germany.[3] Local governments in Poland, the Czech Republic and Romania tried to regulate these imports by introducing ad-hoc measures on the grounds of greening their fleet by taxing the imports of old and polluting cars. But the European Commission and the European Court of Justice systematically rejected these measures because they run against the principle of the free movement of goods within the Single Market (Pardi 2018). Strong political support was created in these countries to back-up these measures and defy the European Commission; however, no political coalition emerged in Brussels to defend the development of these emerging markets for new cars.

As a result, between 2004 and 2008 the sales of new cars in CEECs declined and fell below the 1 million bar, while capacity doubled from 1.5 million to 3 million light-vehicles and would keep growing during the crisis to reach 4 million by 2015. Since this capacity could not be absorbed by local markets, on average more than 80% was exported. As illustrated in Table 5.2, German carmakers could use this extra capacity

Table 5.2 Differences in production volumes by location between 2004 and 2016 (Renault, PSA and Volkswagen)

	Domestic base	Spain	Others EU 17	CEECs + Turkey + North Africa	Total
Renault	−565,458	+57,184		+405,497	−102,777
PSA	−925,928	−105,094	−156,405	+437,618	−749,809
VW	+972,848	+129,537	−56,767	+504,892	+1,550,510

Source: OICA, author calculation

to take market shares from competitors and to export premium models outside the EU, increasing their production at home. However, French carmakers that were struggling to go upmarket and defend their positions in the A and B segments used it to substitute high wage production at home with low wage subsided production in the CEECs (and Turkey).

The Impact of the Crisis

When the crisis arrived in 2008, and worsened in 2009, its impact amplified the already evident effects of the dynamics of deindustrialization underway since 2004. The manufacturers' revenue index in France, which had already dropped by 6.5% between 2004 and 2007, accentuated its fall in 2008 (−5%) and collapsed in 2009 (−14.8%), highlighting the fragility of the manufacturers' treasury, which was rapidly threatening their ability to sustain the investments needed to develop new models (see Fig. 5.2).

The revenue index of suppliers in France, which had held during the period 2004–2007 (−4%), lost 7.8% in 2008 and sunk in 2009 (−20.6%). The top first-tier suppliers were the ones who suffered the least; particularly, the main global suppliers that could count on both the growth of production volumes in the Brasil, Russia, India, China (BRICs) to compensate for the contraction of the European market, and on contracts with German carmakers to compensate for the decrease in volumes sold to French manufacturers. For the other first-tier suppliers, many of whom had allowed major investments to follow the upmarket strategy of French manufacturers, losses began to build up in 2008, and quickly brought them to the brink of bankruptcy in 2009.

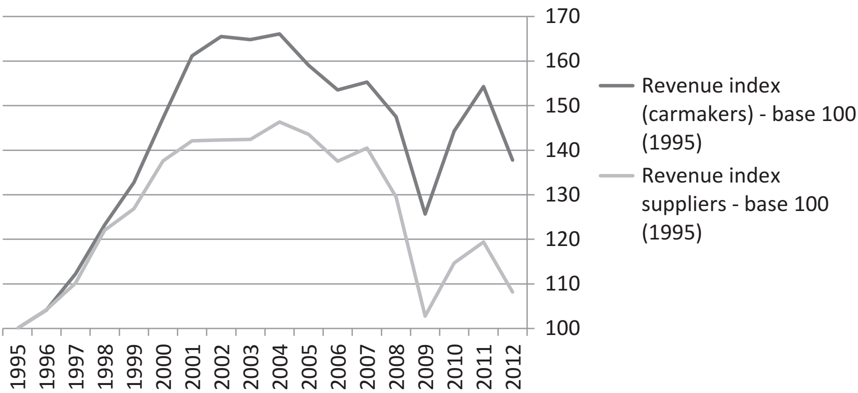

Fig. 5.2 Revenue index of French carmakers and suppliers (1995–2012—base 100 1995). Source: INSEE

As for second-tier suppliers, except for those particularly diversified in sectors less exposed to the crisis, their situation immediately seemed desperate. The problem, at least in part, was that carmakers were very cautious in the crisis situation, and preferred to substantially reduce production rather than end up with a stock of unsold products. In 2009, while the French market held up, thanks to the effects of scrapping incentives (−2.3%), the European market lost "only" 11.4%, and the market share of French manufacturers increased in France (+4%) and Europe (+1%). Yet French production fell again by 20.2%, going from 100% to 82% of national registrations (see Table 5.1). Moreover, when it came to choosing where to reduce production between French sites (older and more expensive) and Eastern European sites (more recent and cheaper), the preference systematically went to the latter. This led to the transformation of factories of Bursa in Turkey for Renault, and Trnava in Slovakia for PSA, in the main European sites of the two French manufacturers (Pardi 2017).

The opportunistic behaviour of French carmakers did not only amplify the consequences of the crisis, but it also ran the risk of retaliating against their own interests. The bankruptcy of a large number of second-tier suppliers, which likely increased as the crisis progresses, risked, in fact, blocking the entire production chain.

At the beginning of 2009, it was already clear that only the State could rescue the French automotive supply chain from collapsing.

Policy Responses to the Crisis

The "Pact Automobile" and the Creation of the *Plateforme de la Filière Automobile*

On 20 January 2009, the right-wing government of Nicolas Sarkozy convened all the main players in the automotive sector to the national "General Assembly of the automobile". The objective was to agree on short-term ad-hoc measures to sustain the demand and protect the industry, as well as on a long-term strategy to restore the competitiveness of the domestic supply chain. On 9 February 2009, the national plan "pact automobile" was launched.

The short-term measures consisted of the following:

- €6.5 billion worth of loans to Renault, Renault Trucks and PSA to support the development of new models;
- €2 billion of funds to the carmakers' financial institutions to maintain the provision of consumers' credits;
- creation of guarantee funds for loans granted to first- and second-tier suppliers through Oséo (a private funding institution backed by the State): up to 90% of the loan and up to €15 million per company for a total credit volume of €4 billion for small and medium enterprises and €1 billion for first-tier suppliers;
- creation of the *Fonds de Modernisation des Equipementiers Automobiles* (FMEA) with a budget of €600 million to support the sector and encourage its consolidation through the crisis;
- introduction of a "part-time unemployment" measure for the automotive sector that would allow companies to reduce their working time by up to 50% and to receive compensation from the State of €1.5–1.7 per hour not worked according to the size of the companies;
- extension of the scrappage scheme introduced in 2008 (€1000 for vehicles over 10 years old) associated with an ecological bonus/malus incentive (up to €2600 per vehicle acquired according to its level of CO_2 emissions).

In exchange for this massive injection of public funds, the government asked the main players of the industry to sign a "code of performance and good conduct" in the customer–supplier relationship. The code of good conduct not only laid down a number of rules concerning the contractual framework, intellectual property and the terms and conditions for settling transactions between customers and suppliers, but also provided for the creation of "a permanent platform for consultation and exchange between customers and suppliers in the motor vehicle manufacturing industry". These two initiatives aimed at addressing the two main causes of the structural decline of the automotive industry: first, to halt the process of relocation towards low-cost countries driven by the carmakers by redressing the balance of power between carmakers and suppliers; second, to provide the industry with a shared strategy to increase production in France by forcing all the players to agree on one.

In general terms, the code of good conduct aimed to redefine manufacturers' practices towards their suppliers and to establish a form of supply chain solidarity in return for government support and as a programmatic basis for the consolidation and modernization of first- and second-tier suppliers. It explicitly forbade the clients from (a) requiring "a minimum part of the supply contract to be carried out in low-cost countries without an objective economic justification being provided on the basis of the price proposed" (point 1) and (b) using "a criterion relating to such a minimal part (see above) in its internal processes of evaluation and definition of the fixed and variable remuneration of its collaborators" (point 2).

The code of good conduct also foresaw the cooperative development of a series of "actions" (point 4):

– Develop a programme for the dissemination of lean manufacturing in the supply chain;
– Identify ways of improving the competitiveness of the sector according to the trades and technological specialities;
– Clarify and simplify the processes of ordering, receiving and acquiring production tools.

The code of good conduct was signed on 9 February 2009 by all the professional syndicates in the industry, which formally invited all their members to apply its principles. The *Plateforme de la Filière Automobile* (PFA) was created two months later, on 28 April 2009, to organize this delicate balancing act: on the one hand, the PFA was to rapidly intervene in accordance with the interests of carmakers to avoid the collapse of the supply chain; on the other hand, it was to consolidate and modernize the supply chain while simultaneously acting on the practices of carmakers who had largely contributed to weakening it. Finally, the PFA was to integrate, through the concept of "supply chain solidarity", the interest of the State and the territories against the relocation strategy developed by carmakers.

The formal governance of the PFA reflected the concept of "automobile pact" and the attempt to redress the balance of power in a consensual way through the hybrid nature of the instrument. It was clear that the PFA was a government initiative, but it was jointly piloted and financed by manufacturers (Renault, Renault Trucks and PSA) and suppliers (Comité de Liason des Industries Fournisseurs de l'Automobile). Therefore, the PFA was a hybrid instrument that combined elements of industrial policy (national solidarity, public support for the industrial chain and direct intervention to save companies in crisis) and the objectives and traditional mechanisms used by manufacturers to manage and secure their supplies (consolidation and rationalization of the chain through cost reduction, investment planning and the merger and acquisition of companies).

The first difficulty consisted in organizing such a device at the scale of the supply chain, considering, on one hand, the historical rivalry between PSA and Renault, and on the other hand, the increasingly conflicting and tense relationships between manufacturers and suppliers. Therefore, the organization chart of the PFA was formally drawn up to ensure that all the important players were equally represented. The presidents of the suppliers' syndicates would seat in the steering committee, while Renault and PSA representatives would alternatively hold the position of general director, and they would also lead, supported by representatives of the main French global suppliers, the working groups. Contrastingly, the State's presence in the PFA would only be symbolical, with two representatives seating in the steering committee, while second rank suppliers were not included at all.

Since 1 July 2009, the action of the PFA was organized into four working groups (GTs—*Groupes de Travail*):

- The first group (GT 1) had the objective of diffusion of lean manufacturing at the level of the supply chain;
- The second group (GT 2) was focused on the skills and jobs of tomorrow; its objective was to promote the supply chain to attract talented candidates and to develop and adapt available skills;
- The third group (GT 3) focused on information and communication management within the supply chain, with a particular focus on the role of new information and communication technologies;
- The fourth group (GT 4) was responsible for developing the common medium and long-term strategy to improve the performance of the supply chain in terms of competitiveness.

Of the four GTs, the latter was the most strategically important because it had to manage the crisis and plan for the future. Concerning the crisis, the strategy chosen by the GT 4 was "to identify the main avenues of progress to reduce excess capacity and make the supply chain more competitive".[4] In practical terms, it mainly consisted of using FMEA, the financial fund of €650 million jointly created in 2008 by the State, the carmakers and the main first-tier suppliers,[5] to rescue from bankruptcy key first- and second-tier suppliers of PSA and Renault and to manage their restructuring through the crisis. The goal was explicitly to "invest in the strongest and in the firms considered as strategic", but not "to reinforce the lame ducks", as stressed by Hervé Guyot, president of the FMEA and former purchasing director at PSA, at a public business conference.[6] Not surprisingly, when the GT 4 presented its preliminary results on 6 May 2010, it concluded that the supply chain still suffered from structural overcapacities, which it estimated at around 50,000 workers, more than half of the total remaining employment in the supply chain.

In other words, what emerged, de facto, as the PFA's course of action was a very partial view of the crisis reflecting the quasi-exclusive perspective of carmakers and French global suppliers. Instead of acknowledging their responsibility for the structural weakening of the supply chain, particularly with regard to local second-tier suppliers, the carmakers and their first-tier global suppliers made them responsible for the sector's lack of "competitiveness". This development in the governance of the PFA contradicted the notion of "supply-chain solidarity" introduced by the

State and undoubtedly reflected the weak presence of State's representative in the whole system. While the government had endowed the PFA with a number of rules and institutions to promote "supply-chain solidarity", such as the code of good conduct or the participatory nature of sub-sector working groups, it had left the entire management of the PFA to the dominant players in the sector.

The assessment of the application of the code of good conduct on 5 May 2010 tended to confirm the following reading: few suppliers had officially requested its application through the mediation mechanism, many of them evoked its virtual character, and some denounced the reluctance of major players, in the supply chain, to apply it (Chanaron and Boireau 2011).

On the positive side, the GT 4 and the PFA more generally forced PSA and Renault to cooperate together and with their first-tier suppliers in consolidating the supply chain. However, there were no traces of any power-balance redressing between Original Equipment Manufacturers and smaller suppliers. Since carmakers considered that only cost competitiveness mattered, this implied in the short and medium terms that capacity and employment at home would be reduced, while low-cost production sites abroad would keep growing. And this is precisely why the definition of a common plan for the future in order to build the competitiveness of the French automotive industry on other bases than cost was a crucial stake of the "automobile pact". But here the PFA could not really make a lot of progress as all the main players had quite different views on how the industry should develop. Instead the most ambitious attempt to force a national plan for the future came from outside the PFA, when Renault successfully lobbied the government to launch the most ambitious plan in Europe for electro-mobility in 2009.

The National Plan for the Development of Clean Vehicles

Through its alliance with Nissan, Renault had gained access to advanced Japanese technologies in batteries (NEC) and foresaw the opportunity of developing a range of battery-powered cars (EVs). In

2009, oil prices were high and growing, while political pressures to move towards low emissions mobility were increasing in France and Europe. Since 2007, France had launched under the initiative of its influent minister of environment, Jean-Louis Borloo, a national plan for improving the environmental sustainability of the economy, called "Grenelle de l'Environnement", introducing a bonus/malus system to subsidize the sale of low CO_2 vehicles and tax high CO_2 vehicles. From there the step towards a national plan for EVs was not very difficult to achieve. Renault was ready to launch a range of relative affordable EVs by 2010–2011, and convinced the government that EVs would not only be extremely eco-friendly, since 90% of the energy produced in France was carbon-free,[7] but would also solve the competitiveness problems of the French automotive industry, particularly, against the more polluting cars produced by German carmakers (Jullien and Pardi 2013).

The National Plan for the Development of Clean Vehicles was, therefore, launched on 1 October 2009. It foresaw 14 "concrete actions" to encourage the development of electric and hybrid rechargeable vehicles. These included support for battery research, the development of charging infrastructure in car parks and private homes, standardization of objectives and support for the development of alternative mobility offers to the individual vehicle owned.

The long-term objective was to convert 5% of France's car fleet to electricity by 2020, equivalent to around 2 million vehicles.

The "road map" of the plan was as follows:

- 2008–2010: Preparation of the market for the electric car
- 2010–2015: Construction of the market for electric cars
- 2015–2020: Mass market for electric cars

The government provided this package of incentives with a fund of about €1.9 billion, of which €500 million was a bonus of €5000 for the first 100,000 electric cars purchased by private individuals. The remaining part (€1.4 billion) was concentrated on the development of the EV supply chain and research.

The bonus/malus scheme was maintained but progressively transformed to favour the sale of rechargeable electric and hybrid vehicles. The plan also provided for the establishment of a fleet of 100,000 electric vehicles with a range of at least 150 km by the year 2015, which was to be borne by a consortium of large companies, associations of local authorities and representatives of the State led by the French Post.

Finally, the plan integrated into a "national strategy" for the dissemination of the charging infrastructure needed for electric and hybrid rechargeable vehicles: 900,000 private and 75,000 public charging points (of which 15,000 fast-charging) were planned for 2015, and 4 million private and 400,000 public charging points (of which 75,000 fast-charging) for 2020.[8]

Despite its national scope, strong ambitions and the active engagement of the State, it became clear soon that the national plan would not be able to achieve any of its objectives. If retrospectively the plan largely overestimated the maturity of battery technology, the consumers' demand for EVs, the capacity of Renault of producing them at a reasonable cost, and the time required to install the charging infrastructure, the active opposition of the rest of the industry, and in particular of PSA, also played a role in its rapid demise.

The works of the PFA in the GT 4 (noted earlier) particularly aimed at developing a counter-discourse to redirect government policy towards wider support for the development of new, less polluting and better performing technologies, including the improvement of internal combustion engines and the introduction of non-rechargeable hybrids.[9] By the end of 2010, it became clear that the disruptive scenario of a rapid transition towards battery vehicles pushed by Renault was over, and that the conservative scenario of technological continuity through hybrids and improved internal combustion engines backed-up by PSA and by the main French suppliers would prevail.

Whether the plan for the development of clean vehicles was a good idea or not, its failure again highlighted the incapacity of the French state to force the main players of the automotive industry to agree on a common strategy or to carry out one on its own.

From Industrial Policy to Damage Limitations: Restructuring and Competitive Agreements

As the crisis seemed to fade away in 2010, the PFA became rapidly an empty shell: PSA and Renault had obtained what they wanted from the government in terms of financial support and they were now ready to go back to business as usual. But, when the crisis rebounded in 2011, due to the peaking of the sovereign debt crisis, it became clear that none of the structural problems that threatened the collapse of the French automotive supply chain in 2009 had been solved. This time however the crisis was not perceived as temporary, but as structural. No attempts were made to sustain the demand, and the only plan proposed by the carmakers, and accepted by the government, was to reduce capacity by closing down factories and cutting employment.

PSA announced in 2011 that it would close down the factory of Aulnay two years later. Both PSA and Renault also negotiated with their trade unions "competitive agreements", which implied further redundancies (around 20,000 in total, but mostly on voluntary basis), increased time and geographic flexibility, and more working time and wage freezes (Sauviat and Serfati 2013). By 2013, the French production of light-vehicles was at its historical lowest of 1.74 million, 52% below its 2004 level. The gap with the German production had never been so important from 1.8 million vehicles in 2004 to 4.7 million in 2013. Total 113,000 jobs had been lost in the automotive industry since 2004 (−36%).

Confronted with such a catastrophic situation, the socialist government of François Holland tried in 2012 to re-launch the PFA around a new "automobile plan" geared towards the development of green cars. The most important measures consisted of increasing the bonus for EVs from €5000 to €7000 and for hybrids from €2000 to €4000; providing €350 million to support the development of plug-in vehicles and related innovations; and equipping the FMEA with an additional €260 million for modernizing the supply chain. This time the government did not even try to address the structural causes of the decline. It was more a matter of limiting the damages. But, by 2014 the situation of PSA started to look desperate and the State had to inject additional €750 million in the ailing group to rescue it from bankruptcy. This meant that it was now the main shareholder of both Renault (15%) and PSA (14%), but still without a clear industrial policy for the automotive sector. Meanwhile, in 2012, Renault had installed a new factory in Morocco with a capacity of 350,000 vehicles, and PSA had announced in 2017 the creation of a new factory in Algeria.

Future Prospects and Challenges

"Dieselgate" and the Electrification Challenge

In 2015, when the crisis of the European market for new cars finally seemed over, a different crisis suddenly arose. Following investigations by ICCT, it was found that Volkswagen had put a defeat device in diesel engines to reduce NO_X emissions during homologation tests. The "dieselgate" emissions scandal rapidly affected the whole industry as several other carmakers, including Renault and PSA, were suspected of having used similar devices in their models.

In Europe, the "dieselgate" triggered a rapid hardening of environmental regulations as a new double homologation test, the worldwide harmonized light vehicle test procedures and the real driving emissions, was introduced in September 2017 for the new models, and in September 2018 for all new vehicles. It also led to a rapid decline in the sales of diesel models (from around 52% in 2015 to 44% in 2017 on the EU scale). Keeping in mind that in 2021 the target for the average CO_2 emissions of new cars will move from 130 gr/km to 95 gr/km, this means that it will become extremely difficult for all carmakers based in the EU to achieve this target. Not only because the CO_2 emissions of new models will be now measured by more rigorous tests, but also because the decline of diesel sales will increase the average CO_2 emissions by brand as gasoline cars emit on average 20% more CO_2 than diesel ones. Indeed, already in 2017, the average CO_2 emissions of several brands have increased for the first time after a decade of constant decline. This has been notably the case of Peugeot, Citroën and Renault (ICCT data), which have suffered from the sharp decline of diesel market share in France (from 64% in 2014 to 47% in 2017). Furthermore, the European Council has already announced that the new targets for average CO_2 emissions in 2025 and 2030 will be of 81 gr/km and 59 gr/km, respectively. For all these reasons, the electrification of new car sales that the French national plan of 2009 had failed to promote will now be produced, at least, to a certain degree,[10] by the new EU tests and regulations. This is because most of the brands will not achieve the 2021 target without selling a certain amount of electric cars and these sales (for all passenger vehicles emitting less than 50 gr/km) will count almost double in the calculation of the average emissions by brand.[11]

It is still unclear whether this is a good or bad news for the French automotive industry. Probably, it will depend on the technology of average electric vehicles and their cost in 2021, 2025 and 2030. If, for instance, the average electric car will be a plugin-hybrid with a large battery for regulatory reasons, then no matter how less the battery cost, it will still be an expensive car. This will give a key advantage to premium German brands that already dominate this segment of the market. This will be also the case if it is an electric vehicle with a large battery that will provide a comparable level of autonomy than an Internal Combustion Engine car. Contrastingly, if it is an electric vehicle with a relatively small battery, then its total cost of ownership might be low enough to allow French carmakers, and in particular, Renault, to have a competitive advantage, but it would require a dense network of charging points. PSA, but also Toyota that has produced in France 230,000 Yaris in 2017, of which 47% are electric hybrids, will rather hope that the average electric vehicle will be a plug-in with a small battery, but this will hardly be the case after 2025.

How this electric transition will affect employment and work in the French automotive sector will also depend on these different scenarios. Because the battery modules and electric engines are imported from Asia, it is clear that the production of electric cars will require less employment. Since the electric engine is also most of the time purchased, and that all the ICE technology is gone, the loss through all the supply chain is estimated at 20% of the existing employment. But in the case of plugin-hybrids, the equation could be sensibly different.

Autonomous Driving, Connected Cars and New Mobilities

In parallel to the side-effects of the "dieselgate", the global automotive sector is now confronted with a second unexpected challenge, coming this time from the Silicon Valley. Starting in 2012, Google began experimenting with an autonomous vehicle, the Google Car, but very few people expected at the time that only six years later all the major car companies worldwide would follow in its footsteps. Several factors explain this acceleration: successful testing of the Google car; entry of other Silicon Valley players such as Tesla and Uber in the race towards Autonomous Vehicles (AVs); rapidly increasing capital evaluation of these digital companies despite relatively low sales and severe losses, which provided them with a strong investment capacity; the development of cameras, sensors and required connectivity for AVs by leading global automotive suppliers such as Valeo, which allowed carmakers to join the race and envisage mass production; and, perhaps the most important factor, growing interests of national governments for promoting and developing AVs that has allowed the multiplication of testing and experiments.

This has notably been the case for France. Since 2014, the government has produced an industrial roadmap for the development of self-driving vehicles. Between 2014 and 2018, 41 experimentations have been authorized (26 for personal vehicles and 15 for urban shuttles) and a total of 200,000 km has been travelled with no major accidents. Recently, following the organization of a large scale consultative convention on transport issues by the Ministry of Transport in 2017 (*Les assises de la mobilité*), a national strategy for the development of self-driving vehicles has been launched on 14 May 2018. Led by former Minister, Anne-Marie Idrac, the strategy aims at combining the advantages of autonomous driving for public transport and transport regulation, with the development of competitive French firms in new markets for technological services linked to autonomous vehicles. It foresees the construction of a framework by 2020–2022 that allows the use of personally-owned self-driving cars, as well as public transport vehicles and highly automated freight delivery vehicles; the establishment of a national framework for the validation of automated public transport systems; and the structuring of a national experimentation programme on large scale partially financed on State funds (the "Future Investment Program").

It should be noted that beside the French mega-supplier Valeo, which has been very active in promoting and developing AV technologies, both PSA and Renault have announced the launch of several AVs of level 3–4 by 2020–2022. But all the other major global carmakers have done the same during the last couple of years. It is therefore unclear whether this achievement, that is still far from evident, will actually generate any competitive advantage. Furthermore, if mass production is achieved, the extra-cost for autonomous driving features will probably range between €2000 and €3000, and contrary to Audi, Mercedes and BMW, French carmakers will find much more difficult to sell these technologies to their customers.

While it is true that most of the business models associated with AVs imply that carmakers would eventually not sell cars anymore but shared mobility services, this would require the development of robot-taxis, which appears, at the end of 2018, a quite remote possibility. On the other hand, French carmakers have already started to experiment with shared mobility services, as their competitors do, but have been reticent so far to develop any serious offer, as they do not see how these services could be profitable (Jullien and Rivollet 2016).

In France, shared mobility services have significantly grown during the last couple of years, pushed by the relative success of domestic start-ups like Blablacar and Drivy, and also of Uber, for which France is the second European market. However, in 2017, all these new mobility services combined represented only 0.2% of the total kilometres travelled by car in France and the prospects of further developing these services were slim as some of these markets already appeared saturated and almost none of these companies were making profits (Jullien and Rivollet 2016). In 2018, the failure of Autolib, the iconic electric car sharing service in Paris, and the growing difficulties of Uber, confronted with recurrent strikes and a tribunal decision by the court of cassation that qualified the relationship between a driver and the American digital platform as an employment contract, confirmed all these difficulties. While all scenarios are still possible, the combination of self-driving and shared mobility services does not seem for tomorrow.

Conclusion

In 2018, the French automotive industry is doing better. Production volumes have exceeded the symbolic bar of 2 million vehicles (2.2 million in 2017 from 1.7 in 2013) and the ratio of domestic production on domestic sales has risen to 87% (from 76% in 2013) in favourable market conditions. But the employment keeps falling in the industry (further 8000 jobs have been lost between 2015 and 2017) as the trade balance for automotive products keeps worsening (from €−6.4 billion in 2015 to €−9.7 billion in 2017). The main problem is that none of the structural causes that have spurred the catastrophic decline of production and employment between 2004 and 2013 have been solved. The repeated attempts by the French governments of creating a large coalition of interests around the PFA, to restore the competitiveness of national production and supply chain and to develop the notion of supply chain solidarity, have failed; mainly because all these attempts relied on the goodwill of multinational companies rather than on binding political institutions and strong interaction between civil servants and managers. In a similar manner, the national plan for clean vehicles of 2009 has also failed because of a fundamental lack of coordination.

If the French automotive industry is not now necessarily bad placed in dealing with the upcoming challenges of electro-mobility and autonomous driving, the renewed activism of the State to organize national strategies around these topics might very well fail again for the same reasons. Many different and complex organizational and technological factors will certainly affect the probabilities of the different scenarios, but the fact that the French automotive industry has not been able (yet) to come up with a common shared industrial strategy and cannot therefore rely on a long-term industrial policy to achieve it, will remain a major handicap for its future prospects.

Notes

1. Source: ICCT, European Vehicle Market Statistics, Pocketbook 2018/2019, pp. 36, 64.
2. Source: ICCT, European Vehicle Market Statistics, Pocketbook 2018/2019, p. 17.

3. About 40% of the second-hand cars imported to the CEECs comes from Germany (source: "Consumer Market Study on the Functioning of the Market for Second-Hand Cars from a Consumer Perspective". Brussels: European Union, 2015).
4. Source: Presentation by Patrick BLAIN, Executive Secretary of the PFA, seminar G05 PREDIT "Fabrication-Process".
5. Renault, PSA and the State contributed with €200 million each, while the main first-tier suppliers added €50 million.
6. Recorded at the conference "Les journées de l'Usine Nouvelle", March 2009.
7. About 78% of the energy produced in France comes from nuclear power stations, and 12% from hydroelectric power stations.
8. Source: *Plan national pour le développement des véhicules électriques et hybrides rechargeables*, ppt, 2009.
9. Source: https://www.pfa-auto.fr/sites/default/files/Rapport_GTEC4.pdf
10. The non-binding targets set by the new EU regulations for the market share of Zero and Low Emissions Vehicles are of 15% by 2025 and of 35% by 2030.
11. The exact value of the multiplier will depend on several factors, such as the country of sale, as New Member States will have higher multiplier, and the level of emissions between 0 and 50 gr. of the models sold (see: ICCT, Policy update—CO_2 emission standards for passenger cars and light-commercial vehicles in the European Union, 2019).

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6

Britain's Car Industry: Policies, Positioning, and Perspectives

Dan Coffey and Carole Thornley

Introduction

This chapter provides an overview of the current state and global positioning of Britain's car industry. While historically informed, its focus is on understanding the present situation, with an appraisal of the strengths and weaknesses of the sector and the many challenges it faces, including reducing carbon emissions while planning for connected and autonomous vehicles. It begins with the current shape of the car industry in Britain; moves on to the evolving national policy platform for export-led growth; and then to an assessment of stress points, prior to a summary of prospects. In a field which changes as rapidly as the car industry, this is a snapshot. But in Britain, there is currently a revivified interest in industrial policy, in the context of a massively reduced manufacturing base

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which now accounts for less than 10 per cent of national Gross Value Added (GVA) and less than one in ten direct jobs, and with added urgency added by the debate over Brexit. For all of these reasons, the car industry is now deemed a strategic industry for policy; and this fact frames the selection of themes in this chapter and discussion of risks.

Britain's Car Industry Today

A striking feature of Britain's car industry, compared with other European car industries, is its thoroughly international character. Production and sales are spread across a range of competing interests, and foreign-owned corporations account for all of the larger original equipment manufacturers (OEMs). In addition, some of the corporate players that are relatively small manufacturing presences in Britain are still large from the viewpoint of retail and distribution, with implications for imports, parts and aftermarket services.

Because of this, two fundamental attributes of British policy are:

1. a desire to be non-discriminatory in negotiating relationships between the national government and the different international business interests operating in and from Britain, in the car industry;
2. a pronounced bias towards measures intended to attract further inward foreign direct investment to the sector, while retaining existing investments and sustaining existing production sites.

At the most general level, the British policy stance is also paradoxically mounted on two almost contrary propositions. On the one hand, Britain boasts about its de-regulated labour market and 'competitive' labour costs; on the other, about business access to higher level engineering skills as well as the resources of 'world-class' university and research centre networks. What is sometimes called a triple helix policy sits alongside cheap labour. Until recently Britain has positioned itself as a gateway into the European Union (EU) marketplace, while maintaining an arms-length distance from some of the preoccupations and costs of European economic integration. However, the 'no' vote in the national referendum on EU membership means that so-called Brexit threatens this positioning, absenting a 'good' deal with Europe (which at the time of writing is far from certain, with no deal at all possible).

Why There Is No British-Owned Volume Car Manufacturing Industry

Debate continues as to how Britain arrived at a situation where it no longer has any sizeable and domestically owned businesses making cars. While a precis of the steps by which British-owned volume car manufacture disappeared is easy to provide (see Coffey 2009), it remains a point of live controversy as to what the causal mechanisms were. The most common approach invokes failing trade-competitiveness, with blame distributed among managers, trade unions, and government according to taste but following a broadly similar script. This could be called the *failure approach*. A different approach highlights the destabilising role of transnationally capable actors in the run-up to, and following on from, Britain's 1973 entry into what was then the European Economic Community (EEC) (now the EU). This was led on the car side by Ford, which had tilted its axes of operation sharply in favour of the continental mainland of Europe, and amongst component manufacturers by a number of British firms. The resulting pressure on the industry left British car assembly isolated, exacerbated by political responses which curtailed continuing state support for an independent and domestically owned volume producer (Coffey and Thornley 2009: chapter 2; also Cowling 1986; for the negative lobbying proclivities of some British-owned component manufacturers, see Pardi 2017). In contrast with the failure approach, this could be called the *destabilisation approach*. But regardless of exactly why things happened as they did, insofar as the reality of Britain's car industry today is concerned, there are no 'national champions'. Nonetheless, a number of foreign-owned car manufacturers in Britain continue to deploy British brand names and to exploit 'Britishness', obvious cases being BMW producing the Mini at Oxford, and Tata's Jaguar Land Rover (JLR). The historic British brand MG Rover is similarly owned by SAIC (previously

Shanghai Automotive Industry Corporation), a Chinese interest, now a small-scale marketing and sales operation which imports from China.

Current Industry Profile

Six mainstream car manufacturers have recently operated as volume producers: BMW, Honda, Renault-Nissan, JLR, Toyota, and Vauxhall—the last of which is now owned by the French Groupe PSA. At time of writing, there are also five commercial vehicle producers, which partly overlap with the group of six carmakers because of the presence of Vauxhall in each. There are nine separate manufacturers of buses and coaches; a substantial number of niche producers of specialist cars and vehicles; and in addition to this a major business cluster organised around a motorsport hub that counts eight formula one competitors, and with spillovers into premium sports cars (SMMT 2018: 5). Turnover for automotive as a whole is estimated at £82 billion in 2017; exports generated £44 billion of this total, accounting for around 12.8 per cent of total British goods exports by gross value, and adding more than £20 billion to national GVA (ibid.: 7).

Because the Tata-owned JLR specialises in premium price luxury cars (Jaguar) and four-wheel drive off-road utility vehicles (Land Rover), there are currently just five producers of passenger cars for the mass market. Volkswagen (VW) also produces in Britain but is usually excluded from this list because its direct interest is through ownership of Bentley, a niche luxury marque. Following the counting method used by the Society of Motor Manufacturers and Traders (see SMMT 2018: 8), Britain's largest producer in 2017 was JLR, although as in previous years Nissan's Qashqai accounted for the largest number of units built as mass-market cars. The size rank ordering by producer has also been relatively stable in recent years.

Total engine output, an important industry subsector, for cars and light commercial vehicles (vans) in 2017 was over 2.7 million units, an exceptional year for the industry, and with an approximate 60:40 split favouring petrol over diesel engines (SMMT 2018: 16). Unlike car production, which contracted over the previous year, engine production continued to rise. However, conversion to non-fossil fuel technologies, and the shock of the worldwide diesel engine test scandal where cheating obscured the extent of health-damaging particulate emissions, are major challenges. In recent years, Ford has accounted for around two-thirds of this total engine output, with a split between petrol and diesel engines broadly mirroring the national picture. A secondary group of volume producers comprising Renault-Nissan, Toyota, BMW, and Honda makes up most of the remaining production, with a small output by VW (Bentley), at less than one per cent of the total, followed by fringe production from a range of established niche firms like Rolls Royce Motor Cars Ltd., Morgan Motor Company, and Aston Martin. Riversimple is a small hydrogen fuel cell specialist.

Table 6.1 shows total car production, registrations, exports, and imports for Britain in 2017, using SMMT estimates. Production is export oriented, more than three-quarters of all cars assembled going overseas. As the aggregate data also shows, Britain imports substantially more cars than it exports. Percentage changes are given on three select years: 2007, 2009, and 2016. The first of these years was the peak production year just prior to the economic and financial crisis which hit European economies in 2008/2009; the second, the year in which car production experienced its sharpest contraction to fall below one million units, with domestic registrations also slumping. Because of a recent tendency for pronouncements on the health of the industry to look at production and export growth since 2009, it is useful to contrast with 2007 to make some allowance for the distorting effects of the slump. While the increase in exports since is proportionately larger than the increase in imports whichever of these two years is compared with 2017, the apparently improved trade

Table 6.1 Car production, registration, and trade data

	2017			
	Totals	Change on 2007 (%)	Change on 2009 (%)	Change on 2016 (%)
Production	1,671,166	+8.9	+67.2	−3.0
Registration	2,540,617	+5.7	+27.3	−5.6
Exports	1,334,538	+12.6	+75.1	−1.5
Imports	2,203,989	+7.3	+25.4	−5.2

Source: SMMT (2010, 2017, 2018), plus authors' calculations ratio is more muted when the earlier year of reference is 2007. In any case, Britain still imports substantially more cars than it exports. In 2017, 53.9 per cent of car exports went to, and 78.6 per cent of imports came from, other parts of the EU, according to SMMT (2018: 19). Although differences in rates of economic expansion are also a factor, this imbalance is striking because, comparing exchange rates on the basis of a ten-year average on both sides of 2008, sterling post-2008 was devalued by more than a fifth against the Euro. Two-thirds of components made in Britain were similarly exported into the EU, while Britain, in turn, was again a sizeable market for EU component imports.

As the last column in this table shows, there was a contraction in both production and registrations between 2016 and 2017. In fact, further weakening of the domestic market has seen production contract further in the first six months of 2018, down minus 3.3 per cent on the first half of 2017 (BBC 2018a). The weakening so far is on the side of domestic demand. While exchange-rate weighted price premiums for luxury and off-road vehicles of the kind produced in Britain, principally by JLR, means that a trade surplus is achievable in sterling terms even while a larger number of cars are imported than are exported, Britain has struggled to escape trade deficit. In 2012, when Britain achieved its first trade surplus in cars since 1976, measured by the *gross* value of car exports versus car imports, the sector as a whole remained in a state of overall deficit owing to other weaknesses (BBC 2014). But the situation is less chronic for cars than for large commercial vehicles, where production in Britain remains significantly down on 2007 although registrations are up.

Although no longer making cars in Britain, Ford is the biggest importer of cars into Britain, followed by Volkswagen. Both companies, therefore, have an active interest in the health of the domestic British market. In terms of general market trends, the last decade or so has seen a growth in registrations of smaller cars and larger executive cars, with a squeeze in the medium segment, most especially in the upper medium category; dual-purpose vehicles are increasing in popularity, although multi-purpose vehicles have slipped back, and demand for specialist sports cars and luxury cars has waned (SMMT 2018: 22). Of total car registrations, in 2017, 51.9 per cent went to business fleets of 25+ cars, including larger dealership demonstrator ranges and some leasing firm fleets; 3.8 per cent to smaller businesses, including dealership demonstrators; and the remaining 44.2 per cent to the private (household) sector (ibid.: 23).

Of importance too is the subdivision of new car registrations in Britain into more and less sustainable technologies. Table 6.2 shows the breakdown between petrol engine, diesel engine, and alternatively fuelled vehicles (AFVs) for new car registrations in 2017, as given in SMMT (2018: 21). The share going to alternative vehicles includes petrol-hybrids and diesel-hybrids, with a much smaller percentage going to pure electric cars. Referencing this against the estimated 34.7 million cars on British roads in 2017 (ibid.: 5), even on this broader categorisation the cumulative total of *all* AFVs registered between 2007 and 2017 would still amount to just 1.5 per cent. The number of pure electric cars currently registered in Britain, measured against a 34 million-plus car fleet, if the 2017 estimate is used, is less than a tenth of this. Slow progress in part reflects the 'drive to diesel' before the diesel scandal struck.

Recent estimates are that the British automotive industry defined to include cars, light and heavy commercial vehicles, buses and coaches, off-road utility vehicles and specialist cars including motorsports, directly employs over 180,000 workers in manufacture; including related activities like retail and aftermarket, this rises to over 850,000 (SMMT 2018: 6). Although a separate estimate is not provided, and would, in any case, be exceedingly difficult to make with any accuracy given joint industry activities, the car industry can be assumed to account for a sizeable part of these totals. Of the more than 40,000 employed by the motorsport hub, more than half are qualified engineers.

Table 6.2 Engine selections in new car registrations

Type	2017 (%)
Petrol	53.3
Diesel	42.0
AFV	4.7

Source: SMMT (2018)

Connected and Autonomous Vehicles and Digitalised Manufacture

While the car industry has over the decades been host to a succession of major labour saving technologies that have reduced employment, there is much interest in the job-creating potentials of connected and autonomous vehicles. SMMT and KPMG (2015), assessing the impact of vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-device (V2D) technologies, predict a net annual addition to the British economy of £51 billion per year by 2030, together with significant job creation of 320,000 jobs. This is explained in the study partly as an expected general benefit from improved workforce mobility, as well as new markets and jobs that will open up for other sectors as a consequence of the networked technology in areas like telecommunications, digital services, and media services. The same study predicts that advances in safety, reduced congestion, better space utilisation for parking, and enhanced potentials for car-sharing and mobility rental services will see demand for connected and autonomous vehicles rise over time, led by premium brands like the Tata-owned JLR, but expanding gradually into mass markets for new cars and commercial vehicles. An accompanying predictive road-map, constructed for five progressive levels of vehicle autonomy, suggests that driverless cars will begin to phase in from 2030+ (ibid.: 6–7). But the report itself predicates these outcomes on state support being provided to the industry.

A second report by SMMT and KPMG (2016) again promises substantial gains from the rapid development of fully digitalised vehicle manufacture, suggesting a cumulative benefit to the economy of £74 billion by 2035. In Schumpeterian fashion, it identifies connected devices and sensors; predictive analytics, cognitive computing, and artificial intelligence (AI); changing human-machine interfacing; direct production from digital constructs; and improved cyber-security systems and block-chain technologies; as industry disruptors. These, in turn, are predicted to lead to improvements in production-line design, production planning, production rescheduling, defect remedies, plant maintenance, supply monitoring ('track-and-trace'), and product launch. While the predicted benefits are likewise confidently presented, the report makes clear that this is not based on actual British experience, because it identifies a limited number of pilot projects and little movement amongst small and medium sized enterprises (SMEs). Nonetheless, despite acknowledging lack of knowledge and skills as a barrier to the development of company-wide strategies for digitalisation, the report uses survey responses from this admittedly inexperienced industry to generate its £74 billion figure (ibid.: 19). It is not clear either how expected benefits, in areas like process downtime, are monetised in the study to generate a predicted monetary benefit because details on the formulas used are not given. The linkages made are thus opaque.

Nonetheless, many of the policy recommendations in both reports are eminently reasonable. On connected and autonomous vehicles, the first makes the case for policy work in areas including liabilities, data ownership, privacy, cyber-security, and cross-border connectivity (work on connectivity and interoperability of global communications systems being essential to maintaining cross-border trade in connected cars and other products). For its part, the second report looks at obstacles to digital infrastructures, including cyber-security and digital standards for data sharing. Also, it recognises the relevance of Britain's motorsport hub for innovation, with its high employment ratios of qualified engineers and technical strengths in areas like real-time scenario modelling and analytics. Both reports call for state resourcing, for finance, skills, and demonstrator projects, reflecting industry-wide demand.

Recent Policy Evolution in Britain

The main government department in Britain with policies connecting with and impinging upon business strategies in the car industry is the Department for Business, Energy and Industrial Strategy (BEIS). This was formed by the relatively recent merger (in 2016) between what were previously the separate Department for Business, Innovation and Skills and Department of Energy and Climate Change. This merger and the chosen form of the departmental rebranding can be interpreted amongst other things as signalling a desire to achieve joined-up strategy for business and energy, including responses to climate change. As part of this, it has also helped push 'industrial strategy' to the foreground of public policy debate. Other key institutions include the Department for Transport, and the Office for Low Emission Vehicles (OLEV) which now works with both departments and was established to focus on low and ultra-low carbon vehicle technologies. Support for the relevant research activity is also sponsored and coordinated via national research councils, principally the Engineering and Physical Sciences Research Council (EPSRC). A body called Innovate UK, previously the Technology Strategy Board, manages funding support for private business innovation.

A number of successive policy initiatives, pertaining to the future development of the car and wider automotive industries, include the launch of a low carbon industrial strategy for Britain in 2009; the establishment of an Automotive Council for Britain, organised as an industry-government deliberative body and launched in the same year; and the formal designation of the car and other automotive industries as a leading strategic sector for Britain, alongside other sectors like aerospace and pharmaceuticals. Most recently, a new industrial strategy for Britain, launched in 2017, has again prioritised the car industry as an industry meriting state support to lift growth and exports. These developments are now reviewed, prior to a brief critical assessment.

Low Carbon Industrial Strategy

The aim of the low carbon industrial strategy, when launched, was to foster ways to convert carbon emissions targets into commercial opportunities, in energy and resource management, products, skills and infrastructures, and information and communications technology (HMG 2009). Key sectors included automotive; and amongst the generalities of this policy document, one of the more specific measures to emerge for the sector and its industries was the respective designation of the North-East of England and the Midlands of England as Low Carbon Economic Areas (LCEAs) for ultra-low carbon vehicles and advanced automotive engineering, respectively. The first of these was and remains the home of the Renault-Nissan assembly site. The company's production there of electric cars and battery cell technologies forms the centre of a hub of clustered electric vehicle activities that includes smaller businesses, linking in with local university networks and other support. The second includes a series of major automotive suppliers as well as sites run by several carmakers including Tata through JLR and Toyota—and again with networks linking into university as well as private R&D centres. Another LCEA was established for hydrogen and low carbon fuels. In this case, the area designated as the appropriate 'centre' for support was the country of Wales.

While policy launches 'come and go', this one is important because it marks the transition in Britain into an industrial strategy which frames sustainability not only as environmentally necessary but as a commercial opportunity meriting targeted state support for designated sectors and places. Although anticipating a shift into 'placed-based' policy (see Bailey et al. 2015), the LCEA initiative met with some scepticism, partly because of the abolition of the existing regional development agencies which were expected to be a source of resourcing and policy coordination; moreover, there were political pressures too as to which areas were recognised (Harper and Wells 2012). It would also be hard to argue that the Oxford area, home of BMW and the centre of much of Britain's substantial motorsport cluster, was somehow less privileged in terms of its support for car industry R&D simply by dint of not being called a low carbon economic area by government; this area is exceptionally rich in research capabilities, consultancies, and business services (Waters and Smith 2016: 36–39). But in the case of the geographically more isolated and less historically advantaged North-East of England, where Renault-Nissan manufactures lithium-ion batteries for electric vehicles together with its own electric cars, and both it and other electric vehicle producers network with local universities and government, the notion is not unappealing.

Automotive Council for Britain

Britain's Automotive Council was also established in 2009, following the recommendations of a policy review undertaken by the so-called New Automotive Innovation and Growth Team (see NAIGT 2009). The Automotive Council's opening set-up saw it jointly chaired by a British government cabinet minister and an experienced representative from the industry side (although the merger of departments since to form the new BEIS department appears to have changed the arrangements for Council chairing). On the industry side, its membership includes representatives from original equipment manufacturers, component manufacturers, and professional service providers, and also the main trade union, Unite. There is representation too from the EPSRC, which disburses university research grants in science and engineering; and in this last respect, the Council is an institution that could be assessed in 'triple helix' terms. It benefits from the organisational capabilities of the SMMT as the sector's main trade association, whose trade sections include cars, commercial vehicles, buses, engines, components, design engineering, aftermarket, and others. Interestingly, France launched its own version of the British Automotive Council in the same year as Britain, albeit with a narrower remit and for the French-owned segment of its industry only, while Italy first considered then dropped the idea of its own council (Calabrese et al. 2013).

The intended remit of the Automotive Council at launch was a strategic one, with in particular a focus on identifying commercial opportunities for developing and exploiting sustainable vehicle technologies while seeking ways to attract inward investment. This is in keeping with the way that British governments have oriented towards sustainability as an opportunity. Another key aim has been to improve communications between industry and government and thus facilitate a stable environment for business planning. Its organisation has included a Technology Group, tasked with developing technology road maps predicting likely timelines for commercially viable battery and fuel cell technologies for cars and vans, along with a series of similar projects for off-road and other vehicles, energy storage, intelligent mobility, and so forth. Other activities have included projects for low carbon vehicle infrastructure development, and intelligent systems transport development. A Supply Chain Group has also worked to improve dialogue between original equipment manufacturers and first-tier suppliers; to guide budget holders on training and support needs; and to develop forward-looking supply-chain visions for automotive industries.

Sector Targeting Policies for the Car Industry

Three years after these developments a sector strategy document HMG (2012) set out a series of explicit assumptions about the future development of the industry. This document is of interest because of its explicit quality in identifying the car industry as a sector of strategic interest for Britain, and for further expanding on the intent to commercially exploit 'greener' auto-products. Rising world incomes and changing patterns of demand, reflecting environmental pressures and changing consumer lifestyle choices, were identified as prominent future drivers of export-related growth for Britain's car industry, supported by new business practices and changing technological potentials. In a nutshell, the policy was described as one of leveraging innovations to reduce emissions from fossil fuel combustion engines and introduce non-fossil fuel alternatives to capture more of the global value chain (ibid.: 20–12). Policies in this regard would include support for innovation through R&D, the automotive sector spend on R&D as a whole being estimated in this document to be in the region of six times the British national average (although it is not made clear if this figure is calculated gross or net of state support). SMMT (2018: 7) suggests an R&D investment estimate of £3.65B for automotive in 2017.

The Automotive Council has been instrumental in further developing automotive strategy. A new automotive strategy drawn up by the Council in collaboration with the government was published in 2013 (see, inter alia, HMG 2013a, b), looking at measures to foster sustainability and promote inward investment. This strategy was noteworthy for a candid run-through of problem areas, ranging from gaps in British capabilities, including forge work and casting, electrics and electronics (HMG 2013b: 16–17), to long-standing problems around SME financing, fragmented support systems, and maintaining a national engineering base. That these are difficult areas to tackle is readily indicated, because in recent years it has been suggested that domestic tier-one suppliers miss opportunities worth £4 billion (SMMT 2018: 18). Other important initiatives include an Advanced Propulsion Centre (APC), organised on a match-funding basis vis-à-vis support from the government, which complements a number of other dedicated research, design, and test centres in Britain.

Each of these policy launches and institutional developments have taken place against a backdrop of evolving measures to support innovation for more sustainable product architectures. These include discriminatory taxes and direct grants/subsidies, match-funding schemes, public procurement programmes and support for local infrastructure investments. On the whole, the approach has combined complementary measures to stimulate demand, as for example through discriminatory fuel duties, vehicle excise duties and tax exemption thresholds for business fleets, with policies to develop capabilities via investment support for innovation, including match-funded product trials and demonstrator projects for new technologies; and running alongside a developing national charging point infrastructure for battery vehicles, although this has not been particularly rapid. Coffey and Thornley (2015a: 409–417) provide a brief overview of selected initiatives for cars and light commercial vehicles ('vans'), which are typically grouped together in British policy. Heavy goods vehicles, it should be noted, remains, like the other larger classes of automotive product, a distinct policy area, with its own technical challenges, regulations, performance metrics, business models, and issues. For the car industry proper, policy absences as well as presences are equally significant: a fuel duty escalator, to be calculated on a year-on-year inflation plus basis, was quickly abandoned as a likely vote loser. Another key policy misfired: discriminatory fuel duties intended to drive up diesel car use over petrol, to help with carbon emissions targets, have stoked public health problems, now acknowledged as severe.

The New Industrial Strategy for Britain

A new national strategy document HMG (2017) has since been published which calls 'the future of mobility' a 'grand challenge', together with AI and the data economy, clean growth and the ageing society (ibid.: 10). Insofar as commercial exploitation of sustainable technologies is concerned, continuities are more evident than novelties, although there is an enhanced focus on electric vehicle infrastructures and electric battery technologies. A £400 million investment fund for charging infrastructures evenly split between public and private finance, and an extra £100 million to extend plug-in car grants, are main elements of the push on infrastructures (HMG 2017: 50). New finance has been promised innovation in charging technologies, and in a context more generally of higher tax credit allowances for R&D. On the demand side, there are new central government car pool procurement targets. For battery technologies, a dedicated research institute called the Faraday Institution is being financed by a £78 million investment from a newly created Industrial Strategy Challenge Fund, to work with OLEV; there is an £80 million investment in a new UK Battery Industrialisation Centre, facilitated by the APC, and new finance to help finance R&D projects on a competitive basis. The cumulative investment thus entailed is put by the government at £246 million (ibid.). The government now proposes other measures, including fitting new suburban homes with charging points for electric cars, linking street lighting to charging points, and moving to ban conventional internal combustion engine cars by 2040 (BBC 2018b).

Turning to connected and autonomous vehicles, Britain's Law Commission is tasked with developing a long-term regulatory framework for self-driving cars; there is a new innovation prize for appropriate roadbuilding; and supporting investments in a part-government funded 5G Testbeds and Trials programme, developing fifth-generation (5G) wireless networking architectures, that focus specifically on applications to roads and mobility (HMG 2017: 51). The new national strategy for the future of mobility builds on a prior £200 million grant to support intelligent mobility made in the 2015 national budget; and it makes much of new business models such as ride-hailing and ride-sharing, and the increasingly popular notion of 'mobility as a service' (ibid.: 48).

Stress Points for Britain's Car Industry

It would clearly be far from accurate to suggest that Britain's car industry lacks government interest or support. However, there are significant stress points for policy to consider. First, there are current uncertainties around the outcome of negotiations for Britain's terms of exit from the EU ('Brexit'). Second, notwithstanding hopes of a positive future organised around self-driving cars sustained by alternatives to fossil-fuel dependent ICE technologies, the environmental crisis of the car remains an extremely urgent one.

Brexit: A Maze of Uncertainties

At time of writing, the terms of Brexit, should it happen, are unknown, and there is the possibility of a 'no deal' scenario in which Britain faces tariff barriers for trade with the EU in keeping with World Trade Organization (WTO) rules. However, this is still unknown. The complication thus posed for any evaluation, made before the outcome is known, is that events may soon render parts of it redundant. But there is still some value in considering what would happen should a 'no deal' Brexit occur, because even if this proves to be the counterfactual scenario, thinking through some of the issues shows how complex cross-border relationships are for Britain's car industry.

For example, and as already described, in 2017 Britain exported more than half of its car production to other parts of the EU, while imports from the EU made up significantly more than half of the new car sales in Britain. In response to tariffs being imposed on British car exports to the EU, Britain could retaliate by imposing tariffs on cars imported *from* the EU. It is germane to recall that the two largest importers of cars to Britain are Ford and VW, neither of which (except for fringe production by VW via Bentley) assembles cars there. By putting Ford and VW at a post-tariff disadvantage in the domestic British market, car manufacturers who assemble mass-market cars in Britain would have a local gain to offset again the problem of EU tariffs—especially if Britain imposed tariffs on imported cars only, and not components.

However, pursuing this example further, if this were Britain's response an immediate concern would be the overall consequence for Ford engines. It will be recalled that Ford accounts for about two-thirds of Britain's substantial engine production for cars and vans. For this, it employs two sites: at Dagenham, for diesel engines; and Bridgend, in Wales, for petrol. The medium-term prospects of diesel engine production are clearly not good in any event, while despite some investment Ford has recently scaled back on its ambitions for petrol engine manufacture in Britain, with doubts emerging in 2017 about the long-term future of Bridgend (BBC 2017). A threat by Ford to withdraw altogether from Britain, in the face of tariffs both on its engine exports (to the EU), and on its car imports (into Britain), would be a credible one given the costs being added to an already precarious position. In this event, Britain would have to decide whether to risk this or take an amended tack. Policymakers would also have to be cognisant of consumer resistance to tariffs on any products from the EU within Britain itself, vis-à-vis higher prices (for which reason tariffs on imported replacement parts for used cars are unlikely).

It would be fruitless to work through every possible combination of response-pattern, including direct state support for manufacture in Britain, absenting knowledge of the final outcome of negotiations. But uncertainties over Brexit are occurring in a context of multiple fracture points: for instance, the sale of Vauxhall to the French Groupe PSA has introduced uncertainties over the future of the Ellesmere Port site. Moreover, Britain's car industry, in volume terms, is highly vulnerable to loss of investment in a small number of models, or a decision to switch some production to other sites. Thus while it is highly unlikely that the German-owned BMW would abandon Oxford, it has sites elsewhere in the EU at Austria (Graz) and Holland (Born) that could parallel produce models built in Britain; similarly, while JLR has many reasons to maintain a base in Britain, it has developed capacity in Slovakia which could be expanded and which in fact is already taking work from Britain. There are close connections between Britain's car and steel industries too, and the latter has recently faced threats of a massive capacity loss (APPG 2017).

In addition to these difficulties, how border controls will be organised both for goods and personnel, and how visas will be managed for EU and

British citizens working respectively in Britain and the EU, is a headache. How cooperation on carbon emissions policy and other important environmental regulatory frameworks is affected is a whole further problem area. The same applies to cooperation in areas like legislation for information sharing, or work to achieve cross-border compatibilities for connected and autonomous vehicles and digitally managed factory systems. Further discussion, covering a range of pertinent issues, is given in Bailey and De Propris (2017). But the general picture is that it is a very difficult situation. Moreover, uncertainty has already been impacting negatively as the car industry holds investment back while waiting to see what happens next.

The Environmental Crisis and Sustainable Business Models

Accepting the difficulties that this has created, there are unresolved questions too on the side of which business models are appropriate for the industry. Britain remains preoccupied with capturing environmental improvements for trade competitiveness, within an essentially expansionist vision. An immediate and pragmatic objection to this is that the larger car manufacturers producing in Britain organise their British operations as just one element in a transnational investment portfolio. The prospects of Britain cornering an indefinitely expanding output is therefore remote, because assembly operations by these car manufacturers, as with other transnationally capable businesses, will tend to spatially redistribute over time in keeping with the global patterns of growth to emerge—even if 'British' brand names are retained. But more fundamentally, the expansionist vision understates the bleakness of the scientific data that is gradually emerging on global warming; underestimates the length of time it will take for lower emission technologies to substitute out the globally massive and still growing worldwide fleet of fossil-fuel dependent vehicles; is heedless of resource scarcities in areas like trace elements used in battery technologies, and the pressures worldwide demand will put on supplies; and tends to ignore the environmental downsides of actually producing cars, with a one-sided awareness of the issues arising from car use only. While British policy takes stock of carbon emissions from cars, and other forms of transport, inside its own national territory, it lacks a realistic global perspective. For these reasons, its export-optimism is not a balanced one (Coffey and Thornley 2018).

An alternative approach from a British viewpoint would be to look towards import-substitution in cars rather than export-expansion. This could be achieved by working towards ways to realise the United Nations Environmental Programme (see UNEP 2002) recommendation of service-oriented business models, predicated in the case of the car industry on the sale of 'mobility' and related services rather than the sale of cars (Ceschin and Vezzoli 2010). To some extent, the impact of connected and autonomous vehicles will push in this direction, to a degree not considered ten years ago. In addition to new income from areas like decision making software, the evolution of cyber-security systems, and monetisation of 'big data' gathered in the course of car use when cars are connected to networks (SMMT and KPMG 2015: 14), the technology lends itself to a realignment of profit centres in the car industry allowing manufacturers to shift towards a service-oriented model. Working to rebalance the role of the car in Britain's national economy—reducing export-dependencies by substituting out imports while scaling back the national car fleet—would not be an easy policy to manage given the imbalances of the extant industry structure, but it would be environmentally credible. By contrast, the industrial strategy for Britain set out in HMG (2017) manages the worrying trick of packaging connected and autonomous cars as a way of achieving 'higher density use of road space at home' (ibid.: 48), while linking greening to an export-drive that will simultaneously expand production.

A related area that remains under-studied is the impact of the technological changes underway on the commercial viability of the old business model in which car manufacturers sell both cars *and* car parts. Although insufficiently discussed, reduced car ownership, because of car-hailing, car-sharing or car-leasing services, would imply a reduced used car market, in turn implying a reduced market for replacement parts; 'new' business models could thus make the 'old' business model for car manufacturers less commercially viable, with potentially unpredictable consequences. While a potentially positive development, because of the inhibiting effects the 'old' business model has on the commercial viability of electric cars (say), which do not seem as able to generate a replacement parts market, there is not much evidence that policy formulation in Britain is giving thought either to this or to the scope for the emergence of conflicting business models and opposing lobby groups. Some of the issues are raised in Coffey and Thornley (2013).

A quite different kind of business model, most visibly associated with Uber in the case of Britain, is at the same time under pressure. Amidst recent headline news about a collaborative investment from Toyota, to develop mass-market autonomous vehicles for use in Uber's ride-sharing network, as well as Uber's decision to expand its presence in electric bikes and scooters, losses continue to be made by the firm despite its public valuation. In Britain, a new Indian interest, in the shape of Ola, a rival taxi-hailing business, plans to expand its presence beginning in Greater Manchester, in the North of England, and South Wales (BBC 2018c). Although legislation is not as yet enacted, the work practices of Uber, as with other platform businesses in the 'gig economy', have also generated calls for reform. A relatively mild set of recommendations in an independent review submitted to the government (see Taylor Review 2017) calls for its drivers to be redefined as 'dependent contractors'. There have been legal challenges in the meantime, with appeals pending. It remains to be seen what effect this combination of pressures has on the Uber business model in Britain, but neither conduces to enhanced profitability.

The question of employment practices more generally, and employee rates of remuneration and access to benefits like paid holidays, sick leave, and work-related pensions, is also likely to grow over time. Weak union recognition in the 'gig economy' is also recognised as an issue, although the manufacturing wing of the car industry in Britain remains highly unionised and the largest trade union Unite is a formidable presence. Coffey and Thornley (2015b) provide an overview of the positioning of trade unions vis-à-vis new industrial strategies and environmental issues in Britain.

Conclusions

In conclusion, the following might be said of Britain's car industry, in terms of its policies, positioning, and prospects. It is an industry in the process of a state-assisted transition towards more sustainable forms of energy use, organised at the level of vehicle propulsion mechanisms and fuels. A considerable set of changes have been enacted in the conduct of policy, and in the institutions supporting the formulation of policy and its implementation. However, while sustainability is a major feature of the policy drive, this is framed in terms which emphasise commercial exploitation within the broad context of a steadily growing world economy and rising world demand for cars. That there is currently a reinvigorated interest in industrial policy in Britain more generally is consistent with this, albeit within an essentially expansionist framework which assumes that technology as such will resolve the environmental crisis of the car; and even as connected and autonomous vehicles emerge as the next wave of improving breakthroughs in car design. But this is to understate the scale of the global environmental challenge that is unfolding.

By contrast, nearer term threats have been more successful in imposing on thinking about the industry, including the impact of Brexit, where the most likely immediate consequences are on the downside. Although nowadays not much discussed or acknowledged, the peculiarities of Britain's car industry, lacking anything that resembles a domestic national champion and penetrated to an overwhelming extent by foreign ownership, poses structural dilemmas for policy. The appeal of Britain as a base of operations for non-European carmakers, seeking a congenial non-discriminatory host and a gateway to Europe, is obviously diminished if Brexit leads to EU tariff barriers; but equally, Britain is also at a disadvantage in thinking through its options. Looked at on a plant-by-plant basis, major stress points include the fall-out from the sale of Vauxhall to the French Groupe PSA, and manifestly poor medium-term prospects for continuing Ford engine manufacture in Britain. The industry is also dependent on a small number of models for most of its volume, and withdrawal of investment in any one would have a large overall effect. Furthermore, there are ongoing questions around the national steel sector. Prospects for Britain's car industry are therefore reasonably described as uncertain.

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7

The Italian Automotive Industry: Between Old and New Development Factors

Giuseppe Giulio Calabrese

Introduction

The Italian automotive industry is characterised by a number of peculiarities compared to the rest of the other automotive-producing countries. In Italy, there is only one main automotive assembler, Fiat Chrysler Automobiles (FCA),[1] and a set of differentiated companies, which represents one of the most important automotive clusters in Europe, able to supply all types of modules, components and parts expected in a vehicle. However, the Italian automotive suppliers are mainly composed of small and medium enterprises, which, in the past, were mainly linked to the national producer.

The last decade has witnessed a number of important changes in this peculiar historical context. The first and most important change has been the process of internationalisation underwent by the former

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Fiat after the closing down of the agreement with General Motors in 2005 (Camuffo and Volpato 2002). The need to expand operative markets re-emerged with force during the last economic and financial crisis of 2008 that affected the automotive sector worldwide. Fiat was considered too small in the competitive scenario and a possible prey to its competitors (Volpato 2011). Therefore, in 2008, Fiat began to define a new strategy aimed at maximising the exploitation of the economies of scale through internal and external growth. In turn, the main objective of that plan was to increase the company capacity by 6 million units in terms of global production (Ciferri 2008). The internal growth was pursued by investments in new production lines in Brazil, China, Serbia and Argentina, whose results were partially achieved only in Brazil (Amatucci and Mariotto 2012). In the case of external growth, Fiat tried to conduct some mergers and acquisitions. The strategy has been partially realised with the integration with Chrysler (Balcet et al. 2013) and the establishment of Fiat Chrysler Automobiles, the lack of the acquisition of a second carmaker[2] has not allowed, so far, the achievement of the intended target in the production rate.[3]

The second important change is related to the last economic and financial crisis that has caused heavy repercussions on the automotive industry which, from 2007, has registered a strong decrease of vehicles produced, mainly in Italy (−51.2% from 2007 to 2013), but also in the European Union (EU) overall (−23.2% in that same period).

This chapter analyses the restructuring process of the automotive industry, which, on average, represents 3% of the Italian Gross Domestic Product (GDP) (ANFIA—*Associazione Nazionale della Filiera Industria Automobilistica* 2017). The balance is positive for the trade of parts and components, 5.7 million Euros in 2017, and negative for the trade of passenger and commercial vehicles (9.6 billion Euros). Indeed, contrary to expectations, foreign trade data provided by both the Italian association of the supply chain (ANFIA 2017) and the Italian National Institute of Statistics indicate that the automotive filière has shown a great deal of resilience to the crisis (Manello and Calabrese 2017).

The chapter is structured in five sections, including this one. The next section analyses the production and the Italian market of motor vehicles.

Data, herein discussed, highlight the increase, in recent years, of the importance of foreign markets, which, in turn, has contributed to the development of a number of changes in the quality required from Italian vehicles. Section "The Italian Supply Chain" applies the same methodology of Section 2 to the study of the production of cars. To the previous two factors of development (foreign markets and quality improvement), we have added a possible third factor represented by FCA. Section "Driving Factors for the Italian Automotive Industry" goes into detail in analysing the three drivers emerged so far, particularly focussing on the new industrial relationships developed within the job market. A fourth almost missing factor has been analysed, that is, the new business models for sustainable mobility.

Finally, conclusions provide some observations about the inconsistency of industrial policies implemented in Italy and, in particular, within the automotive sector.

The Italian Automotive Market

In quantitative terms, the economic and financial crisis has not been overcome as yet. Indeed, levels of production from 2007 have not been regained. However, the critical period of what has now become an already ten-year-long crisis can be divided into two main periods.

Up to 2013, vehicles' production had registered a rapid decrease, often drastic. The strategy of internationalisation run by Fiat—focussed on the integration with Chrysler, the delocalisation of lines of production originally based in Italy to foreign countries and the decision to postpone the renewal of models—has affected production levels, mainly for the Italian factories, although some of these issues had already been presented before 2007.

Indeed, the production of motor vehicles, in general (e.g. passenger vehicles, commercial vehicles, buses), had already dropped by 26.1% from 2000 to 2007 (see Table 7.1). A further loss of 35.7% was added in the following years up to 2013 (a total of −62.1% for the period 2000–2013), albeit there have been differences according to the type of vehicle.

Table 7.1 Production rates for motor vehicles in Italy

	Passenger vehicles		Industrial and commercial vehicles		Buses		Total	
Year	Units no.	%	Units no.	%	Units no.	%	Units no.	%
2000	1,422,284	100	312,868	100	3163	100	1,738,315	100
2001	1,271,780	89.4	305,710	97.7	2206	69.7	1,579,696	90.9
2002	1,125,769	79.2	298,715	95.5	2597	82.1	1,427,081	82.1
2003	1,026,454	72.2	292,327	93.4	2850	90.1	1,321,631	76.0
2004	833,578	58.6	305,451	97.6	3076	97.2	1,142,105	65.7
2005	725,528	51.0	309,365	98.9	3459	109.4	1,038,352	59.7
2006	892,502	62.8	316,225	101.1	2867	90.6	1,211,594	69.7
2007	910,860	64.0	372,003	118.9	1449	45.8	1,284,312	73.9
2008	659,221	46.3	363,209	116.1	1344	42.5	1,023,774	58.9
2009	661,100	46.5	181,135	57.9	1004	31.7	843,239	48.5
2010	573,169	40.3	263,952	84.4	1065	33.7	838,186	48.2
2011	485,606	34.1	303,919	97.1	823	26.0	790,348	45.5
2012	396,817	27.9	274,466	87.7	489	15.6	671,768	38.6
2013	388,465	27.3	269,320	86.1	421	13.3	658,206	37.9
2014	401,317	28.2	296,258	94.7	289	9.1	697,864	40.1
2015	663,139	46.6	350,319	112.0	765	24.2	1,014,223	58.3
2016	712,971	50.1	389,694	124.6	640	20.2	1,103,305	63.5
2017	742,642	52.2	399,178	127.6	390	12.3	1,142,210	65.7

Source: ANFIA

In 2013, cars' production had dropped by 72.7% overall, while that of industrial vehicles, in particular commercial ones, had nearly come back to pre-crisis levels and even reached higher ones than 2000 (for the years 2006–2008). Data for buses' production were worse, as they were deeply affected by the closing down, in 2012, of an Iveco plant entirely dedicated to that line of production.

Until 2013, the data, specifically for passenger cars, offered an image of the crisis affected by the specificity of the Italian panorama:

- Weakness of FCA levels of production in Italy because of the lack of replacement for models that had already reached their end-of-life point (e.g. Fiat Croma, Fiat Idea, Fiat Multipla, Fiat Punto Classic, Lancia Musa, Lancia Thesis).
- Closure of the Termini Imerese plant in Sicily, with its line of production moved to Poland, where the production of the new Panda was moved to Italy in Pomigliano to meet political complaints.

– Dramatic loss in the volume of sales of vehicles within the national market, which passed from 2.7 million in 2007—year of the absolute peak in positive—to just 1.4 million in 2013, with a decreasing rate of 48.9% (see Table 7.2).
– Limited inclination to the export of cars that is the weakness of entering into foreign markets. When comparing data from both Tables 7.1 and 7.2, a core feature of the Italian market can be highlighted: a low difference rate between motor vehicles produced and sold in Italy which, for 2017, corresponded to 52.1% (42.1% for cars).[4] This data appear extremely negative when compared to countries such as Spain, where the number of vehicles produced is nearly the double of that for registered cars, or to Germany and France, where produced cars are respectively 150% and 80% of the registered ones. Even when taking into consideration the British case, where a national firm car assembler is missing, 60% of the registered ones are locally produced.
– A strong under-exploitation of productive production plants and the subsequent unemployment benefits due to their workers. With regard to the European factories of FCA, in 2012, effective utilisation of their capacity for production goes from the 17% of Mirafiori (Turin) to the 65% of Tychy in Poland, which is still lower than the theoretical balance point of 80% (Ciferri 2013).

Table 7.2 Italian market for motor vehicles

	Registered in Italy		Exported	
Year	Units no.	Rate (in %)	Units no.	Rate (in %)
2007	2,777,175	100	650,508	100
2008	2,421,918	87.2	560,953	86.2
2009	2,357,886	84.9	382,609	58.8
2010	2,164,608	77.9	440,729	67.8
2011	1,942,644	70.0	452,808	69.6
2012	1,532,609	55.2	407,381	62.6
2013	1,419,941	51.1	393,233	60.5
2014	1,493,308	53.8	438,666	67.4
2015	1,726,275	62.2	682,955	105.0
2016	2,052,418	73.9	716,322	110.1
2017	2,192,223	78.9	742,418	114.1

Source: ANFIA

– Until 2013, the only positive fact is represented by the new FCA investments, the reopening of the body parts plant purchased from Bertone in Grugliasco (Turin) to devote to the production of Maserati's new models (Calabrese and Vervaeke 2017), and the renewal of the production lines for the plants in Melfi, Atessa (commercial vehicles) and Mirafiori.

From 2014, and more precisely from its second half, the production and sale trends changed direction, with the only exception of buses. In 2015, the production rate reached more than a million units. Compared to 2007, in 2017, only the export rate has increased (+14.1%) while the production rate is still below 21.0% and the registration rate, of about 2.2 million of units, is below 11.0%. Obviously, the bigger portion of this market is occupied by FCA (more or less 28% of it), followed by Volkswagen (an average 14%) and the French companies—Renault and PSA (more than 10% each).

The Italian automotive market is still characterised by a certain weakness. Some market segments that could have pushed for recovery are penalised by an unfair tax system compared to the main European markets. For example, the segment of company cars is negatively affected by the Italian tax system, as opposed to the rest of European countries. While in Italy, the cost of company cars is deductible for only 20% of its value, in other EU countries it can be deducted up to 100%. Furthermore, in Italy, the threshold of deductibility for cars used by companies or professionals has not changed since 1997 and Value-Added Tax (VAT) is deductible only up to 40%. On the contrary, in the main part of European countries, the deductibility of VAT reaches 100%. That is why the relevance of the segment of company cars in Italy remains very low (40% of registrations) as opposed, for example, to countries such as Germany (65%) where the use of a company car is regarded as an extra benefit for employees.

A specificity of the Italian market is represented by gas vehicles (liquefied petroleum gas [LPG] and compressed natural gas), which constitute one of the bridge technologies in terms of their lowest impact on the environment. Together with electrical and hybrids vehicles, in the future, gas vehicles can contribute to reduce pollution. Such advantage is not limited to the environment but it also affects economics and the job market as Italy is a world leader producer of gas vehicles, thanks to its chain of production characterised by factories, vehicles, distribution and maintenance.

Also, thanks to its sale rates for gas vehicles, Italy is the EU country with the highest rate of no petrol vehicles. Eco-friendly cars represent about 10% of the car in use, having accounted for 17.6% of sales in 2014 when they enjoyed important tax benefits. All considered, in matters of emissions, this automotive subsector has allowed Italy to become one of the most virtuous countries in the EU and to reach, as early as 2011, the goal of 129 gr/km of CO_2 set up by the European Commission for average emissions of CO_2 by new cars (130 gr/km). In 2017, the emission average for new cars sold in Italy has been of 113.3 gr/km, lower than 5 gr/km of the European average.

Looking back at production rates for vehicles as expressed in Table 7.1, now those acquire a more intrigued meaning as we go beyond their simple volume and look, instead, at the turnover for the domestic national market and the volume of export (Fig. 7.1).

The different series of the trends do not appear too different in the table and the figure. However, what becomes interesting is that the total turnover production (red line) is always above the total production in

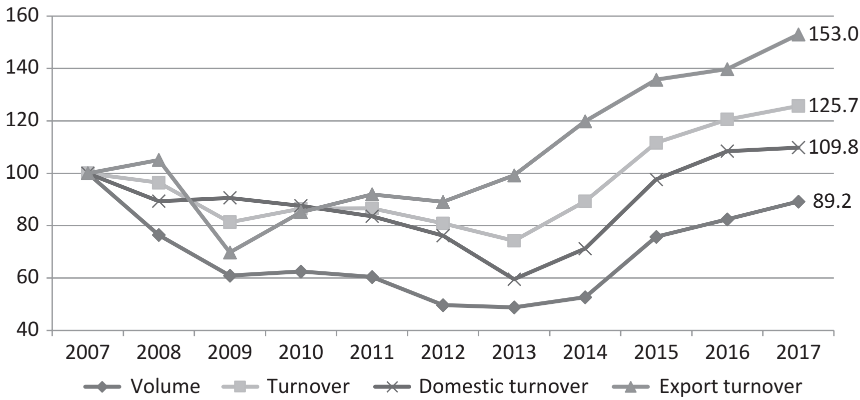

Fig. 7.1 Production rates of vehicles, expressed in volume and turnover. (Color figure online)

volume (black line), with increasing rates above all from 2014. In other words, we can now see a progressive movement up towards models with both a higher value and a better quality. The only exception is 2009, the year in which the economic and financial crisis had its major effects and tax benefits and discounts distorted the market. In that year, the trend of production in value for the foreign market (green line) performed better than that for the domestic market (blue line). In particular, we can observe how exporting anticipated the economic cycle and began to increase its value from 2009 onward, up to the point of reaching the rate index of 100 already in 2013. Thus, we can see how exporting became clearly an important driver for the Italian automotive industry.

In order to successfully compete within international markets, the quality of products is a necessity. Qualitative changes for automotive production in Italy clearly emerge in Fig. 7.2, where export and import turnovers—deflated in both cases—are expressed in Euros per kilogram. From 2014, and for the first time from 2000, export turnover is higher than the import one and keeps on constantly increasing from 2006 and in a significant way in 2013, becoming an important new factor of change for the Italian system.

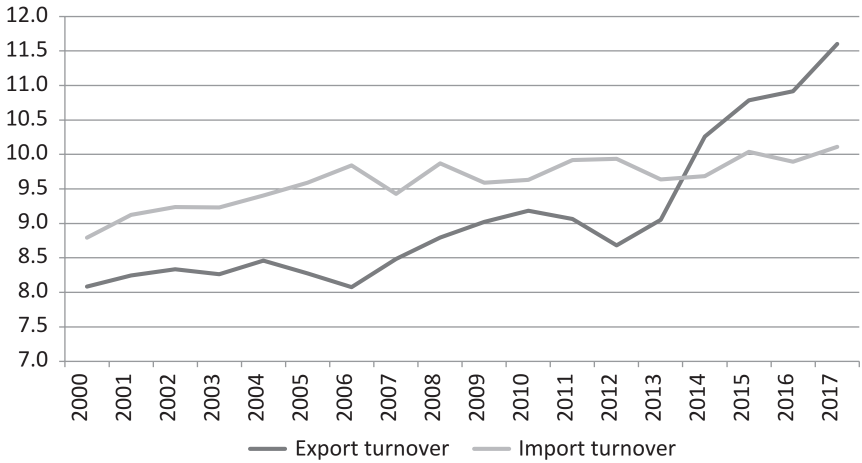

Fig. 7.2 Average of export and import turnover of vehicles, expressed in Euros per kilogram, that is, an exported Italian car costs per kilogram about 11.5 €, and an imported car about 10 €. (Color figure online)

Such change can be explained by looking at the FCA investment for premium models. Initially, it started with the Maserati brand and by increasing production from the Grugliasco plant. It followed with the success of models such as Jeep Renegade and Fiat 500X (both assembled at the Melfi plant), and more recently, it continued by relaunching the Alfa Romeo brand from the Cassino plant.

The Italian Supply Chain

The trend of the Italian supply chain is slightly different from that of the carmakers, even if, also in this case, export and product quality are confirmed as crucial drivers.

First of all, as it emerges from Fig. 7.3, in quantitative terms, even the suppliers of parts and components have not recovered production levels from 2007. However, their performance has been better than that of the final producers of vehicles, which, only in 2016, managed to surpass the former with their production rates.

According to the Italian association of the automotive filière (ANFIA 2017), the companies of this supply chain continue to account overall for about 3% of the national GDP and keep on investing 3.7% in research

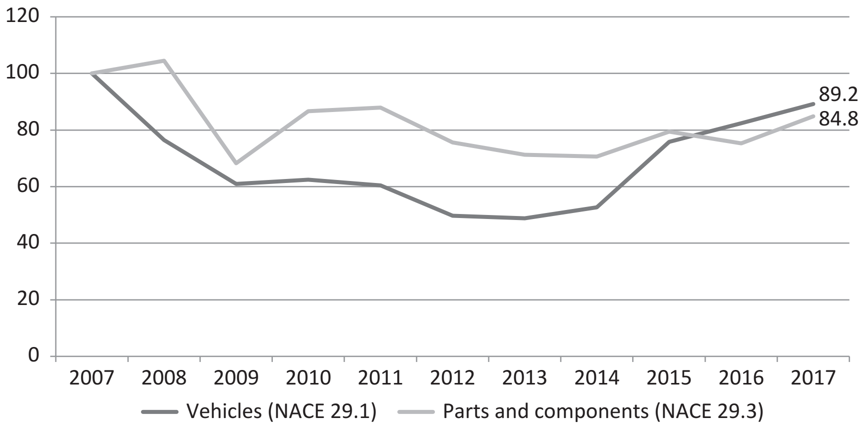

Fig. 7.3 Volume of vehicles production rates and parts and components. (Color figure online)

and development (R&D) of their turnover, which, for 2017, reached about 82 milliards of Euros. Such investments have generated an appropriate rate of innovation, which has allowed to compete at international levels and to achieve a significant positive trade balance (Manello and Calabrese 2015).

In the breaking down of turnover rates in different sectors of earnings (Moretti and Zirpoli 2017), exportations account for 39% of the total, of which 9 percentage points benefit FCA factories abroad, while the remaining national sales go for a 28% to the FCA group and a 33% to other companies. In short, despite the fact that overall FCA takes over 37% of the total turnover of the supply chain, this percentage is constantly decreasing (e.g. it was 55% in 2010). As anticipated, the comparison between the volume of car production and that of the suppliers' turnover presents a different trend for the latter. If we take again, as a starting point 2007, we can divide the following period in four moments (see Fig. 7.4).

The first two years—up to 2009—have been characterised by a severe recession, whereas we can see how trends for all the four indicators (volume, turnover, domestic turnover and export turnover) do not present relevant differences. However, in the following two years—up to 2011—all the indicators were growing apart from that for internal turnover (blue

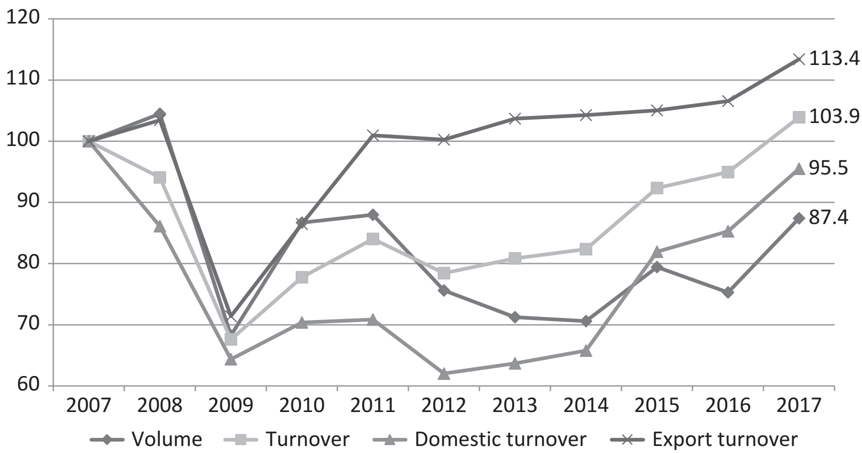

Fig. 7.4 Production rates for parts and components, expressed in volume and turnover. (Color figure online)

line). Therefore, the growth of the total turnover was only supported by export (green line). Although, if we compare the improvement registered in the volume rate for total production (black line) to the production expressed in the value of the total turnover (red line), we can see that the growth is more due to the policy of price than to a major qualitative change. The situation changed again in the following three years—from 2011 to 2014—when decrease in the volume production was more severe than that for the total turnover, while export kept on growing. The importance of the quality effect becomes evident for the last three years for which we can assume that a possible FCA effect shall be taken into consideration. Indeed, the production of parts and components for the domestic market—from 2014 to 2017—has increased by 30 percentage points, pushing up the final domestic turnover to 95.5.

The quality effect, as a driver for development within the Italian supply chain, clearly emerges in Fig. 7.5, where the turnover for components exported and imported is expressed in Euros per kilogram, deflated in both cases.

Considering a time period of 18 years, the average price per kilogram, at the net of inflation, has increased by 37%, moving from 5.0 € to 6.8 €. While the relative data for the import have increased by 32%, if we do

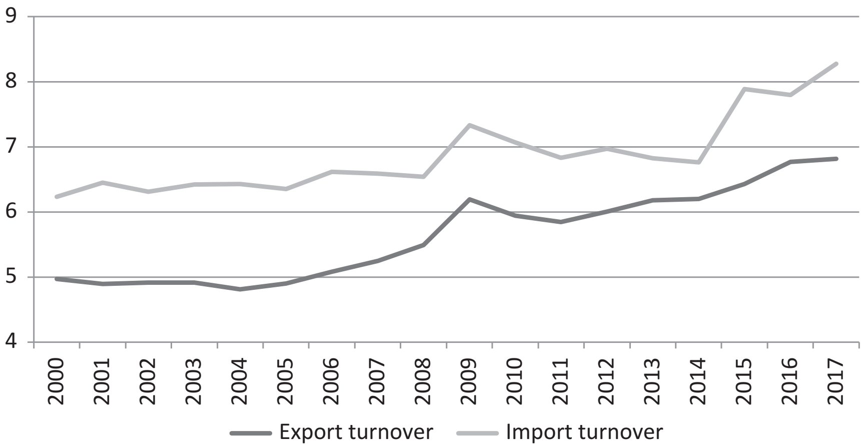

Fig. 7.5 Average turnover for import and export, expressed in Euros per kilogram. (Color figure online)

not take into consideration the last three years, the total increase has been by only 8.5%. On the one hand, the alignment in the trends of the two curves points at a considerable improvement in qualitative terms for Italian suppliers, something that is reflected in the raise of prices. On the other hand, the clear difference registered in the last three years shows that the process has not been completed as yet and, more importantly, that further actions are needed.

Undoubtedly, the raise in the relative data for the import turnover can be linked to the beginning of the production in Italy of new models of premium and luxury models, the components of which at an increased value are purchased by foreign sellers from FCA in greater numbers, as opposed to models of inferior value. Indeed, if we look at informal comparisons and evaluations on the total cost of the Fiat Panda, the weight of purchase by Italian suppliers is 40%, while that of the Jeep Renegade is only 27%, a percentage shared among European suppliers (15%) and above all non-European ones (25%).

Let us consider some of the specific characteristics of the Italian automotive supply chain:

- According to the Observatory of the Italian Automotive Supply Chain (Moretti and Zirpoli 2017) and based on the EU normative system, one out of every ten companies can be identified as "big" (10.4%). These types of companies generate a turnover of more than 50 million Euros or have more than 250 employees. Medium companies are 21% of the considered sample having a workforce of between 50 and 250 workers or a turnover between 10 and 50 million Euros. Small companies (up to 50 employees and a 10 million Euros of turnover) represent the core segment of the sample at 41.7%. Finally, the remaining part of the sample is constituted by micro-companies (up to ten employees and a two million Euros of turnover), which are 26.3% of the total.
- Production is still territorially concentrated: even if Piedmont, where the headquarters of FCA are located, weighs 35.9% in terms of the number of companies, it caters to 47.3% of the turnover and 54.4% of the total workforce (Bianchi et al. 2001).
- The internal structure of the Italian supply chain is structured according to production. First, we have those companies which are subsup-

pliers (55.0%), then the ones that produce parts and components (32.7%), those providing services of engineering and design (9.9%), and finally, producers of modules and systems (2.4% of the total of companies).

- Research centres for engineering and design are mainly based in Piedmont (more than 60%) but only a few of these are globally well-known, such as Pininfarina and Italdesign—both controlled by foreign companies.[5] The majority of these centres are quite small and only a dozen of them have more than 100 employees (Calabrese 2011).
- The majority of suppliers for modules and systems are controlled by foreign multinationals that have gradually bought plants run by big national suppliers and adapted them to a hierarchical production system structured in many levels (Bianchi et al. 2001; Calabrese 2001). Nowadays, their dependence from FCA has diminished, and they produce for other carmakers through their satellite companies. As a result of the increasing dependence on multinational companies abroad, several suppliers of modules and systems have resized or even closed down their Italian research and development centres to move those activities to foreign countries.
- Lately, one of the keywords, to keep turnover levels up and to try to bring them back to pre-crisis levels, has been "diversification" of both commercial and production activities. One of the strategies has involved those suppliers who have focussed on markets, including some of the domestic ones, that have recently increased in absolute or relative values, such as that of industrial and commercial vehicles (65% of companies from the supply chain have stated that they cater to the lines of production devoted to heavy commercial and industrial vehicles, while 36% for those to buses and coaches).
- Also, within the Italian automotive supply chain, there have been important specialisations. Half of the sample sees itself as able to produce parts for cars of medium-big dimensions (55%) or minivans and (Sport Utility Vehicle) SUVs (47%). Furthermore, there is a segment of sport and premium models, within which nearly half of the companies from the sample are active (49%). On the other hand, diversification can change from region to region. It is higher in companies from the Emilia-

Romagna region, which focusses not only on automotive but also on motorbikes, farming vehicles and other mechanic products, in general (Bardi and Calabrese 2007). It is lower in companies based in the Piedmont region, which are more strongly connected to FCA (Castelli et al. 2011).

– Another source of income is represented by the market of spare parts, a sector characterised by a strong competition. To give an example, it suffices to think of how many thousands of spare parts can a car have. If we then multiply that number for the different models and versions available on the market in the last 20 years, the result is an astonishing number. However, it is true that when a car owner wants to change a part in a model out of production, it is necessary to find a supplier able to cater to that particular spare part at a reasonable time and cost. Indeed, that is a profession in which Italy can effectively claim to have a historical specialisation thanks to its recognised manufacturing capacity and flexible production ability.
– As with regard to the diversification of markets and products, it is important to refer to one of the latest trends. In the latest year, one of the reactions to the crisis of the automotive sector has been to reutilise skills and capacities developed in this sector with the objective of attracting other industries. In this case, not all companies have the required skills (Follis and Enrietti 2001). Often, even when it does represent a potential resource, an opportunity of this kind is not enough for them to redirect the volume of business previously guaranteed by the automotive sector. This happens for two reasons. The first is that often other industries are less affected by the crisis than the automotive industry. The second is that members of the automotive supply chain, normally, are companies used to compete year after year and to gradually tune their competitive factors (such as quality, innovation, price, services, etc.), which overall makes them more competitive than companies from other industrial sectors (Manello et al. 2016). Strictly speaking, the automotive sector accounts for 74% of the sales for the supply chain, which means that the chain itself has managed to diversify up to a quarter of the source of its turnover.

Driving Factors for the Italian Automotive Industry

This section analyses, in more depth, the three driving developing factors of the Italian automotive industry as identified in the previous pages, namely: exporting, the improvement of quality, and finally, the FCA role with a particular focus on the new industrial relationships that the Italian carmakers have established with some of the Italian trade unions. Moreover, some considerations are reported concerning sustainable mobility in which Italy is experiencing some delay.

Exporting, an Always Important Driver

For the Observatory of the Italian Automotive Supply Chain (Moretti and Zirpoli 2017) nearly three-fourths of Italian suppliers sell their products abroad. On average, the turnover of companies from the supply chain comes for its 39% from the export and for its 61% from the domestic market. Accordingly, the producers of modules and systems report that 52% of their business relies on sales abroad, a percentage that surpasses the national average greatly, the same for the producers of components (45%). On the other hand, companies of engineering and design and tier-2 suppliers are below the national level by 35% and 32%, respectively.

Obviously, not all companies do export with the same intensity. We can consider, as small exporters, those cases in which companies earn less than a quarter of their turnover abroad, as medium exporter companies with a turnover generated abroad for the 25–50% of their total, and as big exporters those companies with a turnover of between half and three quarters of their total coming from abroad. In addition, there are also so-called exclusive exporters, an expression that refers to companies with an export rate of more than 75% of their turnover. Among Italian exporters, nearly 35% are big or exclusive ones, while only 17% are small. On the other hand, 54% of the sample is constituted by what we can define as “not-small” exporters.

Gradually, all the specialisations of the automotive industry have resorted to open up to a bigger market than the domestic one, and all have developed a prevalence of exporters (Calabrese and Manello 2018a). The biggest group of exporters (85%) has emerged from the supply chain, whereas the percentage of "not-small" exporters is highest than the national average (67%). In this case, we are dealing with companies at a high level of innovation, which have managed to easily adapt their products to international standards. Engineering companies are in the same situation as those producing components are. Thus, 74% of the former are exporters, among which 57% are of the "not-small" type. On the other hand, these are surpassed by companies producing modules and systems (original equipment manufacturer [OEM]), among which 81% are exporters, and among these, not less than 74% "not-small" ones. These data might come as a surprise considering that normally OEMs prefer big clients nearby and are usually controlled by multinational companies. However, the crisis in the automotive industry has pushed all chains to make an effort of adaptation. A possible explanation for that is the fact that these companies, usually dependant on bigger groups, have succeeded in effectively exploiting the international networks of the latter.

In terms of the destination countries of export, Europe remains the main one (for 77% of companies), followed by the American continent (11%), Asia (9%), Africa and Oceania (4%). Producers of components prefer Europe (81%) while OEMs push the national average rate up towards extra-European destinations (31%). If we narrow down our analysis to the U.S. and the BRICS countries (Brazil, Russia, India, China and Southern Africa), we see that North America receive more than half of all exports going to the Americas, while Brazil gets something less than a quarter; within the entirety of Asia, China less than a third and India roughly a tenth. In short, Italian companies seem orientated primarily towards the Americas and, in particular, to the U.S., with a secondary interest in the Asian continent and a preference for China.

As with regard to Southeast Asia, destinations from the area of the Association of Southeast Asian Nations (ASEAN) are scantly represented. While 57% of companies interviewed do not export to the ASEAN area, nor are they thinking of doing so ever, there is an average 6%, which goes up to 11% in the case of OEMs, for which export towards Southeast Asia is increasing. Going into more detail, on average, there are 14% of exporters to the area, although that does not represent their main business destination. A small portion of companies, above all in the case of specialised and OEM exporters, have some of their production lines based in the ASEAN region.

It is interesting to observe that the main obstacles to export are directly linked to the activity of exchange, such as costs of transport (36% of the Italian exporters) and problems of logistics depending on the Italian infrastructures (15%).

The main competitors for Italian companies come from countries in Eastern Europe, followed by Asia, Central Europe and North America.

The best way to access new markets is to directly invest locally. Such process of direct investment is still in progress, albeit it has recently slowed down. It has been focussing on East Asia, mainly China. Indeed, when looking at the last three years, out of a total of 32 openings by Italian supplier companies of new plants abroad, only 3 of these appear to be in Western Europe, while 29 are located in more distant markets (8 in China, 3 in India and 3 in Uzbekistan). On the contrary, in the previous trimester, 39 plants had been opened. As for plants already located abroad, 20 of these have been closed between 2015 and 2017, as opposed to just 7 closed down in the previous period.

All considered, in relation to the data, it can be said that geographical diversification in the last years represents a key factor to overcome the crisis for the main part of the companies in the Italian automotive supply chain. While small companies still have work to do, the path has already been opened. A well-established chain originated in Italy is present in the international market, and indeed, it has gained a useful experience in dealing with global competitors.

Investing in Quality and Innovation

Improvements in quality in the production of Italian vehicles, all the way up from final producers to small suppliers working for third-party companies—as we have just discussed—follow two main paths.

The first goes in the direction of a generalised development of all models from a specific series, such as FCA investments on products with a higher added value. That is the case of small SUV or crossover, such as the Fiat 500X or the Jeep Renegade, both assembled at the Melfi plant—at 400,000 units per year. Both models have positively performed in the market, and they have effectively helped increase employment rates.

More specifically for the supply chain, a recent study has showed that, for the period 2010–2012 and according to European rankings, the technology levels and profits based on supply contracts for Italian OEMs have been very close to countries, such as Japan and Switzerland, that are normally considered to be better structured (Calabrese and Manello 2014). When compared to British, Canadian and Spanish suppliers, Italian ones have appeared to perform better on both indicators. Furthermore, when looking at the previous period, Italian suppliers registered the second-best improvement in technology levels after the Swiss. Here, it is important to note that when comparing different chronological periods, not only adjudications of "more attractive" supply contracts have been taken into consideration but also the process of renovation of the chain itself emerging from its consistent number of acquisitions.

Producers of modules and systems (OEMs) represent bigger companies, which are more inclined to invest in a formalised way on a specific type of innovation based on the balance of research and development. Thus, OEMs are better suited to separate an innovation investment from the rest of their business activities even when the former is undertaken in the conditions of co-design.

According to the Observatory of the Italian Automotive Supply Chain (Moretti and Zirpoli 2017), 68% of Italian automotive suppliers do invest in R&D. Investments of more than 5% of the turnover are made by 38% of engineering companies, 61% of suppliers of parts and components and 58% by OEMs. Particularly for the latter, half of OEMs invest more than 8% of the turnover, while more than half of the suppliers of parts and components (58%) have declared that they do not support any costs for R&D.

In Italy, 93% of companies declare that they do R&D internally: only 6% thanks to public funding, while 9% only acquire R&D from the market. A quarter claim that they do R&D in collaboration with other companies, only one-fifth work together with universities and the same percentage works with customers and suppliers. In these collaborations, the most active are the OEMs, of which 35% co-design with customers or suppliers and nearly a third with the university.

A limited involvement in collaborative projects with universities constitutes a well-known national problem. On the one hand, this is linked to the variety of research technology available, which is more inclined to a theoretical development within universities, as opposed to more practical developments for the private sector. Thus, there is a certain lack of communication at the very origins of the problem. In addition, there are also different systems of incentives typical of those two entities: one willing to publish as little theoretical innovation as possible and the other aiming to keep its procedures as secret as possible until the achievement of a real competitive advantage.

The second path to an improvement in quality refers to premium models, basically the Alfa Romeo brand by FCA, as well as other similar models known as "exotic", which are produced not only by FCA (e.g. Ferrari and Maserati) but also by Volkswagen (e.g. Lamborghini).

Considered together, strategies pushing for the production of premium models bring about the identification—the creation of which is something that has been hoped for by many—of a district for luxury models, which hopefully will be able to compete with its counterparts in England (Jaguar, Land Rover, Bentley, Rolls-Royce, Aston Martin, McLaren, Infiniti) and Germany (Audi, BMW, Mercedes, Porsche).

In this context, numbers are meaningful: in five years, Maserati has moved from producing nearly 5000 units to 52,000 in 2017; Ferrari is planning to double its sales from its current 8000 units and Alfa Romeo wants to pass from the current 175,000 cars to twice as much that level of production. Finally, thanks to its new factories, Lamborghini should also double its production, which at the moment is 3000 vehicles.

Such substantial increase in the production of premium and luxury models also influences the supply chain overall, which, obviously, is keen to provide models assembled beyond the national borders too.

In order to become a supplier for the sector of premium and luxury models, no special requirements are needed, although the low volume of the market for luxury models certainly does require better skills of flexibility in order to more effectively manage technology advancements.

Either way, suppliers are still asked to collaborate with the carmaker, as early as possible during the co-design stage to realise products whose quality is so high as to be perceived artisanal by the final buyer (Calabrese and Manello 2018b).

Such characteristics are present in the Italian automotive industry even when the scale of company and production dimensions are relatively small, albeit it would be better if that did not reach infinitely small dimensions.

However, niches rarely survive for too long. In the future, also this sector shall go through a process of consolidation, which is aimed not so much at performing in the economies of scale, but rather, at rationalising general costs. After all, luxury models will continue to be produced with little attention to their price because the exclusivity guaranteed by a small volume of production is one of the main characteristics that customers look for in this particular car segment. Generally speaking, the latter will never reach a size comparable to some of the big OEMs. Companies' small dimensions will endure, nearly for sure, in the case of the car body, internal finishing and personalised elements (both inside and outside the car). In such cases, small dimensions and artisanal quality can provide an advantage in terms of the flexibility with which the constructor is willing to invest for the sake of the characteristics of an exclusive (final) product, which, ultimately, will be paid for by its final buyer.

Towards Premium Models and Better Quality in FCA

Reactions to the crisis by carmakers have been different. While some of them have tried to consolidate their position through mergers or acquisitions, others have decided to invest in their product with hybrid and electric vehicles or to focus on the company's geographical expansion, or furthermore, they have resorted to technologies of process in order to contain costs.

As with regard to FCA, this leading Italian carmaker has faced this critical period with a governance that had no continuity with the past and heralded a completely new development agenda when compared with the past. In the automotive sector and, more in general, within FCA industrial scenario, two case studies can be regarded as long-term features, above all now when they are in the process of joining up their destiny after having successfully survived a number of critical moments.

In particular, Chrysler has witnessed three acquisitions/mergers (Begley and Donnelly 2011). Although, by then, its profitability was among the highest in its sector, in 1998 “an alliance between equals” was signed with Daimler-Benz. From the very beginning, Germans acted as the strong side of the deal, and in fact, the fusion became soon an acquisition. However, Daimler-Benz was unable to effectively merge the two productive systems into one, and in 2007, Chrysler became the first carmaker controlled by a private equity capital (Cerberus Capital Management). The new situation offered some advantages from the point of view of the management, but the production strategy ended up being a disaster. Thus, in 2009, the financial crisis pushed Chrysler to the edges of bankruptcy. Fiat was the only one to step up to save it, earning in the process a certain credibility by the Obama administration (Balcet et al. 2013).

Mergers and acquisitions are not a cure-for-all-solution to deal with problems within the industrial sector—as we have just observed with the case of Daimler-Benz-Chrysler. Indeed, achievement of the initial optimistic objectives often is far from certain, as it is easier to build up synergies in the marketing phase than to follow up on those in the phases of innovation and production systems. Quite often, it is necessary to wait a long time in order to really see first positive results. Mergers and acquisitions, like that between Fiat and Chrysler, are neither easy nor straightforward. They mainly rely on the endurance of leaderships in both companies, which have to be capable of motivating two existing workforces by integrating them, and at the same time, avoiding forcing and patronising them.

With the legal merging of Fiat and Chrysler into one company and after the formal quotation of the new resulting bond, from August 2014, we can say that the third phase of FCA strategy has begun. Let us briefly recall those steps.

In the first phase—that is, “Searching for transnational integration”—FCA focussed on revamping its line of production for the American market as a way to exploit its recovery while the European market was languishing. This recovery plan has been far from unilateral. Fiat saved

Chrysler from certain bankruptcy because the latter had no technology or capital to support a renewal of its models (which appeared particularly weak after the divorce from Daimler-Benz). Fiat injected new technology and management while the American government put in additional capital, so the destiny of the U.S. historical brand could recover. On the other hand, Chrysler also saved Fiat, which was clearly too small to survive on its own. Additionally, during the years of the crisis in Europe, the alliance has mainly survived thanks to the selling of American brands under the protection of the North American Free Trade Agreement.

In the second phase—that is, "To do better with less"—FCA designed its project to rationalise factories and reduce costs. With these objectives in mind, FCA found particularly interesting, and decidedly feasible, the strategies linked to the economies of scale, by which more components are shared into different models. While each model has to be unique from the outside, in addition, it must have the highest possible number of shared components with other models (e.g. mechanics, electrical and structural parts). Indeed, it is not a secret that Fiat Panda and Fiat 500 are not so different as they look from the outside, or that all models of medium size by Volkswagen are more or less clones of the second to last model of its Golf. Areas emerged as the best ones to cut down costs are plants' coordination and the architecture of models with different brands. In the case of FCA, each segment is supplied by a dedicated production platform which follows specific national requirements (Becker and Zirpoli 2003). Small vehicles are to be developed by Fiat, while the other models will be on the charge of Chrysler. On average, each platform caters for a million vehicles, such as Volkswagen, Ford and Renault–Nissan, and guarantees a better power of negotiations with the suppliers.

Another strategy to cut down costs, albeit with limited results, is that implemented by Lancia[6] and Chrysler by starting to sell nearly similar models, with their respective brand names and in different markets. Something similar also happened with the brands Fiat and Dodge. The Freemont model is a crossover by Dodge, assembled in Mexico and sold in Europe as well, but with the Fiat brand on it.

Needless to say, costs can be reduced above all by eliminating unnecessary waste. The implementation in all FCA plants of the operative system World-Class Manufacturing (WCM)—which we will discuss in the following paragraph—has contributed to the overall improvement of production activities in terms of a decrease in delays, injuries and faulty products.

In the third phase of its new strategy—that is, "Quality first, not costs"—FCA has tried to capitalise advantages acquired by pushing on the development of a world car model: the Renegade. Initially produced in Italy and then also in Brazil and China, with this product, FCA is decidedly aiming at the premium and luxury segments of the market we have discussed above. Overall, the Jeep brand represents the mission at its highest global expansion. While Chrysler looks after U.S. markets and the selling of more traditional vehicles, Fiat develops the concepts of Panda and 500 models in order to expand on the number of buyers that can be further reached by those successful conceptual ideas. On the other hand—and for a different sector of the market—Turkish factories are in charge of producing all the models for the Tipo brand aiming at entering into the low cost market to compete with the Dacia brand produced by Renault. Also in this case, the FCA objective is to maximise the perception of quality for the final customer.

Until the last but one five-year plan, the only aspect that had been underestimated was represented by alternative electric propulsion as these types of models were still not regarded as being profitable. With the new business plan, the production of mild and full electric hybrids will be launched above all in the U.S. in order to satisfy the standards of the Corporate Average Fuel Economy. The current five-year plan provides for the reduction of diesels in the small passengers models in the Europe, Middle East and Africa area and the production of the first fully electric vehicles (500 in total).

New Industrial Relationships in FCA

Strategic change, the necessity to avoid obstacles to the investments needed for the renewal of plants and, above all, the process of integration with Chrysler have brought FCA to require the implementation of industrial relations similar to those in place in U.S. without taking into consideration the different socio-political structure of Italy.

Indeed, trade unions and industrial bodies (e.g. General Confederation of Italian Industry—*Confindustria*) have been unable to fully reform industrial relationships similarly in Germany, where, also thanks to a more flexible and decentralised contractual system, automotive companies have managed to become more competitive.

In Italy, the transformation of industrial relationships has halted in the middle of a difficult transition from a system based on the unity of action between the trade unions, based on the supremacy of the national collective agreement, to a new system that aims to put in competition the trade unions and based more on second agreements at business or territorial level.

Also, the legislator is to blame, since the Italian trade unions are partly regulated and follow the principle of unanimity. The current legislative system can not regulate competition among trade unions and dealings effectively when there are dissimilarities between collective contracts of the same level, neither can it decide which one of these contracts have to prevail (Bubbico and Pirone 2008).

The clash between the old and the new contractual systems has become manifest in occasion of the negotiations for the revamping of FCA plant in Pomigliano d'Arco. Before making the investment of 700 million Euros—which would bring Panda's production back to Italy from Poland—FCA had signed an agreement with some of the trade unions[7] with two main objectives in mind:

- To increase the plant's productivity up to the full exploitation of the hired workforce. In order to achieve that—by intervening on matters of work schedule, extra hours, breaks, rotating schedule and in the effort to fight anomalies linked to absenteeism—FCA had derogated for its metalworkers some of the clauses contained in the National Collective Labour Agreement (*Contratto Collettivo Nazionale del Lavoro* [CCNL]) that, originally, was signed by the totality of the unions.
- To guarantee the plant's governability and binding character of the collective contract, FCA had included the so-called clause of responsibility in the new agreement. Accordingly, those trade unions that had signed it, committed themselves not to go on strike to renegotiate its

conditions for as long as the agreement had been signed for. From the point of view of FCA—above all, after the acquisition of Chrysler and because of the higher productivity rates of factories in Poland and Brazil—such clause was extremely important and much needed in order to guarantee the sustainability of the investment, and ultimately, the conservation of production lines in Italy.

Despite the promise of investments and the unanimous position of all the other Italian unions, not only FIOM[8] refused to sign but it immediately declared an open opposition to the implementation of the agreement because—from its point of view—no change could be made to the CCNL after 2008. FIOM claimed that all derogations to the CCNL were illegitimate. Clearly intending to delegitimise the whole agreement, it dragged FCA in a harsh and long confrontation.

Even the referendum won by the trade unions that had signed the agreement did not manage to improve the situation. In turn, because of the intricate conflict originated from the overlapping of two different contractual systems, there was an increase of centrifugal pushes, something that in Germany had been attenuated by the so-called clauses of opening (Garibaldo 2008). As FCA decided to build up new companies for each plant in order to keep these out from the association of entrepreneurs (Confindustria) and the collective contract, it began a delicate process of revision of the contractual system for the metalwork sector—and thus, of the original CCNL signed also by FIOM. From that moment on the clash went up to the highest levels of the negotiations, questioning the union representative system on the ground, as well as the decision taken by joint union representatives (*Rappresentanze Sindacali Unitarie*). This critical moment was not limited to FCA factories alone but it also spread into other production sectors.

Trying not to get stuck into the difficult transition from the old to the new contractual system, FCA and trade unions—with the exception of FIOM—resorted to the creation of a new system of industrial relationships for the FCA plants, similar but independent than the one already in place. Its guiding lines had been the respect for constitutional principles and those established in the third title of the statute of the workers (Law 300, May 20, 1960). Based on reciprocal acknowledgement of the parts involved in the negotiations, the aim of this new agreement was to set the whole sector—and FCA—free from that intricate net of rules that had allowed FIOM to effectively exercise a veto power.

This way, FCA and some of the unions did sign a specific collective contract of labour (CCSL), which had emerged from the first level of negotiations. This time, it was exclusively devoted to the automotive sector, and in theory destined to eventually become a reference contract for the entire supply chain.

In addition, to give greater political and juridical consistency to the new collective contract , there was a massive recourse to the tools of direct democracy. Indeed, every time that a new working system was introduced in a plant, its workers were called to express their agreement by voting in a referendum. Furthermore, following Article 19 of the statute of the workers in its version reformed after the 1995 referendum, unions' representation within the company—which is a requirement of the third title of the statute—has been limited to those included in the collective contract in place within the firm. In fact, this feature aimed at the exclusion of FIOM from additional negotiations or protests. In 2013, the Constitutional High Court declared such sub paragraph unconstitutional because it violated the principles of solidarity, equality and freedom of representation through trade unions—as stated in the Italian Constitution—so FIOM representatives could not be put at one side.

In addition to the new systems for wages, the rotating schedules and breaks, the extra hours and the new hiring, the CCSL is characterised by three innovative aspects, which are the following: (1) FCA's investments are discussed with the unions, (2) wage increases depend on the overall productivity of both the company and the plant's adoption of the new operating system WCM, and (3) a better treatment for the unions that have signed the new specific collective contract.

The first two aspects were intertwined, as FCA had always declared its commitment to fix plants' saturation, and in this way to apply the same rules to all workers. For FCA, this was the only way to improve productivity and justify larger investments, as well as to safeguard occupation and bring unemployment benefits to an end, in favour of a higher turnover together with the improvement of income for workers. However, whereas this new situation implies a different organisation of working shifts and breaks, it also calls the trade union to undertake a completely new task—that of controlling that the company keeps its word and that it really does make the promised investments.

As for the third aspect—a better treatment for unions included in the CCSL—FCA has agreed into paying workers' fees for the members of the signing unions, which account for an average 1% of their wages. Furthermore, officials from the signing unions enjoy more leave hours than officials from other unions do, and they have preferential access—though advanced invitations on separated panels—to meetings between FCA and trade unions.

Finally, with regard to the WCM system, originally developed in U.S. in the 1990s and introduced in Italy by FCA in 2005 (before the integration with Chrysler), as an innovative operation system, it shares several aspects with concepts such as Total Productive Maintenance, the logics of Lean Manufacturing and Total Quality Management. At the same time, WCM presents an important difference from those, as the basis of its strategies and choices of "critical" factories rely on the so-called Cost Deployment. In other words, when dealing with a variety of organisational and labour issues—such as maintenance, logistics or safety —the working team draws up according to their incidence on the economic level. Thus, all activities, even when run by different teams, aim at the realisation of projects with the following objectives: zero imperfections, zero malfunctions, zero accidents and zero spare parts. In short, there is a general and pervasive tendency towards the reduction of costs within the plant, as WCM works as a consistent methodology for production that refers to the entire organisation by engaging all phases of production and distribution.

The WCM system has been implemented in nearly all FCA plants in the world. Accordingly, in 2015, an average of 65,000 projects have been realised, including several specifically designed to produce a lower pollution impact on the environment.

Last but not least, FCA has also implemented an environment-friendly management system on a global scale following the ISO 14001 standard, which has then been certified for all of the FCA factories.

An Almost Missing Driver: New Business Models for Sustainable Mobility

For what concerns sustainable mobility and the related business opportunities, Italy displays some specific features that stand out in the international automotive industry.

As explained in Section 4.2, FCA will begin investing heavily in electric vehicles only from its 2018 to 2022 business plan, but, as we will see, this has not prevented the Italian supply chain from offering some solutions in the field of green vehicles.

Second, the Italian legislation has introduced carpooling, but it has forbidden the diffusion of peer-to-peer ridesharing to protect the profession of taxi drivers. This is why companies like Uber are not allowed to operate in Italy, except for UberBlack, whereas businesses like BlaBlaCar can offer their services.

Difficulties have emerged also in relation to car sharing. Early car-sharing services were set up by local municipalities, but many have gone out of business since then, while in 2017, the four major private companies (Car2go, DriveNow, Enjoy and Share'ngo) reported losses amounting to 27 million Euros over a total turnover of 48 million Euros, equal to a loss of 4700 Euros for each car. Furthermore, the average usage time of car-sharing vehicles is lower than that of private vehicles, and the diffusion of electric car sharing is limited to few large cities (Rome, Milan, Turin and Florence).

Conversely, Italy has been particularly quick to act in terms of regulations to be applied to the testing of connected and autonomous vehicles.

Indeed, the so-called Smart Roads Legislative Decree of March 2018 regulates road tests for these types of vehicles to ensure that they are carried out in a safe and uniform way across the entire nation. The content of the decree is in line with the principles recently established by the UN Road Safety Forum, requiring the presence of a person who is "ready and able to take control of the experimental vehicle(s)" at any moment; this person may or may not be inside the vehicle. The decree also addresses the topic of infrastructural upgrades, with the aim of transforming the national road network and making it able to communicate with connected and autonomous vehicles. Additionally, the government is due to launch a Technical Monitoring Unit to identify suitable interventions to support testing activities (creation of databases and shared platforms for the use of data from the vehicles being tested).

As for alternative vehicles, currently of greater interest for the supply chain, despite the announcements made by carmakers and the recent growth in the sales of cars with low environmental impact, their numbers are still very low compared to those of traditional vehicles (Hildermeier 2016). Moreover, their distribution is uneven and tends to increase, especially in urban areas among the wealthier portions of the population and among young people. This limited penetration is mostly due to the difficulties in managing electric cars as well as to the lack of charging infrastructures (Chávez and Lara 2016).

Whereas in Italy, the presence of purely electric vehicles is extremely limited (0.2% new vehicle registrations in 2017), but hybrid vehicles are rather widespread (3%), in the countries that have already built the required charging infrastructures, the numbers are considerably higher (in Norway, 40% of new vehicles are electric and 13% are hybrid, while in Sweden both types stand at around 5%).

This is why it is reasonable to conclude that registrations of new vehicles with low environmental impact will concern mostly hybrid cars, pending the completion of Italy's charging network for electric cars.

In any case, the spread of hybrid vehicles will allow for better restructuring and reconversion of the current automotive supply chain and of its companies. These will continue to be necessary for the supply chain, which, rather than scrapping it completely, will keep relying on the old technological paradigm for quite some time, although its progressive downsizing is inevitable.

In this regard, three possible consequences can be identified over different time periods:

– About 34% of companies in the Italian automotive supply chain claim that they already have the necessary expertise to develop electric cars. More specifically, this percentage increases to 81% among companies specialising in engineering and design and to 50% among the producers of modules and systems, which are more heavily involved in the automotive business compared to parts and processing suppliers

(Lanzini and Stocchetti 2017). These results indicate that Italy already possesses the knowledge and skills to develop innovative vehicles and that the Italian supply chain will not be excluded in the short term.
– Nevertheless, only 3.6% of companies state that, over the medium term (3–5 years), sustainable mobility will be a strategic priority and main target for their business investments (Lanzini and Stocchetti 2017). This result confirms that a complete shift in the technological paradigm is still a long way off and that Italian automotive suppliers, especially small and medium enterprises, currently have other strategic priorities.
– Conversely, looking at the long term, half of the companies in the Italian automotive supply chain report that they are developing sustainable mobility projects with other companies and research institutions, while almost a fifth are working on electric or hybrid models and 4% on autonomous driving. This is not in contrast to the above results, since these collaboration and research projects are for the most part financed by public bodies.

The latter result strongly suggests that although FCA has so far shown limited interest in electric and hybrid vehicles, the Italian supply chain has not ignored the expansion of the segment. This phenomenon may be attributed to diversification within the national supply chain and to the fact that Italian enterprises have long been supplying large European assemblers, as well as the major national automaker.

Lastly, as illustrated in Section 2, the Italian supply chain is characterised by specific strengths that should be tapped into, such as its competitive advantage in the manufacturing of methane—and LPG-powered models, in terms of both producers of systems (such as Landi Renzo S.p.A., which has 700 employees and a yearly turnover of 200 million Euros, 80% of which is exported) and models available (above all, within the FIAT range). In this context, it might be logical for the national supply chain to specialise further in the manufacturing of hybrid vehicles combining gas (methane or LPG) and electric propulsion.

Ultimately, sustainable mobility in Italy implies an all-round, integrated approach that relies on the spread of alternative fuels, on continued investments in traditional powertrains (especially diesel), as well as on strengthening local public transport and new models of shared mobility (Aguiléra and Grébert 2014), optimising logistics and sustainable goods transportation, and investing in research and innovation to develop the technologies needed for autonomous and connected vehicles.

In order to obtain real benefits in the short term, conventional and alternative technologies must be combined, in line with the principles of technological neutrality and functionality. This means that each technology has a specific mission. For example, electric propulsion is particularly suited to urban areas, diesel to long-distance journeys, and liquid methane gas to industrial vehicles, making the most of the already available expertise and aiming at the quick renewal of the fleet to guarantee safety and environmental protection (Chevalier and Lantz 2015).

Conclusions: An Industrial Policy for Automotive Industry/Sector

As we have discussed earlier, there is one striking aspect that has emerged forcefully. In accordance to their objectives and specificities, all the actors of the Italian automotive industry have taken an active role in the latest changes taking places. Just an actor is still missing from the whole picture and up to now: the State.

Whether we consider at central or, in a minor scale, regional level, it is clear that in Italy the State is not able to build and effectively pursue a feasible political and industrial agenda for the automotive sector. Indeed, such agenda should be both political and industrial at once, while it cannot focus exclusively on safeguarding production and occupation rates. On the contrary, it must necessarily engage more consistently with the broader dimension of sustainable mobility.

In the last decades, the trajectory of industrial politics in Europe has generally developed into a competitive model based upon more generic political decisions aiming at all of the industrial sectors. The main features of this model were born in the 1990s, thanks to guidelines on free competition set up by the European Commission to foster growth and occupation which, in turn, brought to the writing of the so-called White Books on competitiveness. In short, it was put a great deal of attention on the creation of an environment favourable to private investments, with incentives to enter the market and few restrictions to leave it, flexible rules for both the labour and the production markets, and with a certain number of funding and subsidies. In part, these politics are also aimed at improving training opportunities and the acquisition of new skills.

Currently, in some countries, it is believed that to rely mainly on a horizontal approach for the elaboration of politics has not performed well in catering for the several industrial needs of the different nations that constitute the EU. As a consequence, industrial policies—above all in France and U.K.—have moved to a system within which the existing horizontal approach is integrated with specific initiatives, focussing on those sectors that are perceived as being more able to generate opportunities for development. Up to a point, at least as far as the level of a generic framework goes, even the EU has begun to be more inclined towards vertical policies, such as the Action plan for a Competitive and Sustainable Automotive Industry in Europe (a.k.a. CARS 2020), created to improve competitiveness and sustainable development. In addition, the EU has also looked into other sectors with programmes such as LeaderSHIP 2020 for the shipbuilding sector, Global Construction 2020 for the construction sector and the Action Plan for the sector of iron and steel industry.

To give some examples of this new trend, in France and U.K., two new operative structures have been built up, the *Plateforme de la Filière Automobile* and the *British Automotive Council*. These programmes present two common features (Calabrese et al. 2013). The first is the acknowledgement that a "new" politics for the sector of reference must derive from strategic and long-term collaborations between private companies and the government. The second is that in the case of pervasive sectors, such as the entire automotive economy, the involvement of different levels of the government must be complete—both at the horizontal and vertical levels—and that it requires a renowned leadership for its coordination in order to minimise the risk of inappropriate interventions.

Something similar to the British model has also been tried in Italy. However, because of the crisis and above all the lack of a clear political agenda by the government, the whole initiative has collapsed.

If, on the one hand, Italian initiative with regard to an industrial policy for the automotive sector, and in a broadest sense for mobility,[9] is absent

(Calabrese 2015), on the other hand, the only available opportunities in a structural sense must refer to those initiatives designed for the industrial sector overall. Among these kinds of interventions, we can differentiate policies of attraction of foreign investments from policies of networking, to gather companies from different sectors according to pre-defined objectives.

An example of the first type of interventions has happened precisely within the automotive sector, with the decision by Lamborghini—under the control of the Audi Group Volkswagen—to base the production of its Urus SUV in Italy, rather than Slovakia, because of the better conditions offered by the Italian government. Of a total of 70 million Euros in public incentives, Audi's investment will be of 800 million Euros, out of which 350 million Euros will be invested in R&D, experimental development and design, with 500 newly hired people. In agreement with trade unions, all new factories will run according to the German model of trade unions' relationships[10] and implement the Universal Analysis System, adopted also by FCA and by the firms producing cars all around the world.

As with regard to networking policies, there are two main types of this kind of interventions: bottom-up, through so-called network contracts[11] to foster the collaboration among companies, and top-down, usually promoted by regions to help the creation of technology districts, scientific parks and innovation areas.

Obviously, even in the case that such structural industrial policies are fully implemented, that alone would not be enough. What is much more important is the existence of an industrial political agenda able to influence the country competitiveness, characterised by things such as a tax system that supports business, a consistent culture of effective administration, proper ways to access credit, professional training, communication among the different research centres, an effective and robust juridical system, the normalisation of transport and communication networks.

More specifically, to ensure a smooth transition towards the new technological paradigm, allowing components manufacturers to slowly but progressively shift their production capacity from the traditional to the innovative sectors, what is needed above all are industrial policies able to stimulate new investments in innovation (Begley et al. 2016).

In this regard, it might be worth analysing what has happened in other sectors that are affected by new technological paradigms, for instance, in cases like the introduction of biotech medications to replace chemical drugs in the pharmaceutical sector, or the subsidised development of renewable energies to replace traditional ones in the energy sector. In some cases, the replacement of old, traditional products with new, innovative products has been remarkably fast and has had a strong impact in terms of distribution/substitution of jobs. In other cases, instead, the new technologies have developed much more gradually through progressive steps, such as in the field of mechatronics, which has changed how machinery is manufactured while also allowing companies to keep up with the innovations introduced.

Since current trends seem to point to the quick short-term development of hybrid vehicles, with 75% new vehicle registrations expected in 2025, and to the slow development of pure electric vehicles, with 12% new vehicle registrations in 2025, it is possible to implement industrial policies that support immediate access to the hybrid segment and slow but progressive reconversion of the supply chain towards pure electric propulsion.

Such supply chain reconversion is stimulated by the growing demand for cars with low environmental impact, and it is, therefore, logical to combine supply-based policies with public policies to stimulate demand.

First of all, it is certainly vital to boost the development of charging infrastructures, above all by means of incentives to promote agreements among firms for the construction of shared infrastructures.

Secondly, a wide range of heterogeneous measures can be taken to promote, both directly and indirectly, the spread of electric/hybrid vehicles in Italy. These include discouraging the use of polluting vehicles in urban areas, redistributing the tax burden in favour of low environmental impact models, applying EU Directive 2014/94 about the obligation to provide new buildings with communal charging points, and supporting the environmentally friendly approach espoused by the European Commission to achieve a 30% target reduction in CO_2 consumption between 2021 and 2030 (Degirmenci et al. 2017; Dijk and Parkhurst 2014).

Notes

1. Fiat Chrysler Automobiles (FCA) is a part of the Exor Group controlled by Agnelli family. The FCA's portfolio includes automotive brands such as Abarth, Alfa Romeo, Chrysler, Dodge, Fiat, Fiat Professional, Jeep, Lancia, Maserati and Ram Trucks. FCA also owns automotive suppliers such as Comau, Mopar and Teksid. Ferrari and Iveco (industrial vehicles, coaches and buses) are not part of the FCA group but they are controlled by Exor, the former directly, the latter through CNH industrial (capital goods).
2. Just after the deal with Chrysler, Fiat tried to purchase the Opel unit of General Motors without success. In 2017, Opel was sold to the group PSA (Peugeot–Citroën).
3. In 2017, worldwide production of FCA automobiles for passengers and small commercial vehicles has reached 4.7 million units. The production has been stable in the last three years.
4. In 2013, these results were worst and 46.4% and 29.8%, respectively.
5. Pininfarina is controlled by Mahindra & Mahindra, and Italdesign by Audi Volkswagen group.
6. Lancia is an old Fiat's brand. Nowadays, it is limited to the Italian market with only one model: Ypsilon.
7. In Italy, all FCA employees have been contracted through a collective contract and 32.3% of them are the members of a trade union. Globally, 85% of FCA employees enjoy collective contracts.
8. Federazione Impiegati Operai Metallurgici (FIOM) is the workers' union operating in the metalworking companies that belongs to the Italian General Confederation of Labour. It is the oldest Italian industrial union and is politically deployed on the left.
9. While it is true that, for the mobility, there is the plan for electrical vehicles, that is nothing more than the application of a European legislation for the infrastructure of alternative combustible (DAFI).
10. The German model is based upon the "Charter of relations" in place within the main central plant of Volkswagen. Its objective is to guarantee and increase the group's competition and productivity. It does so by pushing for unions' relations mainly characterised by cooperation and participation.
11. The network contract (in Italian, *contratto di rete*) is a particular juridical tool introduced by the Italian government to help the development of a

more cohesive and conscious process of collaboration among companies involved in shared projects leaving untouched their full management autonomy. While the diffusion of this type of contracts is not a direct effect of public funding, the increase of a number of initiatives—above all those promoted by regions—has certainly helped. Indeed, it has been registered an increase of calls aimed at fostering networks with the objective of supporting research and innovation projects (40%), entrepreneurial development (30%) and internationalisation (22%).

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8

The Japanese Automotive Industry Since 2000: Causes and Impacts of Growth Disparities

Stéphane Heim

Introduction

At the outset of the twenty-first century, the automotive industry of Japan is among the most competitive and mature ones, along with those of Germany and Korea. The seven main Japanese carmakers taken together (Toyota, Nissan, Honda, Suzuki, Mazda, Daihatsu, and Subaru)[1] have yearly domestic production and sales, exports, and overseas production volumes of 10, 5, 5, and 14 million vehicles, respectively. Despite being celebrated in the late 1980s as the industrial model to be followed, the Japanese automotive industry has significantly evolved in its productive organization, employment relations, and inter-firm relations since the mid-1990s. The financial crisis at the beginning of that decade, the regionalization of the Asian automotive industries, the profitability of new energy vehicles, changing consumer behaviours and industrial policies, and the growth of emerging industries (especially that of China) have modified its sources of profits.

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Though in the 1990s several specialists emphasized the peculiarities of Japan's big corporations (once called the J-firm), the Japanese automotive industry started to display a trend of diversification in the carmakers' organizations. While Toyota and Honda went through this rough period without ties with foreign capital, Nissan, Mazda,[2] and Suzuki merged with foreign firms, Daihatsu and Subaru moved closer to the Toyota Group, and, more recently, Mitsubishi has merged with the Renault-Nissan Alliance. Hence, the structure of the industry has evolved towards higher concentration at the top of the supply chain and worsening working conditions at its bottom.

This chapter describes and analyses the causes and nature of these restructuring processes and explores their impacts on the competitiveness of the domestic industry and market, as well as on labour relations. How has the Japanese automotive industry kept a high level of competitiveness? What are the effects of this trend on the overall domestic industry? The second section presents the peculiarities of the Japanese auto industry, inherited from the 1960s–1970s. The third section is dedicated to exploring the diverging trajectories of Japanese carmakers, while the last two sections investigate their impacts on the Japanese supply chain, labour relations, and innovation trajectories. The final section concludes this chapter.

Structural and Historical Legacy

The success of Japanese carmakers is often ascribed to their manufacturing capabilities, which were described as *lean production* in the late 1980s. The basic ideas of the lean system are expressed by its two core pillars. The first is just-in-time manufacturing, which stresses the delivery of necessary products at the necessary time. The second is "autonomation" (*Jidoka*), which goes beyond the automation of work processes and introduces higher flexibility, with machines automatically stopping whenever a defect is detected.[3] Based on these organizational capabilities, Japanese carmakers were able to compete with their Western rivals, especially US firms, thanks to cheaper vehicles and higher quality standards (Shimokawa 2010).

Though one cannot deny that most Japanese carmakers and mega-suppliers heavily rely on manufacturing capabilities, this specificity alone does not explain their success. Without the commitment of workers, suppliers, and dealers, their productive organization would not have been able to develop harmoniously. For instance, under the umbrella of Toyota, until the mid-1990s, the Toyota Production System (TPS) involved two main cost management tools (*target costing* or value engineering and *kaizen costing*), which entailed the strong participation of suppliers and workers from the early stages of R&D until the first few months of final assembly. Moreover, labour and inter-firm relations were rooted in specific monetary incentives through the redistribution of productivity gains to the working units and in the suppliers' ability to continuously improve their working standards. In the pre-War period and during the 1950s, production focused mainly on trucks and vehicles for the army. At the beginning of the 1960s, there was almost no domestic market for passenger cars.[4] Thus, the industry grew from the 1960s onwards, following three development stages and triggering the establishment of a huge number of final assemblers and suppliers.

From the 1960s to the beginning of the 1970s, strong government intervention, growing stabilization of employment relations, domestic demand-led growth, and shortage of production and financial capabilities characterized the industry. While in 1960 production and sales volumes of passenger cars were extremely low (no more than 300,000 units), in 1970 they reached around 5.3 and 4 million units, respectively (taking passenger cars, commercial vehicles, trucks, and buses into account). Vehicle exports started to grow in 1966–1967. At that time, passenger cars accounted for roughly 60% of sales. This extremely rapid growth in domestic sales, coupled with a lack of financial and manufacturing resources, explains why most carmakers had to outsource not only the production of parts but also the final assembly of vehicles (Shioji and Nakayama 2016).[5] As for the suppliers, they came together in suppliers associations (*kyoryokukai*) in order to both improve their manufacturing capabilities (Heim 2013) and stimulate competition through the generalization of the multi-supplier production delegation system. After a long decade of harsh labour conflicts in the 1950s (Cusumano 1985), most of the firms reached agreements with their workers to create the basis for the enterprise union system. This system was rooted in negotiations at the firm level, while sectorial negotiations and agreements were denied to the labour unions, and high wages for blue and white collars were seen as compensation.

This development of the Japanese automotive industry enabled Japanese carmakers to compete with Western firms until the early 1990s. Throughout this period (high growth and export-led regime from the 1970s to the beginning of the 1990s), production, sales, and exports volumes increased steadily and continuously to reach their historical peaks of more than 13 million production units and 8 million sales units in 1990, and around 7 million exports units in 1985. The growth regime thus changed in nature, since it was mostly driven by exports.[6] The two oil crises of the 1970s gave an advantage in the US and Western Europe to more fuel-efficient cars, a segment in which Japanese carmakers had acquired a competitive edge. However, Japanese cars were mainly exported to the US[7] due to the difficulties faced by American carmakers in producing small cars and to the American distribution system, which gave Japanese carmakers greater market access to the US than to Europe (Jullien 2008).[8] In order to counterbalance this commercial deficit, in the 1980s the American government decided to attract foreign direct investments (FDI) from Japan, and most Japanese carmakers that had already developed in Asia in the 1960s saw their American production volumes and sales boom, accounting for roughly 1 million units in 1990. As a result, in the early 1990s, Japanese carmakers were already well established in several parts of the world, with worldwide production volumes exceeding export volumes from Japan. Yet, there were signs of a possible slowdown in market expansion, which most decision-makers did not however take into account.

The third development stage, following the financial crisis at the beginning of the 1990s, was characterized by the restructuring of the domestic industry. The shrinking of the domestic market from 7.8 million units in 1990 to 5 million units in 2010 was outweighed by a twofold rise in foreign sales (9.1–18 million units). These sales were mostly led by foreign production, with a fourfold increase (3.3–13.2 million). Exports were substituted by local production between 1985 and 1995, and new product policies were implemented to strengthen localized models, since the project of the "world car" appeared to be a failure. In Asia, and particularly in the Association of Southeast Asian Nations (ASEAN) countries, Japanese automakers became firmly established as dominant actors, with local production levels having increased from merely 1 million units in 1990 to 7 million units in 2010. Domestic production and sales varied throughout the 2000s between 8 and 12, and 4 and 6 million units per year, respectively, mainly due to stable motorization rates. Coupled with the ongoing economic recession, this foreign sales and production-led growth regime has been the biggest challenge for Japanese carmakers and suppliers in terms of productive and organizational reorganization since the mid-1990s.[9]

Among the mature automotive industries, along with Germany and Korea, Japan is the only country that is still able to combine relatively large domestic sales/production and exports volumes with high foreign production and sales. However, the legacy of the 1960s (large numbers of car and parts manufacturers, specific labour and inter-firm relations, and strong political intervention and regulation) became problematic after the burst of the economic bubble. The following section will examine the evolution of the Japanese automotive industry since then, and especially the diverging trajectories of its carmakers.

Heterogeneity of Carmakers' Trajectories and Performances

The Japanese transport system is, if not complex, at least ambivalent. Although, among developed countries, Japan is characterized by the highest share of public transport in the transport mix and by extremely high car ownership costs, there has been a sound market for passenger cars from the early 1980s onwards. Since the stagnation in sales at the beginning of the 1990s, due to the geographic peculiarities of the country and a specific regulation to favour small cars, the Japanese car market has been split into two main segments: mini-cars (*kei jidosha*) and standard cars (Table 8.1). Along with these trends, consumption patterns have also evolved, with longer periods of car ownership (nowadays, a car is in service for 13 years on average, twice as long as in the mid-1970s), the development of a used cars market (also for exports), and high

Table 8.1 Evolution of the Japanese car market structure (1990–2017)

	Average market share per segment (1993–2017)				Evolution of the overall market share (1997–2017) (%)	Evolution of market share & product mix (1997–2017)					
						Standard		Small		Mini	
	Standard (%)	Small (%)	Mini (%)	Total (%)		Market share (%)	Product mix (%)	Market share (%)	Product mix (%)	Market share (%)	Product mix (%)
Toyota	40.6	45.2	0.5	30.9	+2.8	+6.7	+22.9	+15.3	−24.4	n.a.	n.a.
Nissan	13.6	20.0	5.8	14.2	−5.5	−6.5	+12.6	−8.6	−41.7	n.a.	n.a.
Honda	9.6	16.6	15.3	14.5	+1.5	−4.8	+1.0	+1.9	−30.7	+10.9	+29.7
Mazda	5.9	5.8	3.0	5.0	−0.8	+5.6	+52.5	−3.2	−54.4	−1.4	+2.0
Mitsubishi	3.3	3.7	8.4	5.0	−5.9	−4.5	+15.1	−4.9	−30.5	−12.0	+15.4
Subaru	5.7	2.5	4.8	4.0	−0.8	+7.6	+78.6	−4.4	−59.2	−5.7	−19.4
Suzuki	0.4	2.9	31.4	10.6	+3.4	n.a.	n.a.	+5.2	+4.9	−7.2	−6.6
Daihatsu	0.0	0.6	30.9	9.4	+5.0	n.a.	n.a.	+1.2	−1.9	+4.1	+1.8
Average	25.4	45.3	29.3	100.0		+15.9		−28.3		+12.5	

Source: Author's calculations based on statistics of the Japan Automobile Dealers Association (JADA) and the Japan Mini-Vehicles Association motorization rates in rural and suburban areas, compared with low ones in big cities. Car sharing is still underdeveloped (in 2014, the car fleet did not exceed 12,000 cars for roughly 450,000 users, with ten major providers having an average ratio of around 70 users per station). The dealership structure is organized around strong vertical integration and, due to the high number of dealers, most of them suffer from low profitability (few cars sold per outlet). These market tendencies have bolstered Daihatsu and Honda in the market of mini-cars, while Suzuki's position has weakened in this segment, which is the core of its product mix. At the same time, Toyota, Mazda, and Subaru have attained a competitive edge in the market of standard cars, a segment in which Nissan and Honda have made few investment efforts to maintain their position and lost the greatest market share. The worst situation was that of Mitsubishi, which was keen on making efforts in these two segments, but nevertheless lost a substantial portion of its market share. As a matter of fact, due to the media coverage of its quality problems in 2015 and 2016, its vulnerable position in terms of internationalization (strong in Southeast Asia only), and its weakened product portfolio, Mitsubishi, as a mid-size carmaker with several problems, had no other choice but to be acquired by Nissan and join the Renault-Nissan Alliance. A similar fate is conceivable for Mazda, Suzuki, and Subaru, whose links with Toyota have recently become stronger. As a consequence of the above market trends and the steady but still fragmented regionalization of automotive industries in Asia (Heim 2017b, 2018), there is a tendency towards consolidation at the top of the supply chain.

Among the seven Japanese carmakers, only Toyota, Nissan, Honda, Mazda, and Subaru have product ranges that cover most of the car segments. The two remaining carmakers, Suzuki and Daihatsu, mainly produce mini-cars, contributing, respectively, 31.4% and 30.9% of the domestic sales of mini-cars between 1993 and 2017 (Fig. 8.1).[10] In other words, this indicates that Suzuki and Daihatsu have very different productive and organizational scales compared with the five main "volume automakers". Toyota produces between 9 and 11 million vehicles per year. The production volumes of Nissan (without counting the volumes of Renault) and Honda fluctuate, respectively, between 5 and 4 million units, while Suzuki stands at roughly 3 million, Mitsubishi, Mazda, and

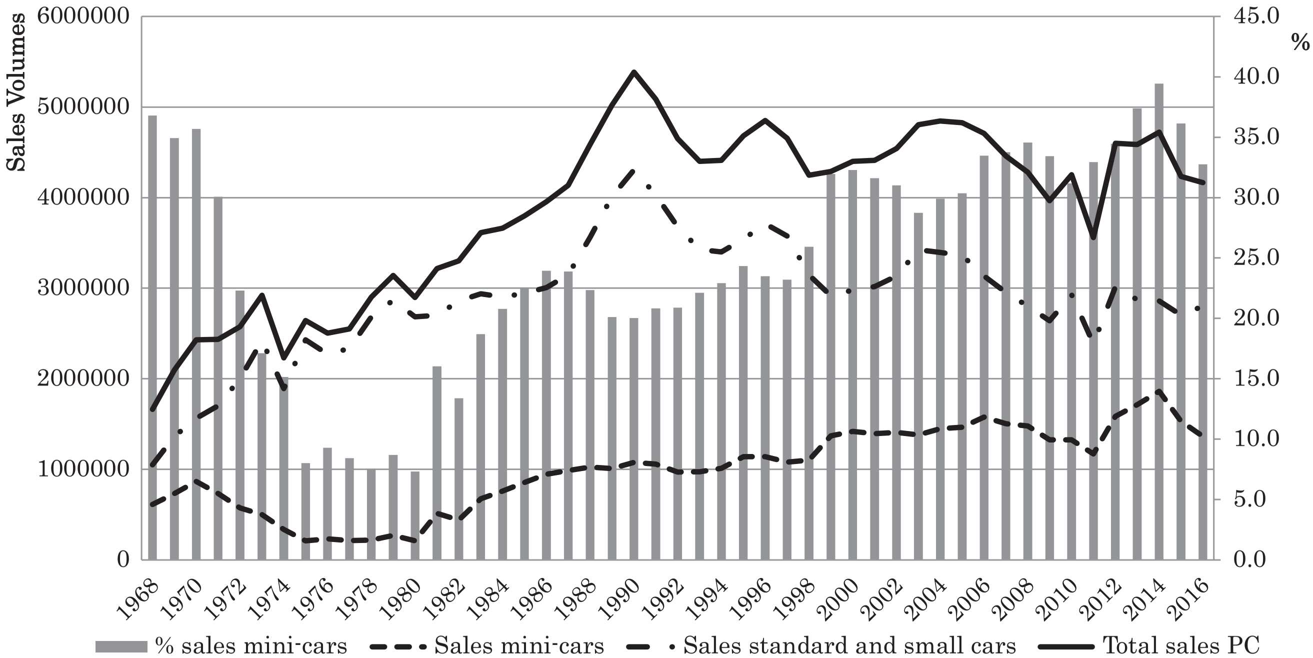

Fig. 8.1 The Japanese automotive market and mini-cars (1968–2016). In 1955, mini-cars had a 360 cc engine. Engine size was then upgraded to 550 cc in 1976, and to 660 cc in 1990 (this also includes the size of the body). Along with specific incentives (lower road, annual use, and sales taxes, lower insurance costs, and no need for a parking space), this explains why sales of mini-cars have been constantly increasing from the beginning of the 1980s]. Source: Created by the author from data published by the Japan Automobile Manufacturers Association (JAMA)

Daihatsu at just over 1 million each, and Subaru at less than 1 million. In an industry where economies of scale and diversification are important determinants of profitability, Toyota is the dominant actor in Japan. Moreover, with Daihatsu in its business group and a possible growing acquisition of stakes in Suzuki and Subaru, Toyota is set to maintain its position as market leader and dominant player in the country.[11] Although domestic sales account for 18% of its worldwide sales, Toyota's domestic production (with 2 million cars exported yearly) is still at the core of its industrial strategy, especially when compared with Nissan and Honda. However, its domestic market share has been decreasing steadily and slowly since 1990, from more than 51% to 29.4% in 2017. The second carmaker, Honda, only has a 16% market share, followed by Nissan, Daihatsu, and Suzuki, each at around 11%. Despite its decline, Toyota's development path and trajectory are still characterized by a strong domestic base, with 35% of domestic production carried out by the company itself and 38% of its worldwide production occurring in Japan. In comparison, Nissan and Honda each account for around 10% of Japan's domestic production, roughly the same level as Suzuki, Mazda, and Daihatsu, and less than 20% of their worldwide production is done in Japan (Table 8.2, Heim 2009: 519–520). Nissan and Honda nowadays are much more reliant on the American market than their domestic market. Their domestic production shares over worldwide production account for less than 20%, and domestic production exported is equal to over 50% for Nissan and 10% for Honda. Honda's low level of exports has several causes (e.g., fluctuations in exchange rates), but the main factor is to be found in its product policy in Japan, focusing on lower segments. Indeed, 45.2% and 35.6% of its domestic sales were in the segments of mini-vehicles and small-sized sedans in 2017.

All these elements converge towards the conclusion that among the five "volume automakers", only Toyota and Mazda have maintained a strong domestic production base. However, Toyota has stronger bargaining power, and its decision-making processes are still very much guided by its Japanese headquarters. Moreover, its willingness to further develop alliances and partnerships with other domestic carmakers starting from the second half of the 1990s is an indicator of its stronger dependency on the domestic industry.[12] This strategy is similar from many points of view

Table 8.2 Comparison of externalization efforts of 200 parts

	Externalization[a]				Internalization[a]			
	Engines[b]	Mechanical organs[b]	Other parts[b]	Total	Engines	Mechanical organs	Other parts	Total
Toyota	111	93	99	303	24	18	6	48
Nissan	119	96	104	319	14	4	2	20
Honda	118	89	108	315	13	7	2	22
Mitsubishi	128	98	97	323	10	6	1	17
Mazda	113	85	88	286	9	5	1	15
Subaru	95	80	79	254	2	5	1	8
Daihatsu	90	76	99	265	13	7	5	25
Suzuki	107	94	106	307	9	5	2	16
Average	110	89	98	297	12	7	3	21
Average Japanese Big three (Toyota, Nissan, and Honda)	116	93	104	312	17	10	3	30

Source: IRC (2014: 12)

[a] *Externalization* covers the number of firms and *internalization* the number of parts

[b] *Engine parts*: main components, valves, fuel systems, intake and exhaust systems, lubrication and cooling systems, electronic systems, and parts for hybrid and electric engines. *Mechanical organs*: powertrain systems, steering systems, and brake and suspension systems. *Other parts*: wheels, body parts, passenger compartment parts, body electronics parts, and other equipment parts

to those of the Volkswagen Group (even though about 40% of its worldwide sales occur in China), Daimler, BMW, and Hyundai-Kia (the latter even increased its domestic production by more than 800,000 units between 2000 and 2010, from roughly 2.2 to 3 million cars). Conversely, the three American carmakers, the two French carmakers, and Fiat (which acquired 100% of the Chrysler Group in January 2014) have followed the opposite trajectory. In terms of internationalization of Japanese carmakers, Toyota has a better geographic mix than Nissan, Honda, Mazda, and Subaru. Mazda and Subaru missed the wave of internationalization their production bases, with, respectively, 75% and 80% of worldwide production volumes manufactured in Japan in 2014 and, even more importantly, 81% and 71% of their domestically produced vehicles exported. As latecomers in foreign markets, they are hindered not only by the volatility of the exchange rates but also by their weak positions in defining financial and technical rules and standards in the emerging markets. Most of Suzuki's turnover comes from India, thanks to its joint venture with the local carmaker Maruti (roughly 47% of market share in India and 53.3%, 51.3%, and 36.6% of worldwide production, sales, and turnover made in India in FY 2018), while it has a domestic production share of 35%, mainly for the domestic market (only 15% exports). The Japanese carmakers are major players in Southeast Asia and Mexico, but in other emerging markets, such as Brazil, Russia, and India, most of them are in the tier-2 group. Even more worryingly, they lag behind the American and European carmakers in China. While Chinese domestic brands nowadays account for roughly 40% of overall domestic sales, Japanese carmakers' market shares have been continuously decreasing in China since the 2000s. In the 1990s, they exported cars from Japan and held the largest market share in this country until the beginning of the 2000s. The Chinese government then decided to cut these imports and attract FDIs through a policy of joint ventures with domestic makers, which were in favour of Volkswagen and GM.

These evolutions show extremely contrasted trajectories among the seven Japanese carmakers. Besides, their product policies, especially for new energy vehicles and entry segments, are affected by inconsistencies regarding market trends in several countries. As a matter of fact, since the mid-1980s, they have been following internationalization strategies that have had various impacts on their organizations and on domestic labour relations. The following section will be specifically devoted to analysing the changing nature of these inter-firm relationships and their effects on labour relations.

Inter-firm and Labour Relations Under Tension

The historical/institutional legacies of the 1960s and the market evolutions begun in the 1990s highlighted in the previous sections led to specific challenges for Japanese car and parts makers. In Japan, carmakers started early on to outsource a large portion of their R&D and production capabilities (including final assembly), while retaining strong control over their supply chains. The elements that represented the strengths of this industry until the 1980s (manufacturing capabilities and their central role in firm strategies and organization, strong reliance on outsourcing with quasi-vertical integration, labour relations stressing collective working units and standards, and strong reliance on small and medium-sized enterprises [SME]) were not only threatened by the financial crisis of the 1990s but also appeared to act as barriers to more comprehensive development and internationalization.

Relationships between carmakers and suppliers revolved around cooperative patterns not seen in the West, where arm's-length relationships gave primacy to short-term contracts with lower levels of inter-firm cooperation (Asanuma 1989; Sako 1996: 651). In the 1960s and 1970s, the (demand-led) growth regime was a trigger for the outsourcing not only of parts but also of the final assembly of cars. Despite extensive literature emphasizing long-term and trust-based inter-firm relationships, Japanese carmakers have very distinct policies regarding the management of their supply chains. Except for Honda, all carmakers developed suppliers associations (*kyoryokukai*) in order to bring their main suppliers together and cooperate with them. The main characteristics of Toyota's suppliers association are strong geographic agglomeration in the Aichi Prefecture area and a relatively high degree of financial and productive integration (Nakajima 1996), in contrast to what is seen for other carmakers. For instance, Mitsubishi's association is dispersed all over the country and, while around 98% of transactions are carried out within Toyota's association, this figure falls to 31% in the case of Suzuki. Besides, while it was claimed that inter-firm relationships were exclusive (a supplier working for a carmaker was not permitted to have transactions with other carmakers), this peculiarity lost its strength at the end of the 1970s, resulting in greater diversification of supply chains. For instance, more and more tier-1 and tier-2 suppliers became members of several of these associations.

The Polarization of the Supply Chain

Table 8.2 shows the different degrees of productive internalization/externalization. First, the Japanese big three (Toyota, Nissan, and Honda) have a greater degree of both externalization and internalization of parts production. They are especially concerned with keeping a high level of competition among suppliers and of internalization for the production of core parts, that is, those related to the engine and mechanical components. While Toyota, differently from Nissan and Honda, has delegated a great number of production processes to its suppliers, it has also relied on a moderate number of mega-suppliers (domestic average on the three segments, engine parts, mechanical organs, and other parts), most of which are members of its suppliers association. Toyota has also kept a high level of internal production of core elements. In other words, Toyota has developed a competitive regime in which a restricted number of suppliers are not only in competition with one another for the production of similar parts, but also in competition with Toyota's own internal departments. On the other hand, Nissan and Honda rely more heavily on their supply chains, displaying greater externalization capabilities with weaker control over several production processes. In sharp contrast, the other three "volume automakers" (Mitsubishi, Mazda, and Subaru) have very different policies. Mitsubishi and Mazda make use of a high number of suppliers, especially in the Chugoku region (around Hiroshima), and have relatively high levels of internalization of parts production, while Subaru has a smaller panel of suppliers and lower levels of internalization, especially for engine parts. As for the two specialist makers, Daihatsu and Suzuki, their policies are also very different. Daihatsu relies on a smaller panel of suppliers and higher degree of internalization than Suzuki. This is explained by its incorporation into the Toyota Group and the promotion of Toyota's supply management system. Our comparison indicates that Toyota has greater control over its supply chain than the other Japanese carmakers.

The chief peculiarity of the Japanese supply chain is its higher density of SMEs, compared with other developed countries. Few of these SMEs are part of the suppliers associations and, with domestic automobile production and sales stagnating since the mid-2000s, the polarization of the automotive sector has changed cooperation patterns and worsened labour conditions across SMEs. Moreover, regional competition (China, India, and Southeast Asia) put pressure on firms at the bottom of the value chain in the 2000s. While some research emphasizes that smaller suppliers in neighbouring countries have not yet caught up with their Japanese counterparts (Akabane et al. 2018), the regionalization of the Asian automotive supply chain is underway, and Japan is still a central actor (Jetin 2018). In some sectors with lower technological know-how and labour-intensive processes, such as tool-making or wire harnesses, Japanese firms have lost their competitive edge. Table 8.3[13] is an illustration of the changing nature of the wage-labour nexus in the Japanese automotive industry since the mid-2000s.

Between 2004 and 2014, the number of SMEs constantly decreased, while wages stagnated (the yearly average wage in firms with fewer than 500 employees was 3.2 million yen in 2014, almost the same as in 2004). In 2004, SMEs with less than 50 employees accounted for 79.5% of the firms in the industry (6111 firms), and their yearly wages were around 57% of the average wage in the industry. Ten years later, the proportion of these firms declined to 74% (4419 firms, as 1692 firms, 27.7% of the firms in 2004, disappeared), and their yearly wages dropped to 55%. During the same period, however, the share of large firms (more than 1000 employees) and the wages of their employees increased. Moreover, the biggest firms (more than 5000 employees) greatly diminished their efforts in terms of investments (from 8.43 million yen per employee in 2004 to 2.27 in 2014), whereas investment levels remained stable in firms with less than 300 employees and decreased in firms with more than 300 employees (from 4.04 million yen to 1.7 million yen).

Table 8.3 The wage–labour nexus in the Japanese automotive industry (2014)

Firm size	Number of firms	Number of employees	% of total workforce	Average wage*	Added value per employee*	Inv. per employee*
4–9	1852	11,582	1.34	2.8	5.43	n.a.
10–19	1244	17,063	1.98	3.2	6.14	n.a.
20–29	754	18,556	2.15	3.3	6.42	n.a.
30–49	569	22,269	2.58	3.6	7.28	0.54
50–99	625	43,869	5.08	3.7	7.89	0.80
100–199	431	60,032	6.95	4.1	9.58	1.13
200–299	156	38,072	4.41	4.6	9.75	1.25
300–499	134	51,794	6.00	5.1	11.77	1.40
500–999	103	73,940	8.56	5.2	10.92	1.52
1000–4999	80	149,405	17.30	6.0	14.63	1.66
>5000	23	377,027	43.66	7.2	29.01	2.27
Total	5971	863,609	100.00	5.8	18.86	1.68

Source: Author's calculations based on METI, Census of Enterprises, 2014 (* million yen)

As a consequence, within ten years, the Japanese automotive supply chain evolved in an unprecedented way. The top of the supply chain underwent a process of concentration, while at its bottom the scale of production shrank, with the same constraints for the remaining firms. Large firms were able to reduce their domestic investments, focusing especially on FDIs, whereas the smallest firms, hindered by limited FDIs, had to maintain high investment levels to both meet the cost and quality targets of their Original Equipment Manufacturers (OEM) and cope with international competition. In addition, productivity gains could not be redistributed to their employees. With carmakers and tier-1 suppliers maintaining their policies of cost reductions, the burden at the bottom of the supply chain became even heavier at the start of the twenty-first century. In 2005, when Toyota announced its VI policy,[14] its CEO emphasized that the ongoing quality improvements and cost reductions were targets that had to be pursued by the Japanese industry in the coming years. For what concerns the suppliers, these two targets have extremely different impacts in relation to firm size, portfolio policy, and technological knowledge. The biggest firms can cut costs relatively easily using several approaches, such as externalization of production, specific employment policies, or sale of non-profitable activities. In contrast, reducing costs by 30% in one or three years is an extremely challenging objective for the smallest firms, which heavily rely on one main OEM and have general and hardly transferable technological knowledge. In order to meet the cost targets set by their client firms, most of the remaining SMEs have either built transplants in neighbouring countries or hired foreign workers from China and Southeast Asia under the so-called foreign workers training programme. Created in the 1990s, this programme allows foreigners to enter Japan as trainees for a period of three years. They are supposed to be on-the-job training programme during the first year and to work for an average monthly wage of US$500–750 for the following two years. This peripheral workforce generates new tensions among workers and, although some independent labour unions tackle these issues, their status is weak. Indeed, this situation has tended to worsen overall working conditions in SMEs. Medium-sized companies have been able to maintain their position in Japan thanks to their close relations with OEMs and their strategies regarding diversification of products, markets, and client firms. While in the 1960s and 1970s employment conditions were often better in subcontracting firms, this is no longer the case nowadays. For instance, Toyota's eight contract assemblers (*itaku* makers) paid on average higher wages than Toyota until the second half of the 1970s, and employment length was longer than at Toyota until the mid-1990s (Kikuchi 2016: 178–183). As a matter of fact, competitive intensity became stronger at the bottom of the supply chain and economic inequalities increased among big and small firms alike.

The Evolution and Persistence of the Wage-Labour Nexus

Another legacy of the 1960s was the practice of ranking the performance of working units and suppliers as a necessary condition to reduce materials and labour costs and to provide high quality standards. The economic downturn at the beginning of the 1990s affected this compromise, and most Japanese OEMs and mega-suppliers introduced new managerial practices to assess individual performance (Shimizu 2004). At the same time, a dual system of single sourcing of components to tier-1 suppliers and multiple sourcing of other parts (parts ordered involved a division of labour among at least three suppliers) was maintained (Fujimoto 1999: 309–320; Nishiguchi 1994: 19–139). To ensure profitability and keep control over their suppliers, the major Japanese carmakers have internal labour markets (ILMs) extended to a wide range of corporations (Heim 2017a). The transfer of workers (blue and white collars) to tier-1/2 suppliers is still a common practice that enables Japanese carmakers to keep a relatively young workforce and to stimulate competition among employees for higher positions. For instance, in 2014, 39.5% of the 1057 executives of 93 core suppliers and companies affiliated to Toyota had occupied or were occupying positions of responsibility at Toyota, some of them (45) being transfers from Toyota itself. Among these executives, 26% had also worked or were working for other suppliers from the Toyota Group, and 17% had worked or were working both for Toyota and other suppliers (IRC 2014). These figures highlight a specificity of inter-firm relations in the Japanese automotive industry, which does not rely heavily on cross-shared ownership but rather on extended internal labour markets, giving Japanese carmakers a higher degree of flexibility than their Western counterparts and, consequently, a sound competitive advantage. Such a flexible tool is rooted in a specific collective bargaining system that engenders not only profound differences among companies but also inequalities between regular employees and temporary workers, the latter being excluded from unionism.

After three decades of economic recession, the Japanese automotive industry has had to adapt to retain its competitiveness. The common patterns of transactions with suppliers and dealers, as well as the wage-labour nexus, were revisited, so that its strengths (low costs and high standards) could be restored after the losses of the 1990s. These structural changes, which had never been seen before, were rather incremental at the top of the supply chain but deeply affected its bottom. The ongoing concentration at the top of the supply chain is also driven by the latest technological evolutions, which are having a dramatic impact on the worldwide auto industry. Such evolutions are dealt with in the next section.

Technological Changes and Product Policies Uncertainties

The development of alternative propulsion systems (hybrid and fuel-cell vehicles in Japan) and energy policies are two closely intertwined core issues in Japan. Emission regulations, incentives to buy new energy vehicles, and safety regulations, which have gained in popularity in several parts of the world, are disrupting the business models of Japan's carmakers and mega-suppliers. Carmakers used to develop under-body components in-house, which was their core business. Despite the growing outsourcing of several R&D domains since the 2000s, Japanese carmakers (as seen above) have retained control over critical technological developments. For instance, in the Toyota Group, the assembly of mini-cars is completely delegated to Daihatsu. However, the development of models is done jointly, with Toyota's chief project engineers heading the R&D groups. As for the development of batteries, Japanese carmakers have kept in-house battery management systems. They are also concerned with the development of new materials in order to lower the weight of vehicles, and have formed several consortiums to define standards for batteries and charging infrastructures. In other words, they are not willing to lose knowledge in these new technological fields. Yet, they face two main problems.

First, the group-based approach that they have inherited can be a risk when considering the timeframe for the development of new technologies. Two Japanese mega-suppliers, Hitachi Automotive Systems (HAMS) and Denso, are intensively engaged in the field of automatic braking systems. However, HAMS has been able to develop this complex automotive component more quickly than Denso, since it has more flexible and adaptive capabilities and is an independent supplier, while Denso, as part of the Toyota Group, has had to follow stricter bureaucratic rules and accept a clear-cut division of tasks with other firms, which has slowed down the pace of innovation (Lee 2018). External resources in the so-called *keiretsu* can also curb innovation. Second, energy consumption is a critical issue in Japan. According to Smitka, "since 1973 demand led by the transport sector rose 70 per cent and that by the household sector 90 per cent. Together they now account for one-third of energy consumption. Half of that, or one-sixth of Japan's total energy usage, is used to power vehicles" (Smitka 2018: 113). As Japan is highly dependent on energy imports, a national debate is taking place as to whether regulations should favour the use of public transport (far less energy consuming than private transport) or provide incentives to further consolidate the market of battery electric vehicles, or BEVs (with less than 1.5 million cars on the roads in 2018 and high electricity prices). Even if the BEV strategy is preferred, this might not eliminate the problem of energy imports, considering that coal and liquefied natural gas (LNG) imports might replace oil imports, as Smitka rightly argues.

In developing BEVs, Japanese carmakers are now facing challenges that are not only technological but also political. Although Toyota, Honda, and Nissan have invested a lot of money and energy to develop hybrid, fuel-cell, and electric vehicles, a mature market of BEVs is highly improbable in the next two decades. The political compromises that will be found are a core issue for the future of Japanese carmakers and of the overall auto industry.

Conclusions

Since the financial crisis at the beginning of the 1990s, the Japanese automotive industry and its carmakers have had to adapt their productive models inherited from the 1960s and 1970s. While Japan's auto industry is still central in the Asian productive network, its subtle compromise between production outsourcing and carmakers' control over the supply chain has been reshaped. The most competitive firms, both carmakers and mega-suppliers, have reinforced their position as dominant actors. This trend of power concentration at the top of the supply chain has caused severe damage to the smallest firms. The growth disparities triggered by the economic recession of the 1990s have resulted in a less balanced redistribution of the sources of profit, which has caused the population of the smallest and weakest firms to decline. While Japanese auto firms still have competitive strength down to the tier-2 level, the industrial compromise that fostered strong ties and a well-balanced division of labour in the supply chain has clearly been affected. This, in turn, threatens one of the Japanese carmakers' sources of profitability and continuous costs reduction, and also affects their technological development capabilities, as the numerous defect problems encountered by some car and parts makers indicate. In the past, improvements in quality standards were achieved thanks to the involvement of the whole supply chain. This regime of production is still sustainable in firms of the size and importance of Toyota, but the future of the other firms, such as Mazda and Subaru, should undoubtedly be on the policymakers' agenda. Another key aspect regards labour issues in some regions, such as around Hiroshima (highly dependent on Mazda and Mitsubishi), where production downsizing might accelerate in the future.

Besides, as the national population declines, the car market is bound to shrink in the coming decades, and its product mix between internal combustion engines and alternative powertrains will not change drastically. The fact that most Japanese carmakers find it hard to define strategies as transport service providers or to understand market trends in some emerging countries is a sign of their strong reliance on manufacturing capabilities. Yet, the energy policies that will guide the overall Japanese transport system are even more important for the future of the Japanese automotive industry. The dilemma between pursuing the primacy of the collective transport system and favouring a transition towards more fuel-efficient cars is as important as the ability of Japan's core carmakers and suppliers to develop alternative powertrains.

Notes

1. Excluding bus and truck makers, as well as Mitsubishi, which merged with Nissan in 2016.
2. Both Mazda and Nissan faced hard times in the 1990s. Nissan had major financial and profitability problems at the very time when the upper management decided to change its organization (the Nissan Way), which is why it had to sign an Alliance with the French carmaker Renault in 1999 (Heller 2009). Mazda merged with Ford in the first half of the 1990s, but a disinvestment process was initiated by Ford after the 2008 financial crisis.
3. These two management tools also implied other organizational capabilities, such as shorter vehicle development times (Fujimoto 1999: 173–222), the continuous improvement of work standards and processes, and team work.

4. In 1945, there were no more than 111,233 four-wheel cars in Japan and, among them, only 25,533 were private cars, most of them imported (Kamiyama 2016: 34).
5. At present, eight *itaku* makers (Toyota Industries, Kanto Auto Works, Toyota Auto Body, Daihatsu, Hino, Central until 2012 and its merge with two other subsidiaries to give birth to Toyota Motor East Japan, Subaru, and Toyota Kyushu), plus three other affiliated firms (Gifu Auto Body to Toyota Auto Body, Daihatsu Kyushu, and Hino Auto Body), are involved by Toyota in the final assembly of more than half of its domestic production. In comparison, Nissan works with five *itaku* makers, Mitsubishi with two, and Honda, Mazda, and Subaru with one each.
6. Exports volumes first exceeded domestic sales in 1980.
7. In 1985, roughly 3.5 million Japanese cars were sold in the US, and only 1.2 million in Western Europe.
8. In Europe, due to the Block Exemption Regulation of the Treaty of Rome and the more constraining and protectionist policies designed by the European Commission (Pardi 2017), it was harder for the Japanese carmakers to build a dealership network.
9. However, this issue is not specific to Japan, considering that since 2010 more than half of worldwide vehicles production and sales have occurred in the so-called emerging countries.
10. The third main actor in this segment is Honda, with a 15.3% market share during the same period.
11. The topic of the acquisition of Suzuki by Toyota often makes the headlines in specialized newspapers. The main advantage for Toyota would be to gain access to the Indian market, where Suzuki has a strong position thanks to its alliance with Maruti. It is worth remembering that Toyota made early FDIs in India but then sold its stake to Hyundai.
12. In order to compete with GM and VW, Toyota developed a strategy of acquisitions/ventures with Japanese carmakers. In 1967, Daihatsu signed a first partnership with Toyota and was completely acquired by Toyota in September 1998 (51.2% of its shares). Toyota has also been Subaru's first shareholder since March 2006 (16.82% of its capital, 8.7% in 2006), after GM sold its shares in October 2005 (20% of the capital acquired in December 1999). In November 2006, Toyota also acquired 5.9% of Isuzu's capital, currently being its third shareholder (6.34% of shares). In 2017, Toyota acquired a 5% stake in Mazda, and the two companies announced new joint-development projects, especially of electric vehicles.

13. Compared with the same figures in 2004 (Pardi 2011: 135).
14. Since the beginning of the 2000s, Toyota has defined three cost reduction policies for its suppliers. On 21 December 2009, following the subprime crisis, Toyota announced a plan, RRCI, whose target was to reduce the cost of purchased parts by 30% within one year. This followed two previous policies, CCC21 in 2000 and VI in 2005, with respective cost reduction targets of 30% within three years and 30% within one year.

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Part II

Making It to the Top: Failing from the Top

9

Catch-up to Lead in Korea's Automobile Industry

young-suk Hyun

Introduction

Korea's Automobile Industry

Korea has been regarded as one of the most rapidly industrialized countries as it has transformed itself completely from an agricultural to economic-based country, which makes it one of the leading G-20 countries since 1960s. Korea has shown rapid progress in semiconductors, mobile phones, LCD, shipbuilding, and the automobile industry. Korea jumped to the 10th gross domestic product (GDP) country in 2005 and reached 12th place in 2017. Korea's automobile industry has transformed itself from foreign car assembling in the mid-1970s to the fifth automobile producer in 1995 and it has maintained this ranking till 2015.

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At the firm level, Hyundai Motor, founded in December 1967, shows a typical example of rapid catch-up in the automobile industry. Hyundai and Kia Motor showed transit from catch-up to lead as fifth producer to sell 8.0 million vehicles, in 2014 and 2015, respectively. As a consequence, it increased the world market share from 5.9% in 2007 to 7.9% in 2015.

Catch-up, Post Catch-up, and Lead

The national patterns of technology development in developing countries can be classified as four types; imitative learning, technological self-reliance, technology dependency, and laissez faire. Korea selected the imitative learning type at the initial stage of industrialization in 1960s (Lee et al. 1988). This government policy has forced private firms to catch up with global leaders. At the initiation stage, Korean firms usually acquired the most current technologies from advanced countries through non-formal channels[1] of technology transfer. But at the internalization state, it began to acquire relatively new technologies through formal channels.

The catch-up process might be one of most important issues for late entrants to be independent at the firm level as well as at the national level. As a consequence, catch-up has been one of the most interesting research topics. Franco Malerba (2004) explained the process, speed, and performance of catch-up by sectoral systems of innovation (SSI) theory. He suggested that the following factors influence the catch-up performance of a nation: (1) knowledge, learning process, and technologies, (2) actors and networks, (3) institutions, (4) demand. The SSI model can be plotted as a following catch-up function (Fig. 9.1).

In the rapid industrializing countries, the concept of "post catch up" was used to explain the catch-up and overpass of established leader by new entrants. "Path creation", "post catch up" means the beginning process of leading (Lee et al. 2005).

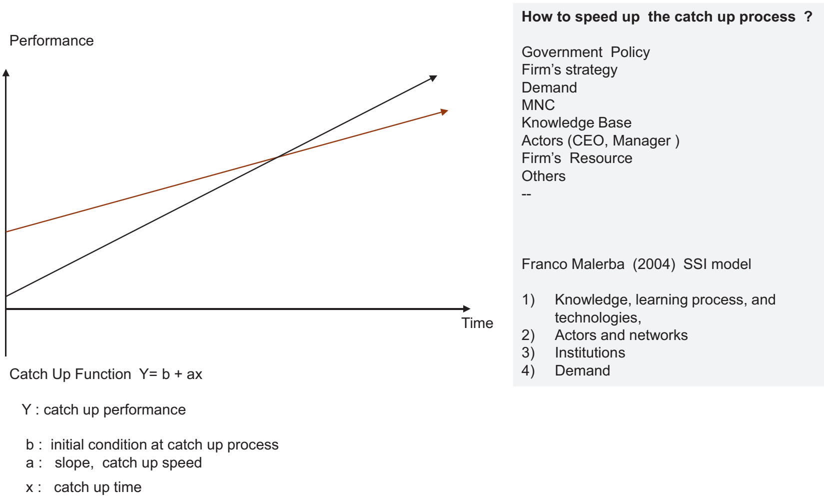

Fig. 9.1 Catch-up function. Source: Plotted by author based on Franco Malerba (2004)

Rapid Catch-up in Korea's Automobile Industry

New Entrance to the Automobile Industry

Developing countries have witnessed many trials when developing the automobile industry, for example, low-cost vehicle plan for Asian and Pacific countries in the 1960s, but they ended in failure. UNIDO (1984) and the UN (1983) paid great attention to Korea, pointing out that it selected a unique strategy in the automobile industry among developing countries. UNIDO also worried that "the Korean example remains of great importance, if this project fails, then there will be no case in the Third World of a producer trying to go it alone".

Korea is a unique case to select revolutionary path in the automobile industry after World War II. Korea was minimal in automobile production, only 123 thousand units in the 1980s but it became the fifth automobile-producing country in 1995. It has maintained this rank to produce 4.5 million vehicles in 2015. However, the Korean automobile industry has dropped down to six place in 2016, 2017.

Table 9.1 Production of automobile in catch-up countries (1000 unit)

Year	Korea	Spain	Brazil	Mexico	China	India
1965	–[a]	229	185	97	–	–
1970	29	536	416	193	–	–
1975	36	814	930	361	137	–
1980	123	1182	1165	490	217	113
1985	378	1418	967	398	363	230
1990	1321	2053	914	820	470	364
1995	2526	2333	1630	929	981	631
2000	3114	3033	1670	1917	2222	801
2005	3699	2752	2493	1682	5718	1642
2010	4271	2387	3646	2345	18,264	3557
2015	4555	2729	2453	3565	24,213	4125
2017	4114	2848	2699	4069	28,459	4779

Source: Based on Hyun (Hyundai Speed Management, 2013: p. 89) and KAMA (2009, 2013, 2014, 2017) Korean Automobile Industry, http://www.kama.or.kr/jsp/common/FileDown.jsp

[a]Below 500 unit

A Different Approach to Catch-up

Mukherjee and Sastry (1996) have compared the development of Korea with China, India, and Brazil, and found that "[t]he Korea's automobile industry, as a later entrant than Brazil, has progressed much further". In 1980 the total production of Korea's automobile industry was only 123 thousand to compare Spain and Brazil producing over one million vehicles. But Korea's production jumped to 4.5 million, far ahead of Spain (2.7 million) and Brazil (2.4 million) in 2015. Government support and a clear vision to have an independent automobile industry, in addition to corporate aggressive strategy, have led Korea to be the fifth automobile producing country in 1995. In contrast, Brazilian automobile makers have assembled foreign-model cars by 2000. China and India might be other cases as they have increased production based on their huge domestic demand after the late 1990s (Table 9.1).

The Catch-up Process of Korea's Automobile Industry

The world automobile industry has been under an oligopolistic market by established policy makers of advanced countries, but the established makers prefer to transfer production technology rather than product technology to other countries. The product technology is essential for catch-up makers to be the independent maker in the long run. But how to get competitive product technologies has been regarded as the most critical dilemma in the catch-up process. In addition, how to escape from the vicious circle—small market → small production → high price → small market—is another critical dilemma as the scale is very important in the automobile industry. New entrant should catch up to leaders in production volume as well as in technologies.

The development process of Korea's automobile industry can be divided as follows on the basis of the framework in the global perspective model by Lee et al. (1988): assembly stage (1962–1974), internalized production stage (1975–1990), generation stage (1991–1999), and leading stage (2010–present) (Table 9.2).

Rapid Catch-up at Hyundai and Kia Motor

Korean Manufacturers

There are five major car manufacturers in Korea. Hyundai and Kia Motor are under the control of local capital but Korea GM, Renault, and Ssangyong Motor are under foreign capital, GM (USA), Renault (France), and Mahindra (India), respectively, as of 2017. Hyundai Motor merged with Kia Motor in 2000. Hyundai and Kia dominated production, domestic sales, and export as leading firms. There are two other makers, Tata and Daewoo Bus, producing commercial vehicle (Table 9.3).

Korea's automobile production industry was only 123 thousand units in 1980 but it increased to 1.3 million in 1990, 3.1 million in 2000, and 4.5 million in 2015. It has increased its production rapidly by way of export since it entered the American market in 1986. This production output implies the rapid catch-up of Korea's automobile industry at the national level (Table 9.4).

Rapid Catch-Up

As the indicator of catch-up performance, technical and market performance can be used.

Table 9.2 Development process in the Korean automobile industry

Dev. stage	Assembly stage		Internalized production stage		Generation stage	Leading stage
Features	KD assembly ('62–'67)	Localization take-off ('68–'74)	Early production ('75–'81)	Late production ('82–'90)	Generation of Technology ('91–'09)	World leader ('10–
Character	SKD	CKD	Local model	Innovate of local model	Engine Design	New Dominant Design
Product	Japanese models	US, European models	Mass prod.	F-F model. Dev.	Indigenous model Dev.	Electric car, smart car
Local ratio (%)	21	30	85	97	100	100
Source of technology	Knockdown parts	Tech. Import (TI) Joint Venture (JV)	TI JV	TI,JV Export market in-house R&D	In-house R&D, TI	In-house and open innovation
Major acquired technology	Assembly, operation	Inspection, Production. management	New model QC EEC test	Mass prod. F-F design FMVSS test	Engine tech Design tech	Electric Smart car
No. of technology import	5	17	47	123	NA	NA

Source: Based on Hyun (1988) PhD Dissertation KAIST

Note: (1) SKD: Semi-Knock Down, CKD: Complete Knock Down. (2) F-F: Front-wheel Front drive car. (3) For passenger cars only in the starting year of each stage except for 21% in 1966. (4) FMVSS: Federal Motor Vehicle Safety Standard. (5) TI: Technology Import (6) JV: Joint Venture

Table 9.3 Korea's car makers (2017)

	Hyundai Motor	Kia Motor	Korea GM	Renault Samsung	Ssangyong Motor
Foundation	1967	1944	2002	2000	1954
Major holder of capital	Local	Hyundai Motor	GM	Renault	Mahindra
No. of employees	68,590	34,720	15,663	4254	4911
Production (1000)	1652	1523	519	264	145
Domestic sales (1000)	689	523	132	101	107
Export (1000)	964	959	392	176	37
Overseas plant	US, China, India, Turkey, Chez, Russia, Brazil	China, Slovakia, US, Mexico			
Overseas production (1000)	2838	1205			

Source: Kama (2017), Korean Automobile Industry, p. 10. http://www.kama.or.kr/jsp/common/FileDown.jsp

Table 9.4 Automobile production and export of Korea

Year	Production	Domestic sales	Export	Export/production (%)	Remarks
1970	28,819	22,442	0	0	
1975	37,179	36,076	0	0	
1980	123,118	102,750	25,252	20.5	
1985	378,099	237,054	123,107	32.5	'84 enter Canada
1990	1,320,949	951,419	346,975	72.0	'86 enter US.
1995	2,628,835	1,552,496	1,088,061	41.4	
2000	3,114,000	1,434,000	1.668,000	53.6	
2003	3,117,870	1,318,312	1,814,938	58.2	
2005	3,699,350	1,173,438	2,586,088	69.9	
2010	4,271,747	1,465,426	2,772,107	64.9	
2015	4,555,957	1,589,393	2,974,114	65.2	
2017	4,114,913	1,560,202	2,530,194	61.5	

Source: KAMA (2009, 2013, 2014, 2017), Korean Automobile Industry, http://www.kama.or.kr/jsp/common/FileDown.jsp

Technical Performance

The Catch-up Process

Product technology is critically important in the automobile industry as it could be used as one of the meaningful indicators to measure the level of catch-up. The technology in power train (engine and transmission) has been regarded as the last hurdle in catch-up technologies. The following figure shows that it takes 26 years for Hyundai to be independent in power train technology. It could have designed its own power train in 1994 since the simple assembly of the Ford car in 1968. Thirty years have passed for Hyundai to catch-up the engine design technology as Hyundai could export its own designed "Theta engine" to Mitsubishi and Chrysler in 2004, exactly 30 years after the import of engine technologies from Mitsubishi Motor in 1974 (Fig. 9.2).

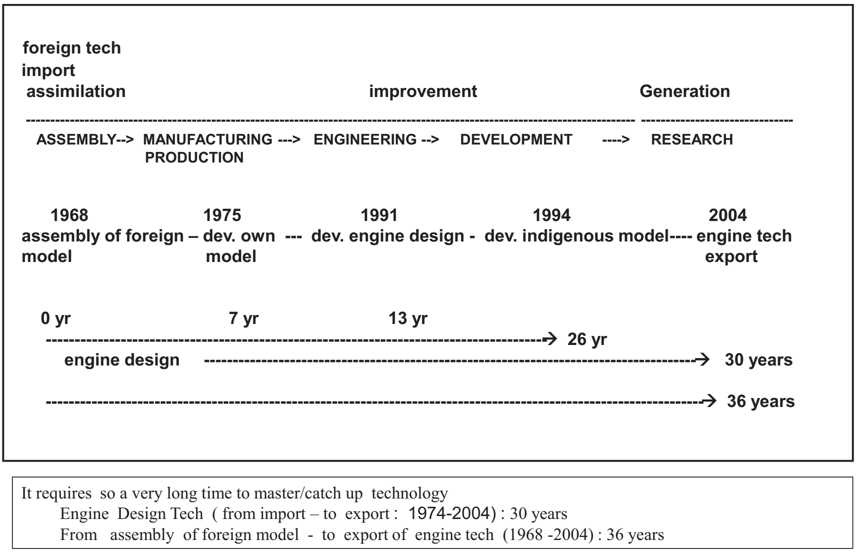

Fig. 9.2 Catch-up to lead in technology at Hyundai. Source: Hyun (2013)

Product Technology

Hyundai finally selected the strategy "to go it alone" and tried to acquire the necessary technologies by licensing rather than joint venture. Hyundai decided to develop its indigenous model "Pony" in 1974, and it succeeded in developing the first local model "Pony" in 1976 in compliance with government policy. Over the next ten years, the "Pony" would prove to be a smashing success, catapulting Hyundai to the status of market leaders in the 1970s. It was followed by other successful new models: Excel (1985), Sonata (1986), Grandeur (1986), Santa-Fe (2000), Tucson (2004), and Genesis (2008). Hyundai also introduced electric vehicle (EV), IONIQ EV (2016), and KONA EV (2018) and the world's first fuel-cell electric vehicle (FCEV), Tucson FVEV in 2014 and NEXO FCEV in 2018. Hyundai's triumph to win "Genesis" and Elantra as "The Car of the Year in North America in 2009 and 2011, respectively", and the "Tau" Hyundai's engine to win one of ten best engines in 2009 in North America could indicate that it had passed the final stage of catch-up and took its place on the leading stage in 2010.

Production Technology

The quality of the product could be the performance of process technology in the automobile industry. The rapid improvement in Initial Quality Study (IQS) of Hyundai shows its rapid catch-up in production (process) technology. Hyundai could catch up to Toyota in IQS in 2004 and 2006, which might be a very concrete stepping stone for Hyundai to be more competitive in the international market place. This might show the speed of Hyundai in process (production) technology. Hyundai and Kia has co-evolved in quality improvement as Kia has jumped to the first rank in IQS by JD Power data, Hyundai has also ranked sixth in 2017.

Patent

Mitsubishi Motor was the major technology source of Hyundai in the 1970s and 1980s. But the study by Oh and Joo (2015) showed that Hyundai outperformed Mitsubishi in a number of granted patents in the US from 2000

Table 9.5 Number of granted patent in the US of Hyundai and Mitsubishi motor

	1990–1999 (A)	2000–2009 (B)	B/A remark (%)
Hyundai	453	1527	237
Mitsubishi	458	407	−11.1

Source: Oh and Joo (2015)

to 2009. The number of patents at Hyundai and Mitsubishi was 453 and 458, respectively, in the 1990s. However, Hyundai's patents reached 1527, compared with Mitsubishi's 407 in the 2000s. This data indirectly shows the aggressive technological efforts of Hyundai in the 2000s. In addition, this recent report also shows that Hyundai has continued to be aggressive in patent activities. Thompson Reuter IP & Science data showed the total number of patents, Toyota 7000, Bosch 5900, Hyundai 4800 for 2009–2013 (MK News, January 26, 2015) (Table 9.5).

Market Performance

Hyundai became the market leader in the domestic market after it succeeded in the development of the first local model "Pony" in 1975. Without Kia merging with Hyundai in 2000, Hyundai's production share would have passed over 50% in the 1980s (Table 9.6).

Hyundai and Kia have joined the fifth automobile industry in 2009 and have maintained this rank up to 2017. Hyundai and Kia dominated domestic production and the market place since the mid-1970s. Hyundai and Kia produced 3175 thousand vehicles, 77% in Korean plants, beside the 4044 thousand of overseas production in 2017. Total production of Hyundai and Kia reached 7,988,469 units (domestic 3,576,852, overseas 4,411,617) in 2015 and 7,218,391 (domestic 3,174,230, overseas 4,944,161) in 2017. Overseas production of Hyundai and Kia passed domestic production in 2013.

Corporate Brand Value

Theoretically, the quality improvement of a product could induce the increase in corporate brand value and profit, as Aaker's hypothesis suggests. In fact, the IQS jump in 2004 has led to an increase in brand value

Table 9.6 Production of Hyundai and Daewoo Motor

	Local firm Hyundai Motor				GM Joint Venture GM Daewoo			
Year	Car	CV	Total	Production share (%)	Car	CV	Total	Production share (%)
1965	–	–	–		106	0	106	75.2
1970	2356	2004	4360	15.1	9575	6207	15,785	54.8
1975	4722	2370	7092	19.1	2559	5846	8405	22.6
1980	39,701	21,538	61,239	49.7	7500	16,913	24,413	19.8
1985	225,970	14,785	240,755	63.7	36,805	8130	44,935	11.9
1990	557,683	118,384	676,067	51.2	184,795	16,240	201,035	15.2
1995	966,283	288,551	1,254,834	49.7	497,761	22,680	520,441	20.6
2000	997,135	528,032	1,525,167	48.9	600,864	23,670	624,534	20.0
2005	1,233,246	449,174	1,681,420	45.5	632,858	13,752	646,610	17.5
2010	1,063,007	680,368	1,743,375	40.8	727,509	16,585	744,096	17.4
2015	1,119,861	738,534	1,858,395	40.8	305,247	309,561	614,808	13.5
2017	914,125	737,585	1,651,710	40.1	208,089	311,296	519,385	12.6

Source: Based KAMA 2017 Korean Automobile Industry, http://www.kama.or.kr/jsp/common/FileDown.jsp
Note: Hyundai was founded in December 1967
CV: Commercial vehicle (Bus, Truck, and special purpose vehicle)

of Hyundai Motor from 0.02 billion US dollars in 2002 to 5.03 billion dollars in 2010 (65th rank among the World 100) and to 13.1 billion dollars (35th rank in 2017). Hyundai has become sixth among automobile makers in 2017. As a consequence, Aaker's hypothesis can be supported in the Hyundai Motor case. The increase of brand value based on product as well as production technology enabled Hyundai and Kia to maintain the position of world's fifth automobile producer in the 2010s (Table 9.7).

Government Policy

"Challenges and Response" and "Stimulus and Innovation" paradigm can explain the rapid development of Korea's automobile industry. The critical dilemma was how to get product technology, most of which were at the hands of multinational corporations. But multinational corporations do not usually transfer product technology. Linsu Kim (1997) explained that "Imitation to Innovation" process could get over this dilemma through the dynamics of technological learning.

Table 9.7 Corporate brand value of Hyundai Motor

Year	Rank among World 100	Brand value ($US billion)
2002	–	0.02
2003	–	1.26
2005	64	3.48
2006	75	4.08
2007	72	4.45
2008	72	4.84
2009	69	4.60
2010	65	5.03
2011	61	6.00
2012	53	7.55
2013	43	9.00
2014	40	10.4
2015	39	11.3
2016	35	12.5
2017	35	13.1

Data: Interbrand and Hyundai Motor, http://interbrand.com/best-brands/best-global-brands/2017/ranking/

Competition Policy

Accordingly, the government permitted the entry of Hyundai Motor and Asia Motor into automobile industry in the late 1960s. This policy aimed to promote the localization ratio of the automobile. The immediate participation of Kia Motor led to competition among four car makers. However, the merger between Asia Motor and Kia Motor led to competition among Hyundai Motor, Kia Motor, and Daewoo Motor in the late 1970s.

Owing to the precedents of Taiwan, Brazil, and Mexico which started the automobile industry at the similar level of income, many differences can be found in the industrial structure. Taiwan forwarded the unification policy establishing and rearing Yulon Motor in 1953. Taiwan, however, allowed the entries as of 1960 which consequently led to five automobile makers' competition in the 1960s. Further, Taiwan was flooded with 12 automobile makers in 1996 after the constant entries of OEMs in the 1970s and 1980s. Brazil and Mexico, which started the automobile industry since the World War, were teeming with more than ten car makers since the initial stage of introduction. This might show the importance of the industry structure and the suitable number of firms in the automobile industry.

MNC Involvement

It was fortunate that multinational automobile makers had little interest in Korea due to its small domestic market in the 1970s, which led the Korean automobile industry to be independent. When Toyota pulled out of Korea to enter China politically, it led GM to make a 50:50 joint venture with Korean automobile producer Shinjin Motor in 1972. Hyundai, at that time in the infant stages, was pushed desperately as it had to compete with the GM joint venture. Three years of negotiation with Ford of Hyundai Motor in trying to establish a similar joint venture or partnership failed—mainly because of Hyundai's insistence on being *in* managerial control of the joint venture. Since then, Hyundai has maintained the independence in managerial control far after the merger of Kia Motor in 2000.

Technology Policy

The mode of technology transfer in Korea's automobile industry is quite different from that of other countries. For 31 years (1962–1993), Korea showed different patterns from other countries in FDI (foreign direct investment), licensing, and import as the way of technology import: FDI 11,208, technology licensing (technology import) 7906, capital goods import 278,758 million US dollars. Korea promoted and absorbed foreign technologies through the procurement of capital goods as its amount is 16 times of the FDI and licensing (Kim 1997). As the shortage of US dollar, Korea's government has strictly controlled the technology licensing. As a consequence, Korean firms were forced to acquire technologies mostly by reverse engineering.

Firm's Strategy

R&D Strategy

The major source of bargaining power that enabled Hyundai Motor to be self-reliant originated from its indigenous R&D efforts to develop local models in the 1970s. This led Hyundai to develop "Excel", a front-wheel-drive car and finally succeeded in exporting this car to US market in 1986. Most local party joint ventures could not escape from the hands of established foreign automobile makers as it is usually rather dependent on them to figure out even the trifle technical problems instead of solving the problems by itself. The external stimulus from the export market to meet customer demand in competition with established automobile makers was another critical motivation for Hyundai in the 1990s.

The R&D efforts in the 1980s built the stepping stone to develop the first indigenous Korean Engine model "Alpha engine", which appeared in 1991. It was the result of Hyundai's effort at the Mabuk-ri Research Center to invest 100 million US dollars over 5.5 years. The success of the alpha engine led Hyundai to develop other engines in succession: the Beta, Gamma, Theta, and Tau engines. The technology of the theta engine was exported to Chrysler and Mitsubishi for 5.7 million US dollars in 2004. The Tau engine, 3-liter large engine, earned one of the best 10 engines prizes in the US in 2009.

Hyundai Motor has expanded R&D investment to 6%–7% of sales to accelerate the development of core technologies in the late 1990s. The R&D investment reached 625 million US dollars (500 billion won) in 1995, 1.5 billion US dollars (1200 billion won) in 2000, 5 billion US dollars in 2015. The number of R&D was 3800 persons or nearly 10% of total employees in 1994 and that number has increased to 7500 in 2005, and 15,000 in 2015. In addition, the technological challenges from the US market led Hyundai to establish overseas research centers: American Technical Center in California in 1985, Design Center at California in 1990, Technical Research Center in Germany and Japan in 1994. Kia Motor also established a technical research center in Detroit in 1989 and Design Studio at Los Angeles in 1991. The total number of R&D centers increased to 13 in six countries in 2017 (Table 9.8).

Marketing Strategy

The relatively small size of the domestic market has forced Korea to export automobiles at the early stage as scale economy is critically important in the automobile industry. The export-oriented policy has led Korea to be a major automobile exporting country. It exported nearly 3.0 million vehicles in 2015. The export to the US market has accelerated the rapid increase of export since 1986 and over 70% of production was targeted to export in the 1990s but the ratio of export decreased with the increase of overseas production. The large demand from the export market enabled Hyundai to be more profitable in terms of the scale economy.

Beside production, the marketing channel was essential to Korean automobile makers. Hyundai established dealers in North America in the mid-1980s. Kia Motor also established its independent marketing channels in the US in the early 1990s. Kia was not satisfied with the alliance

Table 9.8 Number of R&D personnel in Hyundai Motor

	Year									
	1975	1980	1985	1990	1993	1995	2000	2005	2008	2015
No. of R&D persons	197	422	1422	3418	3800	4200	5000	7500	8000	15000

Source: Hyun (2013) and Hyundai internal data

Table 9.9 Overseas production of Hyundai and Kia Motor

Maker	Plant	2010	2015	2017
Hyundai	India	600,480	645,012	678,017
	China	704,441	1,082,552	827,941
	USA	300,500	384,519	328,400
	Turkey	77,000	226,500	227,000
	Chez	200,088	346,349	361,030
	Russia	217	229,500	233,500
	Brazil	–	175,002	182,773
Kia	China	338,866	615,100	354,507
	Slovakia	229,505	338,020	335,600
	USA	153,665	369,063	293,793
	Mexico	–	–	221,500
Total		2,604,762	4,411,617	4,044,151

Data: Kama (2017), Korean Automobile Industry, p. 58, http://www.kama.or.kr/jsp/common/FileDown.jsp

with Ford related to marketing challenges in the 1980s. The independent dealer system of Hyundai and Kia enabled them to increase market shares in the US market from 3.8% (2002) to 7.7% (2010) and 8.0% (2015). Hyundai and Kia expanded their overseas plants not only in developed countries but also in developing countries. Overseas production of Hyundai and Kia had reached 2.6 million (2010) and 4.4 million (2015) (Table 9.9).

Actors

CEOs

The most important actor is the CEO in the automobile industry. At the First Stage in 1967, the founder of the Hyundai Business Group, Chung Jug young decided to enter into the automobile industry business from nothing to something based on his previous experience in automobile after his service business in the 1940s. As the chairman of the Hyundai Business Group, the largest business group, Chaebol, along with Samsung, he has induced the aggressive decisions to "Go it alone" as the basic stone of self-reliance strategy of Hyundai Motor. He has been regarded as one of the most risk-taking entrepreneurs in

Korea. He took risk to build industrial bases in heavy industry, including automobile, shipbuilding, construction, electronics, and so on.

At the Second Stage (1970–1999), the younger brother of the founder, Chung Se-young, maintained the independent management control and made daunting decisions since 1967. He decided to develop the first indigenous model "Pony" in 1974 and selected "Go it alone" strategy in the 1980s to develop "Excel" in 1982 and to enter the US market. He also made very daunting decisions to build its first overseas plant in Quebec, Canada in 1988. His leadership in aggressive R&D led to the success in the development of indigenous alpha engine in 1991. He also initiated the aggressive globalization to build a plant in Turkey and India in the 1990s. He had no other way to accelerate the catch-up as Hyundai's cars had to be more competitive with the cars of the established automobile producers in Japan, US, and Europe.

At the Third Stage (2000—present), Chung Mong-Koo, son of the founder, became the CEO of Hyundai, after merging with Kia Motor in 2000. From the start, the chairman of Hyundai-Kia Motor had to deal with serious quality problems, particularly in the US market, which forced him to concentrate more on quality management. All his efforts, with previous experiences in the automobile service, as the president of Hyundai Motor service company since the 1970s, led him and Hyundai Motor to the quality triumph in Initial Quality Study (IQS) to catch up Toyota in IQS in 2004, and 2006 as aforementioned. He was also aggressive in new product development of the Santa-Fe, Grandeur, Genesis, first premium sedan of Hyundai, as well as building overseas plants in China, India (second plant), USA, Slovakia, Czech, Russia, and Brazil.

He created the word "Hyundai Speed" in the rapid process to build Hyundai Beijing Plant in China in 2002. The old plant in Beijing, which has produced light trucks, was renovated to produce 300,000 cars annually within 10 months. Chinese people named it "Hyundai Speed" due to its amazingly rapid speed. Hyundai Motor, as the late entrant to China, should catch up to the production volume of its existing competitors. This speed catch-up led Hyundai-Kia to be second market leader among foreign makers in the Chinese market in 2009. Under his leadership Kia Motor merged with Hyundai, and the domestic market share of these two companies reached 75% in 2009.

The CEO of Hyundai Motor demonstrated the typical mode of risk-taking entrepreneurship in Korea as well as in the world. The speedy and daunting decisions made by the Chung's family, enabled Hyundai-Kia to be the fifth automobile producer by way of the rapid catch-up process. The base of Hyundai Business Group is construction business, Hyundai Construction Company, as a consequence, the corporate culture of Hyundai Motor can be characterized by the efficient management of time and cost project management. This corporate culture led the acceleration of catch-up at Hyundai Motor as shown in "Hyundai Speed" in China.

Engineers and Managers

The engineer and the manager might be important actors in the catch-up process along with the CEO. But, the "Constructed Crisis" by the government to export cars from nothing to something in the mid-1970s pushed engineers to a life-and-death struggle in the catch-up process. They have to desperately concentrate on catching up the technological capability to develop a local model in the mid-1970s from nothing to something. As Korea and Hyundai Motor selected technology licensing rather than Foreign Direct Investment (FDI) as of limited foreign currency, engineers should catch up technological capability by way of rapid assimilation, improvement, and generation.

The external stimulus and challenges from the international market in the mid-1980s pushed engineers and managers to be more aggressive in the catch-up of technology and management, which led to "Imitation to Innovation" and the "Catch up to lead". One Japanese scholar commented in the early 1980s that "Korean engineers seem to have sponge-like in absorbing capability". Korean's hard work led to the dynamics of technological learning, which has led to the steep of slope (a) in the catch-up function of $Y = b + aX$.

Hard Working Spirit

Korean workers, managers, and engineers have worked hard to get over the crisis constructed by the government to develop a local model in the mid-1970s and to meet the demand for international market survival.

They had to meet the challenges by way of a "life or death struggle". We can raise one question. Why do Koreans work so hard? There are at least five situational factors (Kim 1997): (1) The national trait of tenacity that comes from Korea's geographical location, learning to survive between China and Japan. (2) '*Han*' psyche that comes from overcoming absolute poverty and frustration after independence from the Japanese colonization in 1945. It also comes from the poverty and desperation after the Korean War in 1950. (3) Korean's hard working ethic is the result of conditioning during school days to pass the difficulty examination to enter a good university. In Korea, a graduate from a well-known university usually guarantees a bright future. (4) The physical environments of the nation: a small country with 50 million people. (5) "Beat Japan: spirit" to get over past colonized period, 1910–1945, in addition to the experience of deprivation from Japan's colonization.

Firm's Resources

Hyundai Business Group has maintained the first- or second-largest economic power along with Samsung Business Group in Korea since the 1960s. Hyundai Business Group, founded in the mid-1940s, has operated in the areas of construction, shipbuilding, international trade, electronics, heavy industry, business, and so on. Hyundai Motor, founded in 1967, was strongly supported by Hyundai Business Group in finance, human resources, government relations, and so on.

Hyundai Motor Group, separated from Hyundai Business Group in 2000 to specialize in the automobile industry business, diversified its business lines to automobile parts, steel making, financing, rolling stock, and construction to control over 30 affiliated firms in 2009, which were increased to 64 in 2013. By contrast, after separation, total revenues of the Hyundai Motor Group have progressed rapidly to exceed 234 billion US dollars in 2017. The total profit reached 13.0 billion dollars, and the number of employees increased to 277,558 in 2017. The automobile industry occupied 52%, automobile parts 22%, steel 7%, construction 7%, finance 4%, and others 8% of the total revenues of Hyundai Motor Group in 2017. About 61% and 19% of total employees at Hyundai Motor Group are working at automobile industry and the automobile parts industry.

The tangible assets of Hyundai Motor Group could actualize “Hyundai Speed” and Hyundai Culture”. This is a good case to show the catch-up speed of Hyundai Motor. This kind of integrated support enabled Hyundai Motor to be more aggressive in globalization in the 2000s.

Knowledge Base

R&D: Industry Cooperation

The Korean government has initiated government research institute (GRI) R&D and university R&Ds. The government tried to supply basic science and technology as well as well-trained research personnel by establishing KIST (Korea Institute of Science and Technology) and KAIST (Korea Advanced Institute of Science and Technology) in the 1960s to support industry R&D. In the 1990s, the government initiated a large-scale R&D project which lasted for ten years under the name “G-7 Next Generation Vehicle Research Project (it was renamed ‘HAN Project’)” aiming to upgrade the technology level of the Korean automobile industry to the level of 5 advanced nations by early 2000s.

All resources, researchers from industry, university, government research institute (GRI) were mobilized to develop technology for the next generation vehicle. The large research fund of 323 million US dollars (151 million dollars from the government, and 172 million dollars from private sources) was invested to develop new technologies (31 projects for low emission, 29 projects for safety, and 29 for electric car). In total, 2991 persons participated in this project and this research produced 1082 patents.

In 2002, after finishing a large-scale research project, the Korean government initiated another 10-year research project for the automobile industry to invest 400 million US dollars with a similar resource base in 2002. In addition, the Korean government initiated another 10-year research project to invest 700 million US dollars (half from government fund, half from private/company sources) for 2004–2014 to develop “Future car technology for Electric vehicle (EV), Autonomous vehicle (AV)”.

The Korean government also established three regional innovation centers and an industry complex to produce modules by parts makers, where auto parts makers could use preferentially low-priced land and high-cost facility, inspection equipment funded by the government. The Korean government also established a semi-government research institute "Korea Auto Parts Research Institute" to support the technological development of the parts industry in the 1900s. This Institute supports the parts makers by testing, technical assistance, and technical evaluation with advanced facilities and capable technical experts.

Parts Industry

The automobile parts industry was the one of the major engines for the rapid growth of the Korean automobile industry. Famous firms, including Pohang Steel and Iron Company, Samsung Electronics, LG, Hyundai Mobis, have been the strong industrial bases of the Korea's automobile industry.

Challenges Ahead

Miller and Morris (1999) suggested that the next dominant design products can be opened with architectural innovation. Electric vehicle (EV) and the autonomous vehicle (AV) based on digital technology might be the new dominant designs in the future automobile industry. The way digital technologies and new business models are being introduced in the world automobile industry can be plotted as follows in Fig. 9.3. The AV will involve 5 (0–4) steps and the EV will also require 4 or 5 steps. Who will initially reach points (4.4) and (5.4) in the map of the future automobile industry? The senior manager in charge of new product strategy at Mercedes Benz confessed at the international seminar, held in Seoul Korea on May 2015, that it will develop every EVs, hybrid, plug in hybrid, battery electric vehicle, and fuel cell electric vehicle (FCEV) gradually. It might imply that automobile makers cannot assure which EV mode will be the dominant design, particularly between battery electric vehicle and FCEV in the future.

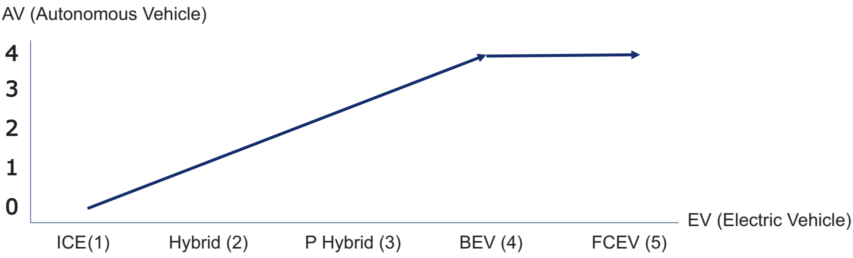

Fig. 9.3 EV and AV Competition Map

The competition in the EV and AV areas is at the beginning stage. Hyundai had initiated a plan to develop fuel cell electric vehicle (FCEV) "Tucson" in 2014, ahead of Toyota "Mirai" in 2015. Among OEMs, the current competitiveness of Hyundai and Kia in AV has been evaluated as above and below the top German makers. The Korean government recently worried that Korea's world automobile makers Hyundai, Kia and world IT makers including Samsung, LG, SK telecom might be the third level in the future automobile industry. In addition, the new business model in the automobile industry including co-sharing initiated by Uber has not so popular so far as local regulations are concerned in Korea. M&A based on aggressive in-house R&D efforts might be the most important measure to meet the uncertainty in the EV and AV competition to be number one.

Who will initially reach the superior position at EV and AV? The earlier, the better, but even the first mover cannot be guaranteed as the final leader as there might be very dynamic competition among traditional automobile makers (Toyota, VW, GM Renault-Nissan, Hyundai-Kia, Ford, Benz, BMW, Honda, Peugeot, etc.) and new entrant IT makers, including Google, Apple, Tesla, Uber.

Nobody knows who will be the leader(s) in future automobile industry among OEM, IT, and start-ups. Nobody knows for sure. Again, full reorientation of the leading technologies and business models is a long process that can take many years before market saturation occurs—that is, the point when everybody who wants an alternative good or service can have it—and new business-balancing act replace entirely the old one (Alex, 2018).

The Impacts of the Current Transformation on Labor

The main impacts on labor brought about by the current transformations of the automobile industry in Korea could be summarized. Within 2018–2025, 17,500 plant workers, 25% of the total current 68,000 workers are estimated to retire but Hyundai Motor is cautious to recruit new workers as the digital technology and automation could enable it to maintain the production demand. In addition, the strong labor union, particularly at Hyundai, seems to be milder as the crisis from the decrease of domestic production demand. Two hundred and four thousand units of production demand have already decreased in 2017 compared with 2011. As aforementioned, overseas production has passed over local production in 2013. The relative high wage and low productivity of unionized workers at Korean automobile plants has been blamed as the increase of overseas production in addition to the rapid increase of imported cars 15% of domestic demand in the 2010s.

The shut-down of the Korea GM Kunsan plant on May 2018, which was built to produce 260 thousand cars annually in 1997, shows another indirect impact of the current transformation on labor. The General Motor's headquarter in US decided to close this less profitable plant producing GM designed Chevrolet brand cars. The decrease of production demands has been decreased from 211 thousand in 2012 but to only 15 thousand as of the GM's retreat of Chevrolet brand from Europe Korea GM shut down Kunsan, one of its three Korean plants and it also laid off 2400 workers including 2000 at the Kunsan plant to make up for the loss from Korea. General Motors has already shut down many overseas plants including an Australian plant in 2013 and an Indonesian plant in 2015 to adapt new transformation initiated by digital technologies.

Conclusion

In this chapter, the performance rapid catch-up in Korea's automobile industry is explained with sectoral systems of innovation (SSI) model of Malerba (2004) with the Hyundai Motor case. In the catch-up function

Y = *b* + *a*X, Y: the catch-up performance in terms of technical as well as market can be explained by fast slope led by the government policy, corporate strategy, demand, least MNC's involvement, knowledge base, actors and other resources. In terms of X time, at the initial stage of catch-up, the government policy was more important but the role of firm becomes more important to survival in international competition at the later stage. Among multiple factors, CEO's role was so critical as a planner as well as an executor of corporate strategy. In addition to motivator to encourage hard working and risk-taking to lead the steeper of catch-up function.

Hyundai has celebrated its 50th anniversary in December 2017. In half a century, Korea's leading maker, Hyundai Motor has succeeded in rapidly catching up to the advanced automobile makers based on the internal combustion engine (ICE) by way of self-reliance strategy. But the self-reliance posture of Hyundai could be a concern as the hurdle for it to make more aggressive alliance and M&A. The current automobile revolution initiated by digital technology could abolish the old routines based on ICE. The EV and AV innovations could lead disruptive innovation rather than sustaining innovation. OEMs as well as IT makers, including Google, Apple, and new start-ups including Tesla, Uber, and so on, are on the dynamic struggle to survival giving more value to customers with smart business models.

The total revenue of the global automobile market has already exceeded 3 trillion US dollars (Covarrubias V. 2018), and the current transformation technology has led to the fusion of automobile and digital industry, which inevitably will hike the sales volume in new business models related to the future automobile industry.

Can Hyundai and Kia Motor maintain the fifth automobile maker status in the future? Hyundai has proclaimed that the more aggressive R&D investment for the EV and AV. Samsung and LG are also aggressive in the EV and AV business by way of a merger of foreign makers. Samsung also merged with the German maker, Harman with 8 billion US dollars in 2017. Korea's government is also aggressive in supporting EV and AV business by way of deregulation and aggressive R&D investments.

The strategic flexibility based on technological capability and financial capability might be the most important weapon to survive in the EV and

AV competition. The competitive strength of Korea's IT and in battery technology for EV is expected to be a strong force in developing new dominant designs in future vehicle. Korea's automobile maker, Hyundai and Kia have to meet new challenges ahead.

Note

1. Technology transfer without paying money for technology by reverse engineering, copy, imitate, etc.

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Who Killed the Australian Automotive Industry: The Employers, Government or Trade Unions?

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Introduction

In all likelihood, the end of Australian automotive manufacturing is imminent. The last remaining producers, Ford, General Motors Holden (GM Holden) and Toyota have announced that they will close their manufacturing operations in Australia in 2016 and 2017. This paper will examine the background to this announcement that will see the cessation of an industry which began in Australia almost 100 years ago. It will analyse the factors involved in the decline of an industry that has played a pivotal role in the development of Australian manufacturing and which became a major source of employment and prosperity.

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During 2013, after Ford's announcement that it would close and when it was becoming increasingly apparent that the days of automotive manufacturing in Australia were numbered, a clear argument gained prominence in the public discourse seeking to apportion blame for the likely confirmation by GM Holden and Toyota that they would close their Australian manufacturing operations. The supposed responsibility of Australia's industrial relations system and, more specifically, the role of unions within it for the industry's demise was a key focus of this argument. For example, soon after GM Holden made its announcement, the Australian Financial Review (2013) published an editorial titled "IR system kills the car industry." This followed the Chief Executive of the Australian Industry Group's claim that the automotive producers were "doing it tough and the unions in particular in some ways are preying on weakness [by] taking advantage of the opportunity to try and gain as much for their members in a very tight time" (Potter 2013). In the lead up to the subsequent announcement of Toyota's closure, Industry Minister Ian Macfarlane implicated unions and the industrial relations system more generally by calling upon "employees on the shop floor to think about their futures and the need for competitive work practices… The unions need to show leadership. The priority should be preservation of jobs, not maintaining archaic conditions in the award" (Massola and Hawthorne 2014).

The objective of this paper is to examine the possible reasons for the automotive companies closing their Australian manufacturing operations including reductions in government assistance to the industry, the volatility in exchange rates, global strategic decisions by the parent companies to shift production to expanding markets in Asia, and the role of trade unions and industrial relations. It will be argued that industrial relations issues have been historically important in the development of the automotive industry. But despite assertions by influential policymakers, business groups and opinion leaders to the contrary, industrial relations played no significant role in the automotive industry's demise. Rather, the decline in the effective rate of protection accompanied by ultimately unsuccessful government assistance packages, the rising value of the Australian dollar, and the difficulties of domestic producers to maintain profitability were the most important factors in the decisions of Ford, GM Holden and Toyota to close their local manufacturing operations.

We examine each of these factors in turn by drawing upon secondary sources and more than seventy-five interviews conducted over several years with key participants in the Australian automotive industry including management personnel, government representatives and union officials. The paper will conclude by considering the possible options for retaining some aspects of local automotive manufacturing in the future.

The Demise of the Australian Automotive Industry

The decisions by Ford, GM Holden and Toyota to close their Australian manufacturing operations followed a marked decline in profit performance dating back to the mid-2000s (see Fig. 10.1). Additionally, a surge in the proportion of the domestic consumer market occupied by imports,

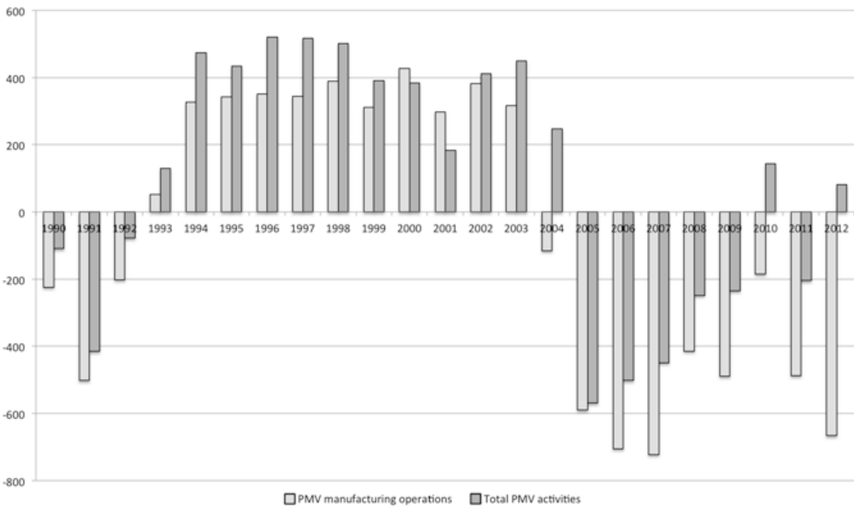

Fig. 10.1 Profit performance of local passenger motor vehicle (PMV) producers, net trading profit (A$M), 1990–2012. Source: Department of Industry (various issues), Key Automotive Statistics, Australian Government: Canberra

Table 10.1 Sales volume of locally produced and imported vehicles by Segmanet, 1992–2012 (selected years)

	1992	1997	2002	2002	2012
Light/small					
Locally produced	61,392	22,348	0	0	28,690
Imports	76,551	205,830	231,178	360,279	360,612
Medium					
Locally produced	65,342	25,698	20,536	26,336	27,230
Imports	20,678	23,441	18,415	66,243	60,444
Large					
Locally produced	125,664	196,717	185,516	124,240	53,642
Imports	6191	2577	2832	15,437	9454
Other[a]					
Locally produced	8022	8906	11,333	6686	1461
Imports	42,587	54,836	70,430	37,798	34,851
Total					
Locally produced	260,420	253,669	217,385	157,262	111,023
Imports	146,007	286,684	322,855	479,757	465,832

Source: Department of Industry (various issues), Key Automotive Statistics, Australian Government: Canberra

[a]"Other" includes upper large, people movers, sports, prestige and luxury vehicles

which increased from 31 per cent of all vehicles sold in 1992 to 81 per cent in 2012 (see Table 10.1), also made it more difficult for the companies to justify maintaining their Australian plants. As their share of the domestic market dwindled, local manufacturers became more reliant on fleet sales but even here they faced difficulties, with the Australian government switching a key fleet vehicles contract from GM Holden to BMW in December 2013 (Kenny 2013). Three factors can explain the declining performance of the local automotive industry. First, the protectionist policies that governments had used to develop the industry in the period between the early twentieth century and the 1970s were abandoned. Despite some evidence of short-term success, the assistance packages introduced in the post-protectionist era to encourage local producers to compete and to modernise their production strategies ultimately failed to deliver sustained performance improvements. Second, fluctuations in the value of the Australian dollar, particularly its sharp appreciation during the mining boom of the mid-2000s and its further rise following the global financial crisis of 2008–2009, increased the relative cost of vehicles produced in Australia thereby eroding the competitiveness of local manufacturers in both domestic and export markets. And third, the strategic decisions of global parent companies also contributed to the difficulties that local producers faced in establishing a presence in export markets. The role of these factors along with industrial relations issues in contributing to the demise of the automotive industry will now be examined.

Tariff Protection and Industry Assistance

The foundations of Australian automotive manufacturing can be traced to the "protectionist settlement" created in the early 1900s, whereby local manufacturers were protected from international competitors through tariffs. Additionally, the significant role in setting wages and conditions through the arbitration system granted unions the capacity to press for higher wages that manufacturing employers could absorb through increased prices with minimal risk of consumers choosing instead to purchase imported products, which were effectively priced out of the local market by high tariffs (Plowman 1992; Conlon and Perkins 2001).

Critics of industry protection argued that it led to inefficiencies and high costs with local manufacturers lacking the incentive to create high quality products and invest in new technology. According to Conlon and Perkins (2001: 2), from its beginnings in the 1920s and expansion in the late 1940s, Australian automotive manufacturing was a "case study in protectionism." Several influential accounts claim that the interdependent nature of policy arrangements underpinning the protectionist settlement meant that the removal of protectionism for manufacturers would expose them to competitive pressures, which would invariably place unions and industrial relations arrangements under strain (Plowman 1992; Kelly 1994).

The long-standing legacy of protectionist policy arrangements together with the absence of government oversight into the managerial decisions of the automotive companies shielded manufacturers and unions from performance-related concerns, which made the industry uncompetitive (Bell 1993). Struggling to compete against higher quality and cheaper imports from Japan and other economies that were rapidly industrialising, several local manufacturers closed and thousands of jobs were lost (Conlon and Perkins 2001). In the early 1970s, the Whitlam Labor government began the process of unwinding the protectionist legacy by reducing tariffs across the board by 25 per cent. The Hawke Labor government (1983–1991), which inherited an automotive manufacturing industry on the verge of collapse, continued this shift away from protectionism through the Passenger Motor Vehicle (PMV) Plan (known colloquially as the “Button Car Plan” after the then Industry Minister Senator John Button) in 1984. The PMV Plan sought to facilitate the reduction in the number of vehicle producers, increase the efficiency of those which remained, reduce tariff protection and abolish import quotas for the industry. Under the umbrella of “the Accord,” a cooperative agreement with the unions to restrain wage and price inflation and facilitate structural economic reform, the Hawke government established broad consensus for these changes between the employers and unions (Wright and Lansbury 2014). While Button saw his main task as weakening the “culture of protectionism” (Leigh 2002: 499), the PMV Plan was able to establish agreement on issues seen as critical to the automotive industry’s future viability such as the upgrading of employee skills linked to wages, export facilitation schemes and increased government grants to enhance research and development (R&D). Despite some shortcomings, the PMV Plan was largely successful in meeting a number of its objectives, such as increased industry productivity and efficiency, lower car prices and greater export capacity among local manufacturers (Sohal et al. 2001: 482–483).

In contrast to the consensus-driven approach of the PMV Plan, the Keating Labor government (1991–1996) pursued a “market driven” approach to reform by exposing the automotive industry more directly to international pressures through sharp reductions in tariffs and introducing a system of enterprise-based collective bargaining as the primary method of determining wages and conditions (Capling and Galligan 1992). Shortly after the commencement of this shift in government policy in 1992, Toyota’s head office in Japan established a new plant in Altona near Melbourne which incorporated “lean production” techniques and aimed to create a “regional manufacturing centre within Toyota’s global manufacturing hub” (Lynch 1996). Fostering cooperative industrial relations with unions was an important part of this strategy. The "partnership" deal entered into with unions led the Australian government to hail Toyota as a model employer (Button 1998; Lansbury et al. 2006). Despite the apparent success of the Altona plant, which contributed to Toyota Australia's relatively strong performance during the 1990s and 2000s, Nissan cited the decline in tariff protection as a key factor for the decision to close its Australian operations in 1992 (Conlon and Perkins 2001: 146).

The Howard Coalition government (1996–2007) continued to reduce tariff protection for the automotive industry but provided some assistance to domestic producers in return for local investment through the Automotive Competitiveness and Investment Scheme (Lansbury et al. 2007: 16). The Howard government also focused on weakening the bargaining power of unions and threatened to withhold industry assistance unless the companies offered more individual statutory employment agreements to their employees. However, when these policies provoked hostility from the manufacturers as well the unions, the government backed down and the automotive industry continued to negotiate wages and conditions through enterprise bargaining (Wright et al. 2011).

The Rudd-Gillard Labor government (2007–2013) also oversaw a lowering of tariff protection on imported vehicles. Consequently by 2010, Australia had the third-lowest tariffs of any major economy with an automotive manufacturing presence (Bracks 2008: 1). Like the Hawke-Keating and Howard governments, the Rudd-Gillard government continued to provide financial support to the automotive industry through a Green Car Innovation Fund established in 2009 which promised A$6.2 billion of assistance to local manufacturers to incorporate environmentally friendly technology and improve fuel efficiency over an eleven-year period, contingent upon complementary investment by the industry. This fund was later reduced due to the government's budgetary difficulties during the global financial crisis and the reallocation of funds to natural disaster relief.

In an attempt to shift the production strategies of local producers from large vehicles towards smaller and more fuel-efficient vehicles in accordance with changing consumer preferences, the government's initiatives prompted commitments from Toyota to produce a hybrid Camry in

Australia, Ford to establish a new engine line, and GM Holden to introduce its Cruze small vehicle. However, these policies appeared to come too late to arrest the declining local market share of the Australian manufacturers. The Rudd-Gillard government presided over the closure of Mitsubishi in 2008, which announced its departure after a long period of poor local sales and export performance, despite financial assistance from Australian governments and its Mitsubishi's parent company in Japan (Wright et al. 2011). Despite increased government assistance, tariff rates during this period declined to their lowest levels in the history of the Australian automotive industry (see Fig. 10.2) and generally were much lower compared to most other countries with large automotive manufacturing industries (see Table 10.2).

After the election of the Liberal-National Coalition in 2013 led by Tony Abbott, who was later replaced as prime minster by Malcolm Turnbull in 2015, the government indicated that there would be no further tariff protection and no increase in direct support for the automotive industry. This was despite the efforts of the Victorian and South Australian state governments to retain vehicle manufacturing and the supplier base. The announcements by Ford, GM Holden and Toyota to close local production directly followed the Abbott government's refusal to commit to continued budgetary assistance, which in 2013–2014 fell to its lowest level in several decades (see Fig. 10.3).

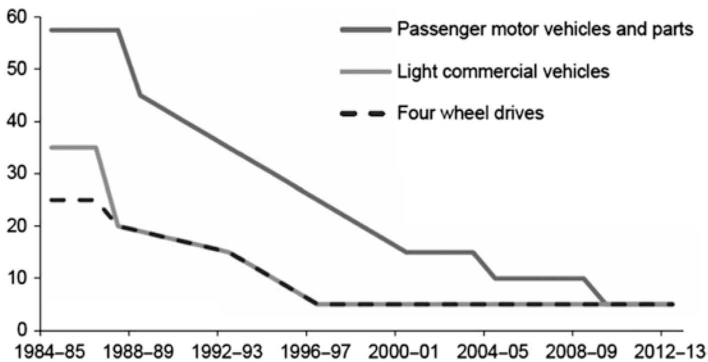

Fig. 10.2 Tariff rates for the Australian automotive industry, 1984–1985 to 2012–2013. Source: Productivity Commission (2014: 108)

Table 10.2 Applied tariff rate in selected countries, 2013

Country or region	Tariff rate on passenger vehicles	Tariff rate on commercial vehicles	Tariff rate on automotive components
Australia	5	5	5
Brazil	35	35	0–18
China	25	6–25	3–25
European Union	10	22	3–4.5
India	60–100	10	10
Japan	0	0	0
Mexico	20	20	0–5
Korea	8	10	8
Thailand	80	40	10,30
United States	2.5	0–25	0–2.5

Source: Productivity Commission (2014: 288)

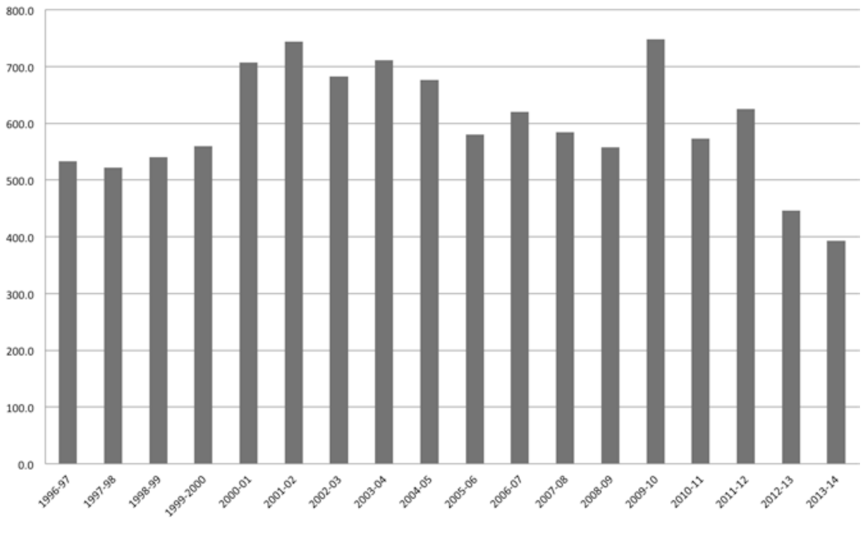

Fig. 10.3 Budgetary assistance to the motor vehicle and parts industry (A$M), 1996–1997 to 2013–2014. Source: Productivity Commission data provided to the authors

In sum, the long legacy of tariff protection produced significant inefficiencies that by the early 1980s had left the Australian automotive industry on the brink of collapse. Subsequent attempts by successive governments to resurrect the industry through a combination of lower tariffs

Table 10.3 Entrants, exits, and new plants established by automotive manufacturers in Australia, 1920–2017

	1920–1947	1948–1963	1964–1974	1975–1983	1984–1998	1999–2017[a]
Entrants	16	18	5	3	2	0
Exits	2	16	9	7	6	4
New plants	16	15	3	0	1	0
Number of plants (end of period)	14	16	12	8	4	0

Source: Fleischmann and Prentice (2001: 354); updated with authors' calculations
[a]Includes the announced exits of Ford, GM Holden and Toyota from Australia automotive manufacturing scheduled for 2016 and 2017

and assistance packages produced short-term improvements in some instances but ultimately failed to improve the long-term viability of the local industry, thereby contributing to its ultimate demise. A telling sign of the failure of government policy is that the number of companies exiting the local industry consistently outstripped the number of new entrants from 1963 onwards, with only one new plant established after 1974 (see Table 10.3). Another indication is the surge in the proportion of the domestic consumer market occupied by imports and the decline or stagnation of local market share among Ford, GM Holden and Toyota in the two decades preceding their announced closures (see Fig. 10.4). However, currency fluctuation is another factor contributing to the decline of the industry that we also need to consider.

Currency Fluctuations

The value of the Australian dollar against the US dollar increased by almost double from A$0.51 to A $0.94 during the mining boom of the mid-2000s. After a short-term plunge in 2008–2009 following the global financial crisis, the dollar increased sharply to a high of $1.09 in 2011—its highest level since the early 1980s when tariffs and other barriers shielded Australian producers from international competition—before

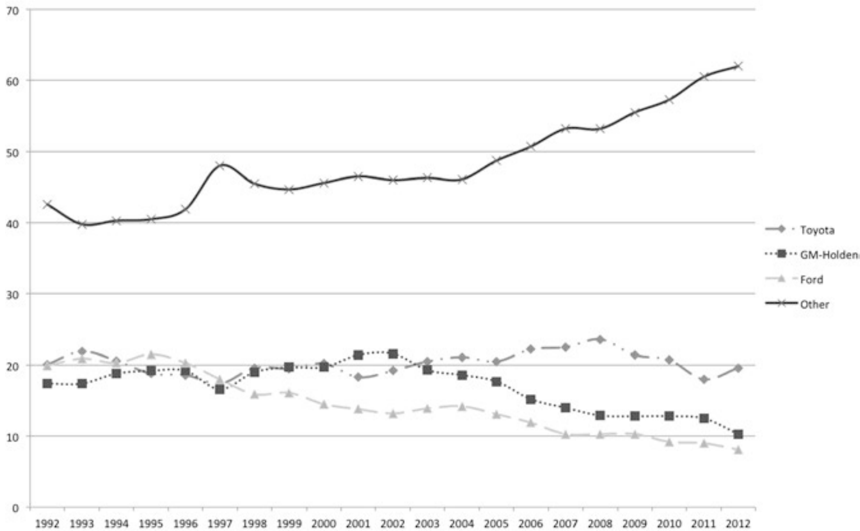

Fig. 10.4 Total Australian market share by manufacturer (per cent), 1992–2012. Source: Department of Industry (various issues), Key Automotive Statistics (Canberra: Australian Government)

steadily declining (see Fig. 10.5). These fluctuations were another factor contributing to falling sales of locally manufactured vehicles. Despite the automotive industry experiencing a decade of profitability from 1993 to 2003 (see Fig. 10.1), the rising Australian dollar from the early 2000s onwards along with increased fuel costs were important factors undermining the international competitiveness of locally produced cars (Bracks 2008: 10), as indicated by declining local and export sales (see Fig. 10.6). Faced with these challenges, the profit performance of the local producers markedly worsened. While the value of the Australian currency declined from 2013 in ways that could be expected to benefit the competitive standing of the local manufacturers, they struggled to overcome the impact of the earlier shocks precipitated by the high dollar. According to an Industry Minister in the Rudd Labor government, the spiralling price of the Australian dollar following the global financial crisis made it very difficult to fulfil policy objectives for assisting local manufacturers to improve "export capacity and global supply chain integration through innovation" (Interview with Industry Minister Kim Carr 2012).

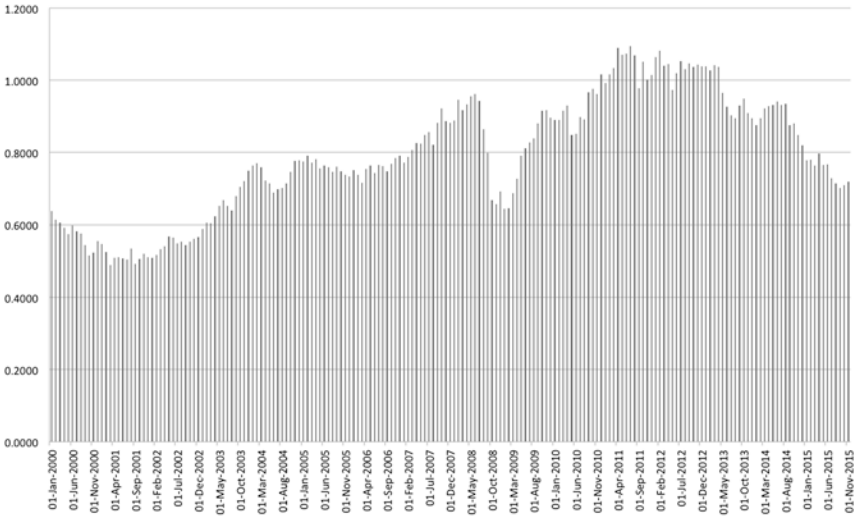

Fig. 10.5 Value of Australian dollar relative to US dollar, 2000–2015

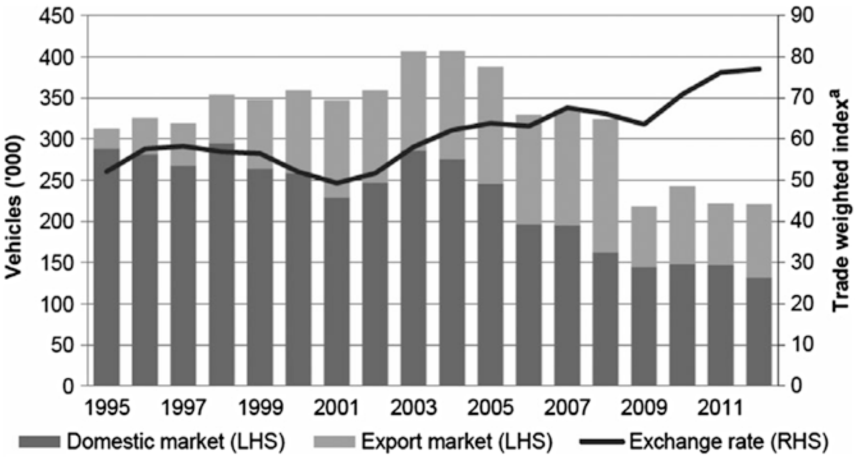

Fig. 10.6 Motor vehicles produced in Australia and the trade weighted exchange rate, 1995–2012. Note: [a]Based on the Reserve Bank of Australia's trade weighted index, May 1970 = 100. Source: Productivity Commission (2014: 66)

Global Strategic Decisions by Parent Companies

The position of local automotive manufacturers has always been dependent on support from their parent companies. But declining tariff protection and budgetary assistance from the Australian government as well as the growing global standardisation within companies of their production systems and "product architecture" strengthened the influence of head offices. Behind tariff barriers and healthy domestic sales, GM Holden and Ford enjoyed a considerable degree of autonomy from their overseas headquarters. For many years, this relative independence and strong local product market allowed both companies to rely heavily on manufacturing vehicles not made elsewhere in the world, the Falcon and the Commodore. In the 1990s, globally consistent production systems were introduced to the Australian companies by their headquarters in the US and Japan. This allowed headquarters to monitor manufacturing performance and to compare facilities around the world on a price per vehicle basis more easily. The Australian subsidiaries pursued different production strategies with varying degrees of independence from their headquarters, with Toyota adopting a strong focus on exports of large vehicles particularly to the Middle East and Ford oriented more towards an import substitution strategy. More recently, the companies sought to gain efficiencies by reducing the number of different models of vehicles produced and coordinating product strategy and design from headquarters. This global product architecture permitted not only savings on duplication of design, production and marketing but also increased emphasis on internal cost comparisons between manufacturing locations. The Australian subsidiaries were acutely aware that their fate was in the hands of managers in headquarters overseas making cost comparisons between production facilities around the world. As one Holden production manager observed: "The guy sitting in [headquarters] looks at the company's cost and … Australia's part of that cost, Thailand's part of that cost. All of these organisations are part of that cost. When you look at getting new product … you want to put the new product where you can make it for the least amount and still make a profit" (Interview with Holden Plant Area Manager 2009). The implications of the global product architecture for the local manufacturers have been a critical issue for the Australian government in recent years. A senior advisor to the Rudd Labor government Industry Minister described the government's concern: "the most pointed question about that for usat the moment is can we attract … investment [from headquarters] … The challenge for the Australian industry is we're essentially dealing with branch plants. They've got to be part of the global picture" (Interview with Senior Advisor to Federal Minister for Industry 2010). While government policy since the 1980s had sought to make the local industry more exportoriented, this was centred primarily—although not exclusively—on improving the performance of manufacturers rather than suppliers. According to an Industry Minister in the Gillard Labor government, this focus undermined the international competitiveness of the Australian industry and was something the local manufacturers should have addressed. "A components manufacturer in Australia is never going to produce sufficient volume in an Australian marketplace to be competitive… [The manufacturers] have got to get their suppliers into the global supply chain" (Interview with Industry Minister Greg Combet 2012). In the context of other factors such as a high Australian dollar that made it more expensive to produce cars locally, geographical fragmentation and low economies of scale, Australia became a less attractive place for the parent companies to make cars, especially with consumer preferences moving away from traditionally favoured large models such as the Falcon and Commodore. The Chairman and Managing Director of GM Holden Mike Devereaux articulated the influence of the global parent companies when announcing the decision to abandon local manufacturing: "GM has made this decision, it is irreversible … It would seem to global leadership at General Motors that it doesn't make long-term business sense for us to continue to assemble vehicles in Australia" (Swan 2013). A detailed examination of GM Holden and Toyota provides evidence of differences between parent company strategies in the industry, particularly with respect to industrial relations arrangements.

Industrial Relations Arrangements

The automotive industry has been highly unionised since its inception. The Vehicle Division of Australian Manufacturing Workers Union (AMWU) has almost full coverage of non-managerial workers among the manufacturers as well as covering most of the large first tier component suppliers. Consequently, the AMWU has exerted considerable bargaining power in the industry, particularly during the era when tariff protection was high and most vehicles sold domestically were manufactured in Australia, but also in the post-protectionist era. In the context of declining union membership in most other parts of the economy, these industrial relations arrangements have been criticised for increasing costs and producing inefficiencies. For instance, in 2002 the Howard government's Industry Minister accused the automotive unions of being "the single greatest threat to the future of this manufacturing sector" (MacFarlane 2002). However, these sentiments stand in contrast with the reality of industrial relations arrangements in the automotive industry, which became increasingly constructive in the two decades prior to its closure. Days lost due to industrial disputation in the industry fell in recent years, especially as tariffs were reduced and the proportion of locally manufactured vehicles accounting for domestic sales declined. While industrial action persisted among some component suppliers in the early 2000s (Federal Chamber of Automotive Industries (FCAI) 2002), the leadership of the Vehicle Division of the AMWU became more cautious about taking industrial action and sought greater cooperation with the employers to ensure that jobs were maintained for their members. As stated by the then Federal Secretary of the union during the global financial crisis: "When you see that the companies are suffering you can't ignore reality… We would be foolish to think that [the union] could continue to make quite substantial demands… When they are shutting down plants around the world you have got to demonstrate that at the end of the day you are part of the solution, not part of the problem" (Interview with Ian Jones, Federal Secretary of the AMWU Vehicle Division 2009). Despite the general improvements in industrial relations, the degree of cooperation between the union and the major automotive manufacturers, as well as the major component suppliers, has varied during recent years. For example, the cases of GM Holden and the Toyota demonstrate that vehicle manufacturers took distinctly different approaches to industrial relations. GM Holden collaborated with the AMWU and the government in order to adjust to declining sales, particularly in the aftermath of the global financial crisis, and sought to minimise the impact of reduced production on the workforce. However, this was not sufficient to prevent the eventual closure of all of its manufacturing operations in Australia. In the years leading to the closure announcement, GM Holden's management and its workers, largely represented by the AMWU, acted cooperatively throughout this time of crisis. The parties entered a number of labour and cost saving initiatives. Notable among these initiatives was a system of rolling shifts for production workers with many working alternate weeks. This arrangement was agreed with the AMWU despite there being no formal mechanism to do so under the collective agreement (Clibborn 2012). The Australian government's role was key in funding training for workers during downtimes. However, cooperative industrial relations were insufficient to convince GM to maintain a place for GM Holden in its global production network. GM's Chairman and General Manager, Dan Akerson said that the decision to close GM Holden's manufacturing operations "reflects the perfect storm of negative influences the automotive industry faces in the country, including the sustained strength of the Australian dollar, high cost of production, small domestic market and arguably the most competitive and fragmented auto market in the world" (Swan 2013). While GM Holden had often struggled in recent times, Toyota was regarded as the most likely company to survive due to a strong focus on exporting locally manufactured vehicles to the Middle East and its long-standing status as leader in domestic sales. Despite its tradition of cooperative industrial relations that was central to the earlier success of its Altona plant, Toyota Australia's eventual closure followed a bitter dispute with the AMWU due to the company's policy of selective redundancies which appeared to target elected union officers within the plant. The announcement by Toyota on 10 February 2014 that it would cease manufacturing at the end of 2017 came after a difficult period of negotiations with the unions over renewal of its enterprise bargaining agreement. Rather than being a cause of Toyota Australia's departure, the tense industrial relations climate was more of a manifestation of challenges facing the company's competitive position. Production at the Altona plant had fallen as exports to the Middle East deteriorated and domestic sales declined causing production lines to be slowed. A senior manager at Toyota admitted that the company had failed to convince the workforce about the crisis that was engulfing it: "We did not truly engage [the workforce] in our business strategy… We never won their hearts and minds. The only time they believed us was at crisis time when we announced the redundancies" (Interview with Toyota industrial relations manager 2013). In comments similar to those of GM's Chairman and General Manager quoted above, Toyota's CEO in Australia, Max Yasuda, stated that "the decision was not based on any single factor. The market and economic factors contributing to the decision include the unfavourable Australian dollar that makes exports unviable, high costs of manufacturing and low economies of scale for our vehicle production and local supplier base" (Workplace Express 2014). It can therefore be seen that despite the contrast in business strategy and industrial relations arrangements at GM Holden and Toyota, neither a cooperative nor an adversarial relationship with unions and employees had any notable bearing upon the ability of local manufactures to withstand the competitive pressures that ultimately led to the decision to abandon local operations.

Conclusion

There are many interrelated factors which led to the demise of the automotive manufacturing industry in Australia, at least in relation to closures by the last three major producers. The situation in Australia cannot be isolated from the global context in which there was an over-supply of vehicles for sale and many multinational companies were relocating their production hubs from higher to lower cost economies. Companies were also shifting their operations to the fast growing markets in China, India and other regions of the world with rising demand for automotive products and components. The multinational automotive companies were historically influenced more by their global strategies than government offers of assistance and this has been more pronounced during periods of economic downturn, when head offices have tended to recentralise decision-making. The global financial crisis also had a major impact on both the global and domestic automotive industry, with most of the Australian based manufacturers experiencing declining export and local demand for their products. A strategy of relying on a shrinking domestic market was not viable for the future of the industry in Australia. With the end of tariff protection, the Australian product market became one of the most competitive in the world with over forty automotive companies offering over sixty models. The dominant view within the Coalition government was against further support for the local manufacturers. While the past few decades have witnessed a general improvement in industrial relations and increased cooperation between unions and employers in the automotive industry, as well as improved work practices and more high quality products, these factors alone were not sufficient to convince the multinational automotive companies to continue their Australian operations. The case of GM Holden demonstrates that the company collaborated closely with unions and the then Labor government in order to maintain employment during the global financial crisis, by means of combining shorter working hours with increased training for workers. Relations between Toyota and the unions were less favourable and the company appeared to provoke the unions by opting for forced redundancies rather than using the accepted method of voluntary redundancies when there was a decline in production. Yet Toyota management admitted that it was external factors, including the loss of export markets, low economies of scale and the unfavourable Australian dollar, rather than industrial relations issues, which led to the decision to close manufacturing operations in Australia. Regardless of the industrial relations strategies adopted by the manufacturers, neither a cooperative (in the case of GM Holden) nor an adversarial relationship with unions (in the case of Toyota) was able to save the automotive manufacturers from their ultimate fate. It is therefore difficult to accept the argument prominent in public discourse that industrial relations arrangements were the main factor contributing to the demise of the automotive industry, given that the nature of union-management relations made no identifiable difference to the final decisions of the parent companies in Tokyo and Detroit to cease production in Australia. While industrial relations were not a cause or at least not a leading cause, the reasons for the demise of automotive manufacturing in Australia are complex and intertwined. The contributing factors include the failure of tariff protection and the ineffectiveness of economic assistance packages to resurrect the standing of local producers, volatility in the exchange rates which resulted in a more highly valued Australian dollar during the period of the mining boom and in the aftermath of the global financial crisis, and changing global strategies by the multinational automotive companies, which resulted in shifting production and other activities away from Australia to expanding markets in Asia. In sum, a confluence of factors killed the Australian car industry: no single issue or actor can be blamed for this outcome. Looking forward, it is possible that there is still time for a more positive approach by government to succeed, for instance by retaining more aspects of the local automotive industry such as R&D which has been scaled back but has not completely disappeared. While the three manufacturers are due to cease operations in Australia in 2016–2017, the question remains as to whether the industry might yet be saved or revived on a smaller scale than previously. New entrants to the global automotive industry might be attracted to Australia as a "test bed" for manufacturing in a new market, as once was the case with Japanese producers. In recent times, the Chinese company Geely purchased Volvo passenger cars and the Indian company Tata purchased Jaguar, both from Ford. In early 2016, a Belgian-based automotive company Punch International made a bid to acquire GM Holden's South Australian plant but the outcome was not resolved at the time of publication. Alternatively, a more established company might be willing to enter into a joint venture as GM Holden did with Toyota in Australia in the 1980s. This would require the Australian government to play a role as facilitator and possible co-investor, perhaps in partnership with one of the state governments and with the support of the unions in order to offer more innovative employment arrangements. New products such as battery driven vehicles and hybrids might be more attractive investments for both the governments and manufacturers. Given that each automotive manufacturing job has a multiplier effect of seven to nine additional jobs in the supply and service sectors, a new initiative to restart niche local manufacturing could be attractive to a range of stakeholders, including Australian consumers. In fact, the leadership of the Vehicle Division of the AMWU have been pragmatic in their negotiations with the employers and the governments, demonstrating a willingness to consider workplace reforms which would keep the vehicle manufacturers and component suppliers operating in Australia. An interim report on the future of Australia's automotive industry by the Senate Economics References Committee in August 2015 urged the Coalition government to work with stakeholders in order to develop policies that would sustain an internationally competitive automotive industry in Australia (The Senate of Australia 2015). It recommended that the object of the Automotive Transformation Scheme (ATS) Act 2009 be amended to encourage new investment and provide greater support for automotive component manufacturers. The Senate Report also recommended broadening the ATS to allow it to support manufacturing of components and materials, the commercialisation of new automotive technologies, and engineering and design for both domestic and offshore automotive customers. It called for the current level of ATS funding to be maintained through to 2021 as provided in the ATS Act. If bipartisan support could be achieved for such initiatives, there may yet be prospects for revitalising the Australian automotive industry before it is killed off for good.

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Part III

Emergent Countries: New Geographies Struggling for Trespassing Frontiers

11

The Automotive Industry in China: Past and Present

Frido Wenten

Introduction

In a period of 30 years, China developed from having hardly any automotive production at all to the world's largest producer and market for passenger cars, representing virtually all global original equipment manufacturers (OEMs) and an emerging range of domestic brands and independent manufacturers. Over 21 million passenger cars were produced—and about the same amount sold—in China in 2015, which accounts for almost a third of the global total, both in production and sales.[1] This rapid growth has been historically unprecedented and sparked an interest in China's developmental strategy and industrial policy for the automotive sector (Chin 2010; Thun 2006; Lüthje et al. 2013). At the same time, waves of contraction and expansion of the auto sector workforce, the "socialist" trade union legacy and, last but not least, a landmark strike wave in the South Chinese auto parts sector in 2010 have inspired

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research on labour relations in China's automotive industry (Zhang 2014; Wenten 2016; Jürgens and Krzywdzinski 2016).

This chapter provides an overview of the development of the automotive industry in China and the implications for different stakeholders involved—central and local governments; foreign and domestic automakers; and the local workforce. In the first two sections—which are chronologically divided between the pre- and post–World Trade Organization (WTO) period (2001 being the watershed)—it unfolds how the specific shape of automotive sector development in China has been a result of central and local industrial policymaking, in particular in its early stages. Yet, rather than on industrial policy design *per se*—that could be replicated elsewhere—China's automotive development strategy depended on a favourable international environment coinciding with very unique local preconditions. The sheer size of the Chinese market and overcapacity in most OEMs' home markets provided mixed push and pull incentives for an expansion to China. And the legacy of China's closed, planned economy enabled policymakers to make market access conditional on local manufacturing in joint ventures (JVs) with state-owned enterprises (SOEs). These conditions have resulted in a win-win situation for SOEs and OEMs when it comes to revenue from the constant growth of domestic sales—but since China joined the WTO, the JV success story has found its limits in increasing overcapacity and the inability of SOEs to develop their own competitive brands. Foreign brands continue to dominate the market, but the pressure has increased through the—largely unintentional—growth of smaller locally state-owned and private independent producers; and from an emerging industrial policy focus on new energy vehicles (NEVs).

Although automotive assemblers tend to pay above-average wages, the rapid growth of car manufacturing has rested on a labour-intensive, low-wage model and extensive working hours. Labour relations are characterised by the dysfunctionality of the state-aligned All-China Federation of Trade Unions (ACFTU) and open conflict, in particular along the supply chain. I will shed light on the characteristic production regimes and labour relations, before concluding with an outlook on the future development of the automotive industry in China.

Catching up and Taming Foreign OEMs: The 1980s and 1990s

Maoist China produced only a single passenger car model and never more than 3000 units per year, which were designed for the higher political echelons. The small motor-vehicle industry focused instead on the production of commercial vehicles (Zhongguo Gongchengyuan and National Research Council (U.S.) 2003: 38f.). At the onset of political-economic reforms in 1978, production was dispersed to 56 small and medium-sized assembly plants, which produced 2640 sedan cars annually (Thun 2006: 54). In the same year the Chinese government began to engage global auto manufacturers with two objectives. It planned to mould existing domestic capacity into large-scale conglomerates and a pool of domestic suppliers in order to increase efficiency and economies of scale—and, ultimately, export capacity. And it sought to do so by promoting JVs between domestic SOEs and foreign car manufacturers, with the aim of upgrading technology, managerial skills and research and development (R&D).

Foreign direct investment (FDI) played a significant role in the emergence of automotive manufacturing in China. But given that other late developers equally used FDI to build an automotive industry—for example, Mexico, where foreign OEMs quickly outcompeted domestic producers both in assembly and in components—the relative "success" in China depended on the steering capacity of Chinese policymakers. Initially, nearly all FDI entered China in the form of joint venture agreements, the terms of which were determined by local states in cases of smaller and medium ventures, but by the central authorities in the case of designated "pillar industries" like the automotive sector (Naughton 2007: 410ff.; Thun 2006: 64ff.). Facing strict limits on imports by an import substitution industrialisation (ISI)-like tariff policy (Naughton 2007: 384f.), in order to sell cars in China, foreign OEMs had to manufacture in JVs with a minimum of 50% Chinese ownership. The Chinese government increased its leverage in negotiations by limiting the number of JVs that could be approved at a time; and it partnered each SOE with at least two foreign enterprises to foster internal competition, technology transfer and learning capacity. Finally, local content requirements were set at 40% for the first year of production, increasing to 60% and 80%, respectively, in years two and three, providing strong incentives for the development of backward linkages (Thun 2006: 63ff.; Chin 2010; Zhang 2014: 35). The expectation that China's domestic market potential would be tempting enough for foreign OEMs to agree to these constraints was initially unmet: in the 1980s and early 1990s, global OEMs remained rather hesitant to invest in China. But this changed dramatically after the mid-1990s, when China's WTO accession became a likely scenario.

The first OEM approached by the Chinese government in the late 1970s was Toyota—but it was unwilling to share its advantage with any other Asian country, focusing instead on expanding in US and European markets (Chin 2010: 60ff.). US automakers, on the other hand, were preoccupied with finding adequate responses to increasing competition at home, which manufacturers like General Motors (GM) and Ford sought in cost-cutting strategies that involved (threats of) relocation—however, not to new markets, but to regions with established supply networks and qualified, non-unionised labour (the South of the US and North of Mexico). Although the American Motor Corporation (Jeep) was the first OEM-Chinese joint venture (1983), it was particularly European carmakers that considered an expansion to China as a solution to offset productivity and sales problems haunting them at home. Two other joint venture agreements were signed in the 1980s between Volkswagen (VW) and the Shanghai Automobile Industry Corporation (SAIC) and Peugeot and Guangzhou Automobile Manufacturing (both 1984)—of which only Volkswagen Shanghai survived.

Up until the mid-1990s the automotive industry in China operated under conditions of soft budget constraints, a protected market and low competition—and therefore, little market pressure on productivity and efficiency. This changed with China's preparation for WTO accession and the anticipated increase in competitive pressure. Overall, public sector profitability reached an all-time low in 1996 (near zero); and new regulations had been enacted in 1994/1995 to address this issue. From 1996 onwards, SOEs were transformed into corporations (i.e. state ownership into shareholdings) and subjected to stricter criteria for profitability and creditworthiness (Naughton 2007: 301ff.). The central government retained control over, restructured and further enlarged a few conglomerates through forced mergers and acquisitions—including the "big four" of the car industry: First Automotive Works (FAW), Dongfeng, SAIC and Chang'an—and left it to local governments to privatise, merge or close smaller public enterprises under their control. During the 1990s an estimated total of USD 60 billion was invested in the motor vehicle industry (Gallagher 2006: 40); and while Citroen and Daihatsu had entered the market in 1992 and 1996, respectively, the majority of global OEMs joined during or after the period of SOE consolidation.[2]

The dramatic increase in competition not only caused an acceleration of industrial upgrading—because the new entrants chose to produce state-of-the-art models, despite the high costs involved—but also exerted severe pressure on profitability. Both dynamics are well illustrated by the example of Volkswagen. While newer models with shared platforms were gradually introduced elsewhere, Volkswagen continued to produce models with long outdated technology for the Chinese market. In the 1990s, Volkswagen sold its 1980s Santana model at prices well above world market level (166% in 1996, Zhang 2014: 33)—which dropped by over 55% until 2004 (Thun 2006: 211).[3] With increasing competition, the entire automotive industry in China experienced a drop in profits (from 11%–12% in 2000 to 4%–5% in 2005)[4]; and Volkswagen Shanghai's market share fell from 54% in 1996 to less than 18% in 2005 (Zhang 2014: 37f.).

The first phase of industrial policymaking provided the roadmap for the future take-off of JV agreements between domestic SOEs and foreign OEMs. The relative success of the Volkswagen JVs proved the viability of the model to Chinese policymakers—at least in the medium run, for which upgrading and spillover effects were the aim. Concentrated public control and the lure of an untapped domestic market provided Chinese policymakers both with the means and the incentives to attract and tame global OEMs. And for the latter, the VW experience created a precedence that seemed increasingly feasible after the restructuring of public enterprises and the promise of WTO accession had reduced uncertainty. With more and more JVs emerging after the late 1990s, it soon turned out though that one central aim of the Chinese government remained a mere distant possibility: the development of domestic brands.

Building National Brands and Finding a Niche for the Future: The Post-WTO Era

Since its accession to the WTO, Chinese industrial policy for the automotive sector has focussed mainly on two issues: the promotion of domestic brands and the development of NEVs and their core components (batteries, transmissions and engines). WTO accession implied the phasing out of import barriers and complicated the clause on 50% minimum public ownership in joint venture agreements. While the clause was retained for terminal assemblers producing for the domestic market, it was loosened for those producing for export—Honda set up a fully owned subsidiary to export its model "Jazz" in 2002 (Hsu 2014: 81)—and abolished for the auto parts industry. Global suppliers, such as Bosch or Denso, began to set up not only joint ventures but also fully owned subsidiaries, followed by global OEMs that manufactured engines and transmissions under full brand ownership. More generally, the government increasingly withdrew from steering the operative functions of automotive SOEs, focussing instead on broader policymaking and market incentives—for example, preferential taxation for the build-up of domestic R&D capacity (C. W. Chang 2011). In fact, the stimulus package during the global crisis of 2008/2009 was the last industrial policy measure that included a programme specifically targeted at the automotive sector.

The automotive industry in the post-WTO era experienced continuous, though gradually slowing, growth. Fixed capital investment grew at almost 14% annually between 2002 and 2007, dropping by half for the period 2007–2012 (*China Automotive Industry Yearbook* 2015; Lüthje and Tian 2015). New entrants and increasing competition drove down the market share of individual joint ventures to about 5%–10% (VW being the exception due to its two large JVs), and the overall share of foreign brands in domestic passenger car sales to about 57.5% (in 2016). Yet, domestic consumer demand continued to grow. Between 2002 and 2007, as well as 2009–2010, overall passenger car sales in China grew by an average of 35% annually, with 2008–2009 sticking out with a 51% increase due to the governmental stimulus package (Lüthje et al. 2013:

35)—slowing down to an internationally still substantial average of 10% for the 2012–2016 period.[5] In 2015, over a third of GM's global vehicle sales occurred in China (GM Communications 2016); and around 40% of the VW Group's profits stemmed from its China business in 2012 and 2013.[6] When it comes to sales and profits, automotive joint ventures continue to be a win-win solution. But the rapid expansion of the Chinese auto sector, in particular after the 2008–2009 governmental stimulus package, which through large infrastructure measures accelerated the opening of so far untapped markets in Western China, created huge overcapacities. Most automotive plants in China have operated, and continue to operate,[7] well below full capacity (at around 80%), in particular those for commercial vehicles, which had an estimated capacity utilisation of 51% in 2015 (Li 2016). In response, the government has recently announced more restrictive investment regulations.[8] At the same time, Chinese policymakers' hopes for technology transfer, domestic R&D and independent brand development have been largely unmet by the large joint ventures.[9] When SAIC entered the *Forbes 500* in 2004, only 2% of its produced passenger cars were domestically developed, while 98% were VW or GM models (Anderson 2012: 79). It is against this background that the term "indigenous brands" first appeared in the 11th Five Year Plan 2006.

While some joint ventures have recently moved towards the creation of separate domestic brands, such as Baojun between GM and SAIC (2010), the important policy shift in the mid-2000s was an increasingly positive view of locally state-owned and private domestic automakers. In the pre-WTO period, their development had been deliberately disincentivised by the focus on SOE consolidation and the reservation of preferential policies and public orders for large JVs. The early developmental trajectories of the four largest independent automakers in China—Chery, Geely, BYD and Great Wall—were therefore significantly different. Chery is a public enterprise owned by the local government of Wuhu, Anhui province. Initially it possessed the centrally granted permit to produce engines, for which it could access local capital and national bank loans. Similar to SAIC, its operative business is directly linked to the local government. In comparison, the government of Baoding, Hebei, has only a minority holding in Great Wall. It provides preferential policies and assists in R&D

through links to local universities, but neither invests directly nor offers access to central loans, nor is it involved in the operative side of the business. BYD and Geely, on the other hand, are fully private and have, similar to Great Wall, raised their capital through the Hong Kong Stock Exchange and recycled profits from their main lines of business—lithium-ion batteries in the case of BYD; and motorcycles in case of Geely (C. W. Chang 2011; Anderson 2012; Hsu 2014).[10] While BYD has had a competitive advantage in the growing NEV market due to its experience with battery production, Geely is arguably the internationally most renowned private Chinese car producer due to its acquisition of Volvo in 2010.

The productive model of the independent carmakers has rested primarily on a low-cost strategy fuelled by cheap labour, low-quality components and low R&D costs—the latter mainly because in the initial stages they purchased engines and transmissions from established JVs and infringed the intellectual property rights of global OEMs by copying the design of platforms and components (C. W. Chang 2011: 6ff.). Lacking skilled personnel, they also relied on poaching experienced engineers from JVs (Anderson 2012). Yet, although the individual sales volumes of China's independent carmakers are comparably small, they are more profitable than the independent brands of the large SOEs. The latter continue to depend on the sales of their foreign JV partners' brands, while only the domestic brands of Chang'an and Guangzhou Auto have ever been profitable (i.e. in any given year).[11] According to the Chinese Association of Automotive Manufacturers (CAAM), the market share of Chinese brands was 42.5% for the first seven months of 2016[12]—but extremely dispersed between smaller independent producers: in 2009, BYD, Geely, Chery and Great Wall only had a combined market share of 15% (C. Chang 2016). These companies are also largely responsible for the small, but growing exports of finished vehicles, which are mainly sold to other emerging markets—and are qualitatively still lagging behind OEM products (with Honda and GM taking the lead of global OEM exports from China). That, on the other hand, OEM exports from China remain limited has multiple reasons, including continuously growing sales in China's domestic market; restrictive licensing agreements; and resistance from unions in the OEM's home countries that fear a global price war (Wenten 2016). Recent efforts to export cars made in China, in particular the house brands of domestic producers (both SOEs and private), have moreover been curbed by the radical change in US trade policy towards targeted tariffs on Chinese products.

Pro-active policies for independent manufacturers remained limited during the 2000s, but this changed with the stimulus package of 2009/2010. It included a 10% discount for the purchase of light trucks in exchange for an older vehicle and lowered the purchase tax for cars with an engine of 1.6 litres or less from 10% to 5%. Both measures particularly matched the product range of indigenous brands, which was amplified by the announcement of substantial subsidies for the sale of plug-in hybrids and electric cars in 2010—targeting not only two traditional SOEs (SAIC and FAW), but also BYD, Chery and Geely (Chang 2011, 2016). More generally, the emerging focus on energy-saving and new energy vehicles, in particular electric ones, seems to be tilting the balance of forces in favour of independent producers. The first post-WTO five-year plan made NEV development a strategic R&D objective, providing central government funding to car producers and research institutions. The initial efforts focussed mainly on developing assembly capacity, although Dongfeng and BYD were early movers in setting up R&D centres for NEVs in this period. As a result, BYD's F3M model was the first indigenous hybrid car to hit the market in late 2008 (Liu and Kokko 2013; Nieuwenhuis and Lin 2015). During the 2006–2011 plan, the Chinese government mobilised RMB 11.1 billion (around USD 1.5 billion) for NEV R&D, of which two-thirds went into the development of batteries and powertrains (Nieuwenhuis and Lin 2015). The 12th and 13th plans have cemented the focus of NEV development on electric vehicles; improvements in their core technology (battery density and temperature adaptability); and an expansion of charging facilities and EV usage in public transport. For the 2012–2020 period, the production and sales of five million NEVs has been envisioned—a target not unlikely to be met, given that the annual production of electric vehicles alone was 680,000 in 2017 (Babones 2018). More ambitious, however, is the projected reduction of fuel consumption to 5 litres/100 km by 2020. To both ends, the government assists with central to local subsidies; tax breaks; and large public orders of electric vehicles (Chang 2016)—which now include traditional hybrids as well.[13] Private consumers in select larger cities benefit from central and local subsidies towards the purchase of NEVs and, in particular, from free and fast licensing, which compares favourably to the high costs and long waiting time for a conventional car registration. To address the critical issue of EV's limited mileage per charge (about 160 km), the government has undertaken to install a growing network of charging stations,[14] mainly via the two conglomerates State Grid and China Southern Power Grid, which are facing competition from large Chinese oil companies that have entered the game (Liu and Kokko 2013; Nieuwenhuis and Lin 2015). In this context, it is also significant that 90% of the world market for chargers is made up of devices using either the Chinese or Japanese charging standard, which the two governments have recently agreed to unify (*Nikkei Asian Review* 2018), potentially setting a global standard. On a wider scale, NEV production also benefits from China's geopolitical strategy of encouraging public and private mining companies to secure access to essential primary resources abroad, such as cobalt or lithium, and of expanding processing capacities at home.[15] In short, governmental support for NEV production is unambiguous—which also has to be interpreted in light of the developmental limits imposed by the JV-driven model.

China's recent ambitious high-tech development agenda *Made in China 2025* (*MiC 2025*) formulates targets specifically for the NEV industry, namely, progress in automation, innovation, quality and use of information technology.[16] Markedly, as Butollo and Lüthje (2017) have argued, *MiC 2025* diverges from prior industrial policy in two regards. It replaces the attempt to link into and climb up existing value chains (which are dominated by foreign players) with the aim of building China-centred global value chains based on Chinese lead firms and R&D. And it shifts focus from the traditional players of SOEs and large conglomerates to medium-sized private or local state-owned enterprises. This addresses the fact that most JVs have long been reluctant to develop and build NEVs in China.[17] Only Toyota has been producing (and importing) hybrid vehicles on a larger scale since 2005, while GM, VW and other European carmakers have only very recently begun to plan the production of NEVs in China. So far, the powerful SOEs and their foreign partners continue to expand conventional vehicle production and are likely to resist an encroachment of their market leadership.

At the same time, a range of new NEV start-ups have sprung up; but as of now, none have commenced production. Nio is one of them, exceptionally aiming at the upscale market, which has been served mostly by Tesla and BMW imports. Most indigenous private producers of NEVs are likely to continue targeting the lower and mid-end of the market, while premium NEVs will remain the domain of foreign OEMs. But the viability of indigenous brands and their development of NEV capacity have to be seen in light of the small company size and fragmentation of the sector. R&D remains moderate if compared to large global OEMs: in 2004 it accounted for only 1.5% of overall investment in the Chinese auto sector; and in 2012 all domestic brands combined reached just about 60% of the R&D investment of Volkswagen alone (Nieuwenhuis and Lin 2015: 117). Foreign brands such as Toyota or VW are likely to dominate the mid-market segment and provide strong competition for domestic brands, which could jeopardise the position of independent producers in the *MiC 2025* agenda. Such contradictions are likely to intensify with the recent entry of Tesla: in July 2018 it announced the approval for a fully foreign owned—and Tesla's merely second—assembly plant near Shanghai, with a planned capacity of 500,000 units.[18] This is part of a landmark shift in Chinese industrial policy *vis-à-vis* the automotive sector, as the cap on foreign ownership is to be phased out by 2022, potentially strengthening global OEMs against domestic competitors.[19] If, however, *MiC 2025* works more or less as planned, NEV production could emancipate domestic brands through intellectual property rights, providing a competitive edge over foreign OEMs and circumventing the technologically unlikely (and economically unwise) catch-up in combustion engine technology.

In retrospect, the post-WTO era demonstrated that the JV model has been successful in building a variegated automotive industry in China; and that these JVs possessed sufficient self-management capacity to be gradually released from central industrial policymaking. Yet, the failure of JVs to develop independent brands or innovative products—particularly NEVs—has prompted a policy shift. Independent (private) producers have increasingly been recognised as dynamic modernisers, receiving tax breaks and subsidies, although the government does not preclude the JV eligibility for these tools, once they decided to venture into the NEV business. It remains to be seen if China can establish and maintain a competitive edge in NEV technology, and what ripple effects increasing exports from China could cause for the global automotive sector.

Production Process and Employment Relations

Research on the production regimes of automotive companies in China remains limited, in particular where labour relations are concerned (Lüthje et al. 2013; Zhang 2014; Wenten 2016; Jürgens and Krzywdzinski 2016). The best information is available for large European and East Asian JVs; and the following paragraphs mainly apply to these producers.

In the typical managerial division of labour between the Chinese and foreign side of an automotive JV, foreign personnel is represented in most departments alongside Chinese managers, with the exception of human resources (HR) and the state-aligned trade union.[20] There is a general trend towards lean production systems, if this characterisation is reserved for issues such as outsourcing; just-in-time/-sequence (JIT/JIS) production; multi-purpose machinery and robotics; and a smaller workforce. For reasons of cost efficiency—and where the nature of operations permits it—many international JVs follow more labour-intensive regimes and have lower automation rates than in their home countries (Lüthje et al. 2013). In 2013, automation in the body shop of a European JV could, for example, be as low as 27% for older models, which made it the most labour-intensive department in the factory.[21] Although all international joint ventures officially follow lean systems—and have applied *kanban* processes—job rotation, polyvalent skilling and *kaizen* only seem to be applied in Japanese JVs, while, in practice, limited task ranges and training dominate at European and American JVs, as well as at domestic producers (Lüthje et al. 2013; Wenten 2016). At a European JV, workers were grouped into teams of various sizes (usually around 15), but these were mere administrative units subjected to a strict hierarchy. Job rotation was absent; *kaizen* and multi-skilling were unnecessary due to Taylorised work flows and a limited task range. In the given example, high-volume production of certain models permitted assembly to be reserved for single models—requiring workers with low skill levels only (Wenten 2016). Labour productivity can thus differ strongly between older plants and newer greenfield sites with higher automation rates and state-of-the-art technology (Oliver et al. 2009; Lüthje et al. 2013).

In terms of employment numbers, the industry experienced a drop of 25% between 1997 and 2001 as an effect of the consolidation of the late 1990s (Zhang 2014: 36). But by 2014, it had increased again by a factor of 2.5 to a total of 3.38 million workers (excluding employment in motorcycle manufacturing, *China Automotive Industry Yearbook* 2015: 426). In total, 78 facilities had workforces of over 10,000 workers—some exceeding 20,000 (Wenten 2016)—but newer greenfield plants are "leaner", with 5000–8000 employees (ibid.; *China Automotive Industry Yearbook* 2015; Lüthje et al. 2013). Dispatch workers—owing the title to their being "dispatched" from labour agencies on a temporary basis—can make up to 25%–30% of the predominantly male and comparatively young workforce (the average age of blue-collar workers is usually in the early 30s); and most manufacturers use a large number of vocational school students on half- or one-year internships on the line (up to a third in labour-intensive departments, Zhang 2014: 70).

Wages in terminal assemblers can be considered low by international standards, although they are usually amongst the highest locally available sources of income. According to Zhang (2014: 76), there is a hierarchy between European/American JVs that paid a median annual cash income of RMB 62,354 (USD 9652) in 2011, and East Asian JVs (RMB 31,433/USD 6615) and domestic enterprises (RMB 31,433/USD 4866). Wages in the auto parts sector are between 50% and 75% of those in terminal assemblers, depending on the position in the supply chain—which is similar to the ratio in other emerging markets, such as Mexico (Covarrubias V. 2019; Juárez Núñez 2012). However, wages have risen continuously over the last decade. According to Lüthje and Tian (2015: 256), on average, labour productivity surpassed wage growth by more than 10% per annum between 1997 and 2002; and 3.5% between 2002 and 2007. But this trend reversed for the periods of 2007 and 2012, when, on average, wages per capita outgrew productivity by 2.9% per annum. And while both growth rates have continuously slowed down since 1997 (ibid.), wage increases are still substantial: in 2016 the average annual wage of automotive employees in

China was RMB 74,463/USD 11,050—an increase of 17.6% in only two years (*China Labour Statistical Yearbook* various).[22] Hourly wages for comparable tasks now range between USD 4.20 and USD 9 in terminal assembly plants (in 2017), which puts them ahead of labour costs in Mexico or India.[23]

With differences in detail, all major JVs have performance-related remuneration systems, in which the fluctuating part of the salary (bonuses, premiums, overtime etc.) makes up about 50% or more. In many cases, including the large JVs, the base wage is set at the local minimum wage for ordinary workers. Seniority only plays a secondary role, if at all. Workers' incomes are stratified according to position (engineers, assembly line workers etc.) and/or employment status (formal, dispatch workers and interns), mainly via different entitlements to bonuses and premiums. There is no automatism for wage increases in any terminal assembler in China—neither through productivity linkages nor through sales (although many foreign JVs distribute large profit-dependent bonuses at managerial discretion)—and workers, in particular women, might end up not receiving a wage increase in a decade (Wenten 2016). Despite the recent wage growth in the industry, in absolute terms working-class incomes are still low, reinforcing the middle- to up-market orientation of most auto producers in China, as well as an extension of (subprime) consumer credit—to an extent that a government crackdown on peer-to-peer lending has been blamed for the decline in vehicle sales in the first half of 2018.[24]

Working conditions and occupational safety and health (OHS) standards in JVs are generally better than in domestic enterprises (Lüthje et al. 2013; Nichols and Zhao 2010), especially in recently erected factory halls with state-of-the-art machinery. However, in some cases (apparently not in East Asian JVs, Lüthje et al. 2013), working hours can be very long—a large European JV, for example, runs a three-shift system with 13 consecutive working days plus extra hours for rework, and consequently, only one rest day every two weeks (Wenten 2016). More generally, regular working days of 10–11 hours or more are no exception.

Promotions and further training of formal workers in all JVs are based on individual performance evaluations and are generally slow, limited and very competitive—but possible. This primarily serves the aim of stabilising the skilled segment of the workforce (Zhang 2014: 107ff.). For example, a German JV offers career paths for formal workers to become supervisors, "expert workers" (similar to the German *Facharbeiter*) or managers, which involves releasing workers for further education and results in officially accredited certificates (Jürgens and Krzywdzinski 2015, 2016). An East Asian JV, on the other hand, organises promotions and further training according to employment status—production, maintenance and white-collar workers—without mobility between categories, and without external schooling or certificates (ibid.). For dispatch workers, however, permanency, promotions and additional training are distant aims and require up to ten years of continuous work experience in the company. And, more generally, only very basic training tends to be comprehensive—which can be cut short to a few days for dispatch workers (Wenten 2016). This can be explained by the Taylorised task range and hierarchical work organisation; and it is particularly true for dispatch workers, who are more likely to quit (Wenten 2016),[25] despite the fact that turnover rates in European and American JVs are generally very low (Lüthje et al. 2013; Wenten 2016).

For reasons of cost and path dependence from now phased-out local content requirements, most JVs have high degrees of outsourcing and localised supplies, including both Chinese (for lower value parts) and foreign suppliers (for higher value parts), although for upscale models/brands components of strategic technological value are imported (Lüthje et al. 2013; Wenten 2016). Lüthje et al. emphasise that supply chain relations differ: European JVs are characterised by arm's-length relations with independent suppliers; US-American by semi-independent first-tier suppliers that have formed JVs with Chinese SOEs (e.g. Delphi, Visteon); and East Asian JVs by suppliers directly controlled and invested by the terminal assembler. First-tier suppliers, particularly those with an SOE partner, have similar production regimes to terminal assemblers, but labour intensity, overtime and income insecurity increase sharply further down the chain, as does the use of migrant workers (Lüthje et al. 2013: 41f.).

There is only one legal trade union federation—the All-China Federation of Trade Unions (ACFTU)—that represents workers in the auto sector on the enterprise level and in higher-level organs of different geographical and institutional scales. Industry-wide branches exist on paper but play virtually no practical role. Higher-level officials of the union are civil servants, drawn on a rota from other state departments. With rare exceptions, enterprise union officials in the auto sector are chairmen of the SOE party cell and/or managers. Collective contracts, where they exist, are enterprise contracts. They stipulate the main responsibilities between workers and management, and, sometimes, clarify the broader structure of shift and remuneration systems—in accordance with national and local legislation. They do, however, not specify actual working hours and salaries, which are only revealed to workers in their individual contracts. By and large, the union is defunct as an interest representation of the workforce, which is also reflected in workers ignoring it in cases of discontent. Its main functions are the maintenance of so-called "harmonious" labour relations, the promotion of productivity (e.g. through the organisation of skill contests) and the organisation of social and cultural events (Nichols and Zhao 2010; Lüthje et al. 2013; Zhang 2014; Wenten 2016). These traditional functions of the ACFTU are most clearly reflected in those automakers that have a centrally controlled SOE for a JV partner. This does not, however, imply that labour relations in China's auto sector are peaceful. On the contrary, wildcat strikes in auto parts plants seem to be frequent,[26] having, amongst others, led to the establishment of cross-factory collective bargaining in the Guangzhou area after a large-scale strike wave in 2010 (Wenten 2017). More recently, even assembly plants have experienced strikes, with VW offering permanency to its dispatch workers after a yearlong struggle at its Changchun location (Nü 2018).

In a nutshell, automotive manufacturing in China has for long been based on low-skilled, Taylorised labour and a higher share of manual operations—which is explained by cost efficiency; the continuous production of older models; and high-volume output of singular models. Low productivity could for a long time be offset by low labour cost, but wage growth, decreases in profitability and the anticipation of high-volume production have induced large JVs to install state-of-the-art technology in newly opened production sites. The use of temporary and precarious forms of employment is widespread in the industry, in particular on the lower tiers of the supply chain. Working hours and rhythm remain intense; and there are hardly any formal mechanisms in place that allow managers or trade union officials to appease workers' grievances, making open conflict likely.

Conclusion

This chapter provided an overview of the main tenets characterising the development of the automotive sector in China, in terms of the industrial policy set up in its initial and more recent stages; related developmental effects; and typical labour relations. The pairing of OEMs with SOEs has proven to be a powerful vehicle for the successful emergence of domestic manufacturing capacity in both assembly and supplies—a strategy that was premised on China's large domestic market and retained control over a small selection of large SOEs that received preferential policies and funding. However, the limitations of this model have become apparent by the failure to emancipate domestic infant industries from dependence on foreign brands. Not without irony, the most dynamic national brands have emerged on the margins of industrial policymaking through mobilising private investments, poaching talent and infringing intellectual property rights. The more recent governmental recognition of their innovative and growth potential has to be seen more as an *ex post facto* adjustment than as a deliberate plan.

The automotive sector in China is dynamic, but the continuous expansion of conventional vehicle production has created overcapacities; and an increase in OEM exports from China could significantly drive down global prices. The push towards NEV development is likely to aggravate the trend, once the large JVs fully jump on the bandwagon. But NEV technology also has the potential of giving Chinese manufacturers a competitive edge over global OEMs. China's industrial policy, while still reflecting the influence of the large, combustion engine focussed SOEs, has shifted in favour of nascent private NEV producers, complemented by a wider agenda of expanding EV infrastructure and geopolitically assured access to raw materials. What this implies for production regimes and labour relations remains to be seen. For the time being—and despite recent wage increases—the industry still rests on a low wage model, with a segmented labour force and widespread use of temporary employment, as well as conflictual labour relations. The low(er)-cost model of indigenous brands, as well as the lower skill requirements of the new product, could aggravate this trend and undermine the comparably higher wages of international JVs. Whatever the future holds for the automotive sector in China, significant ripple effects on innovation, profits and employment in the global automotive industry, as a whole, are a matter of certainty.

Notes

1. Based on: http://www.oica.net/wp-content/uploads//Cars-2015-Q4-March-16.pdf; http://www.oica.net/wp-content/uploads//pc-sales-20151.pdf
2. Among the entrants in the late 1990s and early 2000s were GM (1997); Honda (1998); Kia (1999); Fiat (1999); Toyota (2000); Ford/Mazda (2001); Hyundai (2002); Peugeot (re-entered 2003); Nissan (2003); Honda (2003); BMW (2003); DaimlerChrysler (2004); and Renault (2004, after a failed joint venture founded in 1993).
3. Despite the drop in prices, an adapted version of the original Santana was produced until 2010.
4. Profits climbed up to nearly 9% in 2011, with a small slump during the 2008 crisis (Zhang 2014: 37).
5. http://www.oica.net/wp-content/uploads//pc-sales-2016-Q2.pdf
6. VW Annual Reports 2012, 2013.
7. http://www.autonewschina.com/en/article.asp?id=18403
8. http://www.autonewschina.com/en/article.asp?id=18062
9. This has been attributed to the conservative nature of SOEs and the reluctance of foreign OEMs to share state-of-the-art knowledge and technology with their Chinese partners (C. W. Chang 2011).
10. Chang (2011) is therefore keen to emphasise that the indigenous brands did develop *not* as a result of central policymaking, but on the contrary, *despite* central planners' preference for SOE JVs.
11. http://www.autonewschina.com/en/article.asp?id=15251
12. http://www.caam.org.cn/AutomotivesStatistics/20160815/0905197263.html

13. http://www.autonewschina.com/en/article.asp?id=15392
14. Nationwide, there were 214,000 public and 232,000 private charging stations in 2017 (Babones 2018).
15. http://www.autonewschina.com/en/article.asp?id=17359
16. Butollo and Lüthje (2017) have pointed out that *MiC 2025* is effectively more about robotization, automation and a broader restructuring of industrial supply chains than about innovations in cyber-physical systems envisioned in the often compared agendas of other nations, such as Germany's *Industrie 4.0*.
17. As a condition to its opening of a new assembly site in South China, Volkswagen was, for example, required to develop an electric vehicle for sale in China. It, however, only produced a prototype that was never intended for serial production (Xu 2011).
18. http://www.autonewschina.com/en/article.asp?id=17839
19. http://www.autonewschina.com/en/article.asp?id=17488
20. The exemptions are some Japanese producers, such as Honda, in which Japanese management is also represented in HR (Zhang 2014: 103; Lüthje et al. 2013: 95).
21. By now this is likely to have undergone significant changes, both due to increased pressure on productivity and the *MiC 2025* agenda that specifically aims at the increasing robotisation of manufacturing processes.
22. It is worth noting that between 2014 and 2016, employment numbers have shrunk from 250,000 employees in SOEs to 244,000; and from 19,000 to 14,000 in collectively owned enterprises. Meanwhile, employment in "other" units, that is, mainly private firms, has grown from 3.07 million to 3.15 million employees (*China Labour Statistical Yearbook* various). This reflects the broader sectoral reorientation away from SOE dominance to the rise of privately owned players.
23. https://www.autoexpress.co.uk/car-news/98986/the-global-car-manufacturing-wage-gap-what-do-car-factory-workers-earn; http://www.autonewschina.com/en/article.asp?id=16567
24. http://www.autonewschina.com/en/article.asp?id=18072
25. Here, my observations differ slightly from what Jürgens and Krzywdzinski (2015) have argued for a German JV, namely, that it delivers extensive polyvalent skilling as a requirement of lean production systems.
26. In the absence of official statistics, this is based on anecdotal evidence and confirmation by Chinese trade union officials (Wenten 2016).

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12

The Indian Automobile Industry: Technology Enablers Preparing for the Future

Biswajit Nag and Debdeep De

Introduction

India has emerged as the fourth largest auto market in 2017 with sales increasing 9.5 per cent year-on-year to 4.02 million units (excluding two-wheelers) in 2017. It was the seventh largest manufacturer of commercial vehicles in 2017. The presence of established domestic and international original equipment manufacturers (OEMs), strong market in terms of both, the domestic demand and exports, and so on are driving the industry through technology which is changing the definition of competitiveness in automotive manufacturing industry. Factories are becoming more digitally equipped with smarter machines that produce smart products more efficiently. With the Industry 4.0 in the offing, the automotive

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companies are realising the value of adoption of new technologies to embrace the competition and grow in this fast changing dynamic market.

Against this backdrop, the study would examine the present status of the automobile industry and analyse how the adoption of emerging technologies among the companies is facilitating the Indian automobile industry to grow and remain competitive in this world. The chapter is divided into the following sections. The first section gives an overview of the automobile industry, discussing the trend in growth and production. Also, the export trends are discussed. The second section analyses the trend in production and export of auto components from India. This is followed by section 'The Changing Dynamics of Automobile Market', which discusses the enablers of changing competitive landscape in the industry. Section 'Technology Adoptions in Automobile Industry' highlights the technology adoptions in the Indian automobile industry. Section 'Government Facilitation for Technology Implementation' explains the government facilitation in this sector typically in adoption of technology to remain competitive, and section 'Labour Issues in Automobile Industry' briefly discusses labour issues and globalisation in the Indian automobile industry. Section 'Conclusion' provides the conclusion.

Overview of Indian Automotive Industry

While the automotive industry in India was set up in the 1940s, distinct growth rates were visible only in the 1970s. Cars were considered as ultra-luxury products, manufacturing was strictly licensed, expansion was limited, and there was a restrictive tariff structure. The decade 1985–1995 saw the entry of Maruti Udyog in the passenger car segment in collaboration with Suzuki of Japan, and Japanese manufacturers in the two-wheeler and commercial vehicle segments. After economic reforms took place in India in 1991, it is only in the mid-1990s that the automotive industry started opening up. Thus, the mid-1990s were characterised by the entry of global automotive manufacturers through joint ventures in India. Till the end of 1990s, the automotive industry in India was primarily dominated by Maruti Suzuki, Tata Motors, Hindustan Motors and Premier

Padmini in the passenger car segment (De 2011). Ashok Leyland, Tata Motors and Mahindra & Mahindra dominated the commercial vehicle segment while Bajaj Auto dominated the two-wheeler segment. After the year 2000, further policy changes were introduced and focus on exports was increasingly getting importance. Following that, the Core Group on Automotive Research & Development was set up in the year 2003 to identify priority areas for research and development (R&D) in India.[1] Turnover of the automotive industry in the year 1998–1999 was Rs. 360 billion and the industry provided employment to over 10 million people directly and indirectly. The contribution of the automotive industry to the Gross Domestic Product (GDP) during the same period was 4 per cent, rising from 2.77 per cent recorded in the year 1992–1993.[2]

The automobile industry is one of India's major manufacturing sectors, accounting for 22 per cent of the country's manufacturing GDP and 7.1 per cent of the country's GDP. As per Society for Indian Automobile Manufacturers (SIAM), Indian auto industry is the seventh largest in the world with an annual production of 17.5 million vehicles, of which 2.3 million are exported. The Indian automotive sector has a presence across all vehicle segments and key components. Auto industry comprises of passenger cars, two-wheelers, three-wheelers and commercial vehicles. In terms of volume, two-wheelers dominate the sector, followed by passenger vehicles. The industry had few players and was protected from global competition till the 1990s. After government lifted licensing in 1993, with the arrival of global players, the sector has become highly competitive. Automobile manufacturing units are located all over India. These are, however, concentrated in some pockets such as Chennai and Bangalore in the south, Pune in the west, the National Capital Region (NCR, which includes New Delhi and its suburban districts) in the north, Jamshedpur and Kolkata in the east and Pithampur in the central region. Following global trends, the Indian automotive sector also has most auto suppliers located close to the manufacturing locations of OEMs, forming regional automotive clusters. Broadly, the three main clusters are centred around Chennai, Pune and the NCR. Table 12.1 provides a summary view of automobile clusters in India.

From Fig. 12.1, it is clear that the turnover of Indian industry remains over US$ 60 billion for most of the years between financial year 2011 (FY11) and 2016. The gross turnover of automobile manufacturers

Table 12.1 Automotive clusters in India

	List of companies			
North	Ashok Leyland	Amtek Auto	Bajaj Auto	Yamaha
	Force Motors	Eicher	Hero Group	Mahindra
	Piaggo	Honda SIEL	Escorts	Suzuki Motorcycles
	Swaraj Mazda	Maruti Suzuki	ICML	
		Tata Motors	JCM	
West	Ashok Leyland	Eicher	Renault–Nissan	
	Bajaj Auto	Skoda	John Deere	
	FIAT	Bharat Forge	Mercedes Benz	
	GM	Tata Motors	Tata Hitachi	
	M & M	Volkswagen	VOLVO Eicher	
East	Tata Motors	International auto Forgings		
	Hindustan Motors	JMT		
	Simpson & Co	Exide		
South	Ashok Leyland	Volvo	BMW	TAFE
	Ford	Sundaram Fasteners	Bosch	Daimler
	M & M	Enfield	TVS Motor Company	Caterpillar
	Toyota Kirloskar	Hyundai	Renault–Nissan	Hindustan Motors

Source: India Brand Equity Foundation (IBEF)

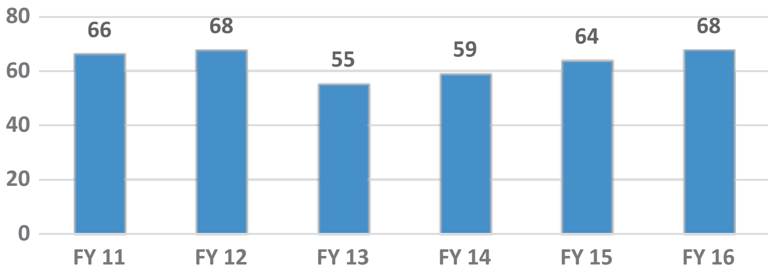

Fig. 12.1 Turnover in automobile industry (US$ billion). Source: Society of Indian Automobile Manufacturers (SIAM)

in India expanded at a Compunded Annual Growth Rate (CAGR) of 11.72 per cent during 2007–2015. However, in the last few years, it has slowed down a bit with stable production.

The domestic automotive market is largely diverse with demands in all kinds of vehicles ranging from two-wheelers to commercial vehicles. Two-wheelers and passenger vehicles dominate the domestic Indian auto market. Passenger car sales are dominated by small and mid-size cars. Two-wheelers and passenger cars accounted for 81 per cent and 13 per cent of over 24.97 million vehicles sold in FY18, respectively. Overall, automobile exports reached 4.04 million vehicles in FY18, implying a CAGR of 6.86 per cent between FY13 and 18. Two-wheelers made up 69.7 per cent of the exported vehicles, followed by passenger vehicles at 18.5 per cent, three-wheelers at 9.4 per cent and commercial vehicles at 2.4 per cent. Overall, automobile exports increased 20.78 per cent year-on-year during April–November 2018 (Fig. 12.2).

The industry is gaining worldwide recognition with a steady increase in the rate of growth of exports. India, being a prominent auto exporter, has strong export growth expectations for the near future. In 2014–2015, automobile exports grew by 15 per cent over the last year within which the passenger vehicles, commercial vehicles, three-wheelers and two-wheelers grew by 4.42 per cent, 11.33 per cent, 15.44 per cent and

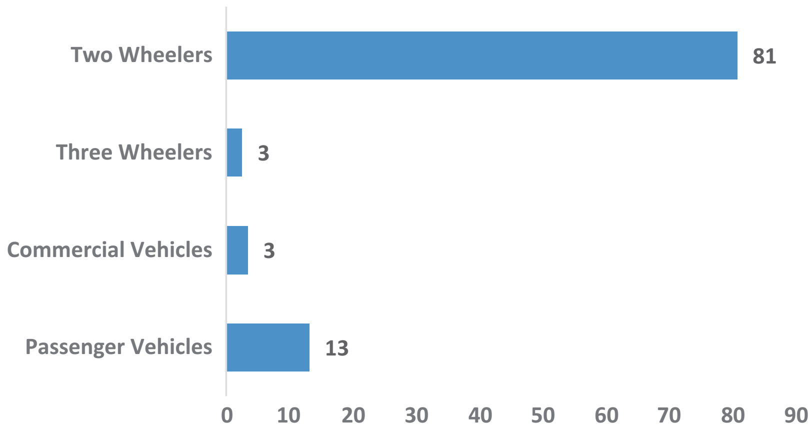

Fig. 12.2 Domestic market share of the major vehicles classified by type (2017–2018). Source: SIAM

17.93 per cent, respectively. The key exporters of passenger cars are Maruti Suzuki, Tata Motors and Hyundai Motors; the key exporter of multi-utility vehicles is Mahindra & Mahindra and the key exporters of two-wheelers are Bajaj Auto and Hero Group. India exports mainly two-wheelers followed by small passenger cars. In terms of values, India's major gain has been in the passenger car segment since 2013 (see Fig. 12.3). Slow growth is observed in the commercial vehicle segment. Though in terms of numbers, India's exports of two-wheelers experienced a jump, it is not fetching large export income as value wise export growth in this segment is much less than the value of car exports. Key destinations of exports are the west European countries, SAARC (South Asian Association for Regional Cooperation) members, Middle East and North America. The trend in growth of the automobiles can be seen from Fig. 12.3.

In the long term, the passenger vehicle segment is expected to grow to nine million units and the two-wheeler segment to 30 million units by 2020, according to Ministry of Heavy Industries and Public Enterprises. SIAM estimates that car sales in India will grow to five million vehicles by 2015 and to nine million by 2020. In fact, by 2050, Indian roads will top the world in terms of car volumes, running a total of 611 million vehicles.

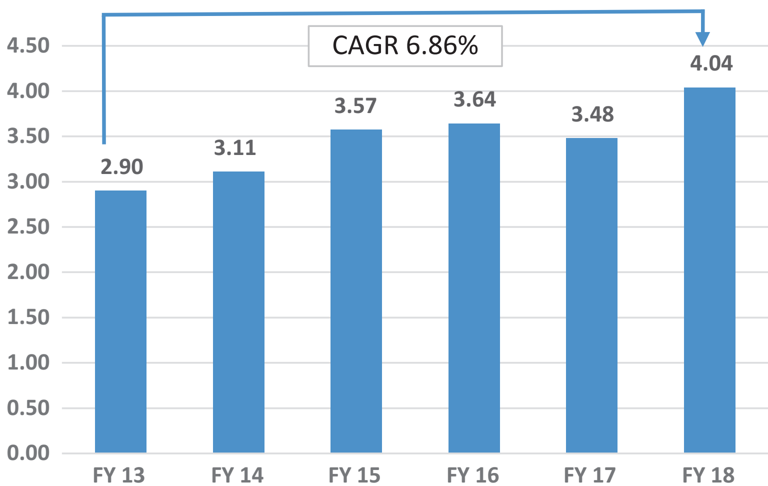

Fig. 12.3 Trend in export of automobiles from India (US$ billion). Source: SIAM

The Indian Auto Component Industry

The auto component industry, on the other hand, is also gaining its significance. Though globally it is not very prominent due to the demographic and maintenance of environmental standards, the industry has attracted a huge investment, and thus holds an important position in the domestic market. As seen from Fig. 12.4, the market size for auto component sector increased by 11.5 per cent, reaching to US$ 43.5 billion in FY16 from US$ 39 billion in FY15 and further to US$ 51.2 billion in FY17 with a growth rate of over 17 per cent. As per Automobile Component Manufacturers Association forecasts, automobile component exports from India are expected to reach US$ 70 billion by 2026 from US$ 13.5 billion in FY17. The Indian auto component industry aims to achieve US$ 200 billion in revenues by 2026. Growth of the domestic auto components industry is expected to reach 9–11 per cent in FY18 on the back of high growth expectation in domestic passenger vehicles and two-wheelers segments. Not surprisingly, the country has emerged as an outsourcing hub for international companies such as Ford, General Motors, Daimler Chrysler, Fiat, Volkswagen and Toyota (Fig. 12.5).

India's exports of auto components increased at a CAGR of 9.96 per cent, during FY09–17, with the value of auto component exports increasing from US$ 5.1 billion in FY09 to US$ 10.9 billion in FY17. Europe

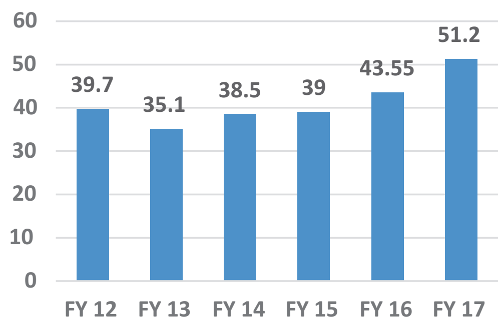

Fig. 12.4 Turnover of auto component industry in India (US$ billion). Source: ACMA

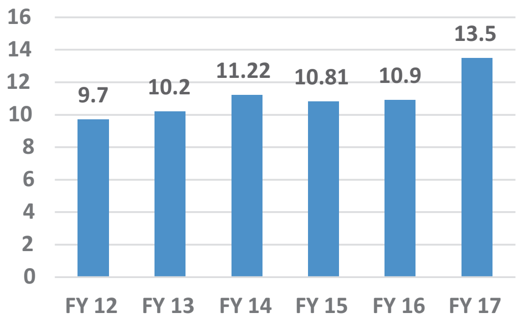

Fig. 12.5 Trend in export of auto components from India (US$ billion). Source: ACMA

accounted for a volume share of 35 per cent during FY17 in Indian auto component exports followed by Asia and North America with 27 and 26 per cent, respectively, in the same year. Though there are still some barriers in terms of access of updated technological skills, regulation of safety, maintenance of environmental standards and so on. The export figures of the auto component sector show that the sector is developing at a rapid pace, especially since 2009–2010. The major export destinations of auto components are the United States, United Kingdom, Germany, Italy, Thailand and so on. The growth rates both for turnover and for exports have gone down due to persistent global recession.

The Changing Dynamics of Automobile Market

The sector consists of an intricate and highly competitive, yet highly interdependent, value chain consisting of a complex supply chain of a number of 'tiers' of suppliers. At the OEM level, product development and manufacturing processes require large investments. As personal vehicles are one of the single most complex direct to consumer products sold today, capital investments are made at all levels of the value chain (Ernst and Kim 2002). Tier 1 and Tier 2 suppliers have significant investment in tooling and production equipment to support the OEMs at high volumes. Beyond CapEx, automakers and suppliers invest heavily in research and development of new models and features to look for an edge in the highly competitive global market.

In coming days, mobility providers (e-hailing, car sharing etc.), technology giants (consumer electronics and automobile software making companies etc.) and emerging market OEMs will define the dynamics of the value chain. As a result, the relationship between OEMs and component suppliers will be subject to the demand of consumers reflected through the modification warranted by tech companies and mobility providers (Fig. 12.6).

Market leaders in two-wheelers have started developing bikes that are 100 per cent indigenous. A very cost-sensitive segment such as tractors is at nearly 100 per cent localisation. Asia is emerging as the growth engine for the global automotive market, backed by its cost competitiveness, rising incomes, rapid urbanisation, improving infrastructure and the scope for greater vehicle penetration in most Asian countries. Automotive manufacturers are adopting a strong zero-defect policy, encouraging component manufacturers who do well on the zero-defect parameter and penalising those who do not. The global supply chain is more connected than ever before. This amplifies the impact of any unexpected changes—from exchange rate fluctuations and price volatility to geopolitical tensions or natural disasters. In recent years, many auto component manufacturers (mostly Tier 1) have gone beyond their role as part suppliers for automotive manufacturers to enter other segments of the value chain. Many companies are moving to operate as system integrators, such as offering electric mobility solutions, a computing platform for self-driven vehicles, a connected infotainment ecosystem, telematics solutions and smart supply chain solutions, among other things. Smaller companies seeking top-line growth and cost synergies are struggling in the face of increasingly complex technology and business models. More and more such

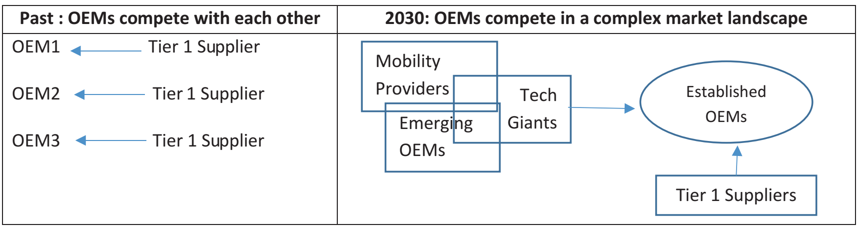

Fig. 12.6 The dynamic value chain. Source: Adapted from KPMG Automobile Outlook

companies end up merging or are taken over by bigger companies. Auto component manufacturers would need to keep pace with the changing needs of automotive OEMs, who in turn are coping with the dynamic expectations of the end customer, consolidation of platforms to reduce complexity and alterations in vehicle cost composition (Kimura 2006). While car production volumes have been rising, the number of vehicle platforms has fallen for most OEMs. This means automotive manufacturers could require simpler, more versatile components that are usable across multiple platforms. Product lifecycles for many car manufacturers have been shrinking. In India, as tastes shift and evolve and new entrants join the ranks of consumers, vehicle owners scout for fresh options more frequently than they did before, eager to upgrade or change their set of wheels. Rapidly evolving emissions and safety regulations as well as technological disruptions such as connectivity and e-mobility could underpin the demand for electronics at an OEM and customer level. For instance, it is expected that the implementation of Bharat Stage VI (BS-VI) standards will lead to a spike in demand for components like catalytic convertors, electronic fuel injection systems, oxygen sensors and intelligent battery sensors. OEMs around the world have been gravitating for a while towards a model of close collaboration with a small, informal group of auto component suppliers that grow and expand a business together (Grandori and Soda 1995). The World Bank has highlighted that only 47 per cent of automotive companies in India have internationally recognised quality certification, compared to 83 per cent in China.

The level of regulation is medium but quickly increasing. Emissions, fuel economy standards and crash safety have been at the centre of regulation for several decades now and are widely known and publicised. Safety recalls have been a recent topic of discussion with both 2013 and 2014 seeing record number of recalls industry wide. Regulations are increasing worldwide, and the lack of international standards leave OEMs with the high costs of certifying their vehicle platforms for use in multiple countries (Table 12.2).

Electric vehicles are one of the trends shaping the sector, now and in the future. Convergent factors such as increasing concerns over energy security, climate change and increasing oil demand from rapidly industrialising nations have created heightened interest in a variety of fuel-saving technology options. However, as electrification is not consumer driven but instead being driven by legislative requirements, market penetration of full electric vehicles will remain low.

Table 12.2 The changing market dynamics in India

Constantly shifting market dynamics		Changing OEM needs	Technological improvements and discontinuities	Evolving regulatory and trade environment
Make in India, for India and the World	The rise of the East	• Changing pockets of growth • Platform consolidation	• ACES gathering momentum • Industry 4.0	Emissions: BS-VI, EV, Methanol, CNG, fuel cells
Traceability and zero defects	Volatility and forcastability	• Shorter product lifecycle	• Advanced materials	Safety: Braking, cabin, rollover protection
Auto component manufacturers integrating up the value chain	Evolving adjacent industries in India	• Rise of electronics • Tier 1: Rationalisation	• Rise of new challengers from unrelated sectors	Scrappage: Lead use, reverse value chain
Consolidation in the global industry		• Tier 2 and 3: Quality	• Mobility as a service	Dynamic Global Trade policies

Source: IHS Markit

Technology Adoptions in Automobile Industry

The role of technology has been crucial for the companies in the automobile sector. Many companies are trying to enhance customer experiences using technologies. They are also raising the bar of customer expectations to redefine competition and gain a competitive advantage. Companies are leveraging technology to improve product quality, operation planning or even factory design (Nag et al. 2007). Innovation in the sector has been imperative for staying competitive in the market. Some of the most important ways through which the firms in the sector are remaining competitive are highlighted below.

Digitalising Factory Operations

Digitalisation of the factory operations has been one of the key instruments which firms are adopting. This not only improves the precision but also maintains the standards as per the requirement. Government of India in its strategy paper on artificial intelligence argues strongly for smart mobility for a developing country like India with a focus on solving several problems such as route optimisation, assisted driving, congestion management apart from several technical modules in production process.[3] It is expected that automation and digitisation will change the landscape of Indian auto industry as production process will move from volume based mass production to value based system. Volume based production has been improving the system through shop floor customisation but connected manufacturing offers the auto sector unique opportunities that would facilitate new business models and innovative products with greater integration of functions through embedded systems. Automation, combined with connectivity are expected to provide more real-time data for analysis and continuous improvement. Indian industries are gearing up for this new reality.[4] Modern automobile factories require a balanced combination of digital tools and human interface. The following are highlighted as some of the key ways of implementation of digital technology in factory operations.

Tracking of Assets and Products

Asset tracking is one of the most common activities in factory operations, especially for companies which are asset intensive. Advancements in technologies are enabling companies to create enhanced solutions to track their assets.

Remote Monitoring of Production Processes

Digital technology enables companies to send process-related data directly to the cloud and perform many operations with it. Companies can store this huge volume of process-related data in a big data store and later analyse it to find patterns. They can monitor live streaming from the production process from anywhere in the world through various mobile devices. They can get notifications by email or SMS if required in certain situations.

Predictive Maintenance

A predictive maintenance solution takes into account various parameters such as temperature, pressure, vibration, revolutions per minute and flow rate from machines through the sensors and applies analytics technologies to understand the probable time for failure based on the historical instances of failure and the corresponding parameter values. A match in the streamed equipment data with pre-identified failure patterns triggers alarms and notifications indicating a deterioration of machine health and the potential for equipment failure.

Flexible Manufacturing

Radio frequency identification (RFID) is used to track products and their movements during the product lifecycle. RFID attached to a product can hold information about the production process needed to manufacture that product. Thereby, it can guide the product through its production process without human intervention. The machines, robots and other components of the production system will follow the instructions from the RFID chip to produce the product.

Augmented Reality–Based Solutions for Training Workforces

Augmented reality (AR)–based training solutions are already used in multiple companies belonging to industries such as automotive, aerospace and logistics. Many other companies are exploring the idea of creating such solutions.

Technology in Product and Customer Experience

Products are being designed to capture data about themselves through embedded sensors, processors, software and connectivity. The data can then be sent to the cloud and analysed for after-sales product performance. Companies can capture the pattern of how certain products are actually getting used by the customer and this can be a valuable input for future product development. Companies can also respond fast to provide after-sales service to the customer if the captured data suggests any problem with the product. A few automotive, heavy machinery and energy sector companies, among others, have started using such solutions.

Technology in Product Design and Prototyping

Virtual Reality and Augmented Reality in Product Development and Prototyping

Virtual reality (VR) in the product development and prototyping space has its advantage. It provides a close to real-life interactive experience. So, engineers can verify fit or compatibility of components and inspect photorealistic 3D objects in virtual space. AR-based solutions are also used for product development. AR can superimpose the 3D designs on a user's view of reality. Therefore, using such solutions, it is possible to compare life-size 3D holograms generated out of the computer-aided design (CAD) model with a physical prototype or even a product.

This can improve the quality assurance process and provide the ability to discover defects fast during the product development phase. It can also reduce the inspection time during the quality control process. Such a solution has saved nearly 96 per cent of the inspection time for a shipbuilding company.

Digital Twin

Digital twins are virtual models of physical assets such as products, processes, systems or facilities. Digital twins are being used by companies in various ways. Some of the companies are using them to plan, design and construct factory building and infrastructure. The technology can support testing, simulation and commissioning of factory buildings.

Rapid Prototyping using Additive Manufacturing

Additive manufacturing offers a cost-effective and faster way to prototype. Often, prototyping for a newly designed product may involve expensive operations like a production run. It may also involve investments like mould alteration before the design is even verified. In such cases, additive manufacturing lowers cost and time (Table 12.3).

Table 12.3 Major steps taken up by India on technology upgrading and mobility

– The Automotive Mission Plan 2016, which aims to increase domestic production of automobiles, increase automotive exports and address environmental and safety challenges
– The National Automotive Testing and R&D Infrastructure Project, which has been set up to enable the industry to adopt and implement global performance standards by establishing nationwide automobile testing agencies
– The National Electric Mobility Mission Plan 2020, which provides incentives to manufacturers of and purchasers of electric cars
– The Faster Adoption and Manufacturing of (Hybrid and) Electric Vehicles scheme, which provides monetary incentives to producers and purchasers of eco-friendly vehicles in the country

Source: https://gettingthedealthrough.com/area/95/jurisdiction/13/automotive-india/

Government Facilitation for Technology Implementation

The initiatives of the Indian government, such as 'Make in India' and 'Digital India', are efforts to foster technology adoption and global standards in the industries. The government is promoting the adoption of 'Industry 4.0' and smart manufacturing throughout the manufacturing sector.

One of the premier institutes of India is building India's first smart factory with a seed fund from a global aviation giant. This factory collects an enormous amount of data from literally every object. It even collects data from the posture of a worker and determines when the worker needs rest after analysing posture data and other data from his working field. In a nutshell, the factory is self-aware.

The government of India's push for electric vehicles under the Faster Adoption and Manufacturing of (Hybrid) and Electric Vehicles in India scheme will help the automotive industry to upgrade their products by using the latest technology. The government's initiative for a comprehensive study on Zero Emission Vehicles (Zevs): Towards a Policy Framework is an important step in this direction. As part of this initiative, the government is procuring electric vehicles from the country's renowned auto manufacturers. It is also bringing electric vehicles under a lower taxation rate. All big automotive OEMs in India are gearing up to use this new technology in their products. Renowned battery companies are researching advanced battery technologies to support these vehicles.

In another initiative to curb environmental pollution, the government of India has decided to adopt Bharat Stage VI as the minimum standard for automotive manufacturing (Automotive Mission Plan 2016). Once implemented, this will require a significant step forward by moving two levels at a time. Bharat Stage V, which was compliant with Euro V standards, will be skipped completely. The implementation timeline is within the next few years. This regulation change and associated implementation are expected to bring technology-driven changes in the automobile value chain, including auto ancillary sectors which are related to the manufacturing of engine and fuel components.

Moreover, the government of India's 'Smart Cities Mission' to develop smart cities across India is expected to boost the usage of sensors, connected objects and emerging technologies. It is also expected to provide improved infrastructure. All of these will ultimately benefit the manufacturing industry as well as many other industries.

The government of India is aiming for 5G network connectivity in India by 2020. The large network service providers in India are working on technologies that can support and enable 5G connectivity. The prospect of 5G connectivity in the next few years will provide a boost to IoT initiatives across industries.

State governments are also taking many initiatives to boost technology adoption. A few state governments have set up partnerships with information technology companies to spread digital awareness, promote technology adoption and develop skills for digital transformation. Some of them are conducting state-level hackathons to develop solutions in challenge areas like fintech, tourism and transportation. They are also trying to build their states into hubs for selected technologies.

Keeping all these trends and expectations in mind, the government launched the Automotive Mission Plan (2016–2026) which aims to make India one of the top three manufacturers and exporters of vehicles and components. It is possible only when India adopts most modern technology and employs skilled workforce. Already, the automobile industry is recognised as the main engine in the 'Make in India' initiative and a lot of investments are made for skill development. Government is also focussing on improving fuel or emission norms, safety regulations, end-of-life policies for vehicles and so on. Fiscal and better tax regime is proposed to finance the growth of the industry along with investment in R&D and participation in global value chain.

Labour Issues in Automobile Industry

Democratic governance structure and several constitutional rights provide Indian workers a bargaining power with the management. India has also witnessed vibrant trade union movement in the past. It introduced Minimum Wage Act in 1948 and later Social Security Act for unorganised workers in 2008. This is important as the long tail of the value chain in the industry ends up with some kind of informalisation. Though the laws are in place, some studies have identified a decline in compliance and a rise in unfair practices (Sreenivasan and Tripathy 2014). Automobile sector has long supply chain with numerous Small and Medium Enterprises (SMEs) engaged at various levels with different level of technology infusion. Given the strong backward and forward linkages, promoting SMEs in the auto sector has been central to the industrial policy of India. SMEs act as subcontractors to large firms, following the production requirements and specifications of the latter. The SMEs also try to regularly upgrade their technologies through vertical and horizontal integration networks of OEMs. After the entry of many international OEMs in India, the relationship between OEMs and SME suppliers has undergone a substantial change. Earlier, OEMs used to take some amount of risk by having JV relationship with SMEs or some kind of collaboration for development of the products or even sometimes financing product development (Ruigrok and Tulder 1995). However, the relationship has become more 'cost based' gradually, which increased the risk of SMEs in taking up investment to fulfil the requirement of OEMs. As Indian industry is now globally linked, this has clearly increased the risks for SMEs who are now directly facing the ups and downs of global demand. This in turn has an effect on the labour relationship. More skilled and productive employees are in demand due to infusion of technology, and slowly, there is an erosion of unproductive labour. Several authors, such as Remesh (2017), argue for more proactive policies from government on labour management so that the automobile sector can contribute meaningfully to Indian economy. Studies highlight labour issues in companies like Suzuki, Hero Honda, Toyota, GM as a demonstration of changing labour relations in India due to the advent of globalisation. Barnes (2014) highlights that auto cluster now relies upon a well-entrenched regional labour contracting system in order to lower labour costs and minimise the impact of collective bargaining and trade unions. Most workers in medium-to-large auto assembly and components firms are hired by labour contractors. A report in Business Today (July 17, 2016)[5] indicates that strikes and lock-outs in automobile firms are due to salary disputes and lay-offs. Companies employ contractual workers considering the cyclical nature of the market with a huge salary disparity between permanent and contractual workers. Nowak (2016) has brought up an important issue analysing the labour unrest of 2011 and 2012 in Suzuki factory. Due to huge difference in salary and other benefits between permanent and contractual labour, different trade union organisations are in conflict among themselves, which weakens the overall trade union movement. The article also highlights that labour unrest at ancillary level has an industry-wide impact as many SMEs supply different OEMs simultaneously.

Due to more automation, several auto majors are now trying to shift some of their operations to other countries. At the juncture when India is eyeing for an improved position in the global automobile market, labour disputes continue to haunt the OEMs. It is only the vibrant domestic market which acts as a binding force for these OEMs to continue and expand their business operation in India. India requires to bring a balance among productivity, skill development and contractual employment system; otherwise, it is going to affect its export performance. Lastly, it is important to note that labour disputes in automobile industry have been under control mostly in recent times due to active involvement of the Indian judiciary.

Conclusion

Overall, technology adoption among companies in the automobile sector is increasing. Industry bodies are generating more awareness about new technology options by providing a common platform to industry leaders, academia, service providers and consultants. At the same time, emerging technologies are going to change the manufacturing landscape in a significant way. There will be new opportunities for developing products and services as the fourth industrial revolution is going to bring sweeping changes in automotive manufacturing and automotive component manufacturing. Competition is expected from nontraditional players. Government has already undertaken certain initiatives to embrace the new technologies in the sector. India is set to create an example of a productive manufacturing environment by leveraging the emerging technologies embracing the new digital industrial revolution in the automobile sector.

Notes

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13

The Boom of the Mexican Automotive Industry: From NAFTA to USMCA

Alex Covarrubias V.

Introduction

In the last few years, the Mexican automotive industry (MAI) has emerged as one of the sector's hottest spots worldwide, becoming the largest producer in Latin America, the seventh producer and fourth exporter globally, as well as the second largest exporter to the American market. The Mexican position became more salient as the Trump administration called to renegotiate the North American Free Trade Agreement (NAFTA), blaming it for the mass emigration of jobs and investment in low-wage industries like the MAI. This chapter aims to identify the nature of the MAI boom and the factors that explain it, showing how these combine in a unique formula comprised of its nearshoring status, free trade frameworks and cheap labor that have been instrumental in defending, pursuing, and reshaping the North American automotive industry. The country is now attracting most of the factory assembly openings in

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the region and auto jobs have more than doubled over the last decade to account for more than 40% of the North American total.

Mexico is the only emerging economy that has gained a place in the industry by becoming an open, cost-competitive platform for exports, able to attract growing flows of foreign direct investment and with no intention of building an industry of its own. This chapter shows the role of American decision-makers in developing this model and how they designed NAFTA[1] to ensure that Mexico would remain the Detroit 3's backyard while also keeping out Asian and European automakers. It is hypothesized that having failed to accomplish that goal, the US-Mexico-Canada Agreement (USMCA), crafted by Trump to replace NAFTA, will eventually also fall short of correcting the US deficit and regaining the initiative over MAI for US producers and markets. The USMCA will fail despite the fact it raises the rule of origin to a 75% threshold and includes a labor value content ruling that up to 45% of a car must be made by workers earning at least $16 an hour.

The chapter is organized in six sections, with a final discussion and concluding remarks. The first section details the boom of the MAI, showing its depth and breadth since the last global crisis. Section 'The Boom of the MAI' describes how Asian and European manufacturers are leading the MAI's boom in a fierce competition to capture and reshape the North American market. Section 'Pursuing and Changing the North America Market' identifies how the types of vehicles manufactured and sold by the MAI, namely compact/small cars and light trucks propelled by traditional internal combustion engines (ICEs), are demanded by the US market. Sections 'Types of Car Output and Consumption: Mexico Trapped in the ICE Era' and 'Factors Explaining the MAI Boom' reflect on the factors explaining the MAI's boom and the key role played by the Mexican industrial relations system, a one-sided system that aims to please management and attract foreign investment. Section 'An Industrial Relations System to Please Management' looks at the motives and conditions that lead from NAFTA to the USMCA and describes the unprecedented labor chapter that the Trump administration included as a condition to ratify the new agreement. The final section wraps up the main findings and likely implications for the future of the MAI.

The Boom of the MAI

In the last few years, Mexico has become one of the auto industry's hottest spots worldwide, with the MAI developing as one of the leading regions for attracting foreign direct investment flows. In fact, by 2013 the MAI captured the largest flow of FDI worldwide (Kynge 2015). Since the 2008–2009 financial crisis, the MAI's output increased overall by 90%, a more than 8% annual rate from 2007 to 2017. In the past year, auto output was 4 million units, representing 23% of the North American total, and up from 3.6 million units and 20% in 2016, respectively. By 2023, NAFTA light vehicle capacity is expected to reach 22.5 million units, of which Mexico will account for 26%.[2] Only China and India have surpassed Mexico in the manufacturing of cars and commercial vehicles.[3] The country is already the seventh producer and fourth exporter worldwide, as well as the second exporter to the American market.

By the end of 2014, Mexico passed Brazil as the leading manufacturer in Latin America, when Brazilian production plunged 15% due to a stagnant internal economy as well as difficulties related to the Chinese and Argentinean economies, its two major international markets. By then Mexico had already overtaken Japan as the number one exporter to the US market. The country also already ranks fifth in both output and exports of auto parts and components and, simultaneously, has taken the lead in the supply of parts and components to the US market.

The MAI is of utmost importance to the country. It is a key factor in maintaining Mexico's trade balance with a 2017 net surplus of $70 billion, representing more than a quarter of the foreign currency received by the country. Its $120 billion exports account for more foreign currency than oil, tourism, and expatriate remittances put together. The MAI is now the largest manufacturing employer in Mexico with almost 800,000 direct jobs (one-fifth of the country's manufacturing positions). The terminal sector accounts for 13% of these.[4]

The American market is the MAI's primary engine. In 2017, of the 82% total output that went to international markets, the US market accounted for 84.5%. In contrast, the domestic market has grown at a slower rate. After increasing between 2009 and 2016, from 0.8 to 1.6 million unit sales, it fell 5% in 2017 with the latter figure only 25% more than the vehicles sold in 2005. As a result, Mexico is not a top-selling market as much as it is a top manufacturer.

The limited domestic market for new cars reflects the median Mexican consumer's limited purchasing power, which in turn points to the embedded low-wage nature of the Mexican economy. It also relates to the fact that in the 1980s, the MAI was reoriented to the external market and, with NAFTA, to a process of total integration with the North American auto industry.[5] Thus, from the signing of NAFTA in 1995 until 2017, the MAI's export share increased from 53% to 82% (Klier and Rubenstein 2017).

The past ten years have seen an unprecedented number of factory openings, retooling, and projects for new plants (Fig. 13.1). These include assembly plants that opened in 2013–2014—such as Honda, Celaya; Mazda, Salamanca; Chrysler Van, Saltillo; and Nissan 2, Aguascalientes—; and companies increasing their operations over the past three years such as Audi, San José Puebla; BMW, San Luis Potosí; Daimler AG, located next to Nissan 2 in Aguascalientes[6]; Kia, in partnership with Hyundai, in Pesqueria Monterrey; and Toyota, in Apaseo El Grande, Guanajuato. Following US president Trump's pressure to go back home or pay a 35%

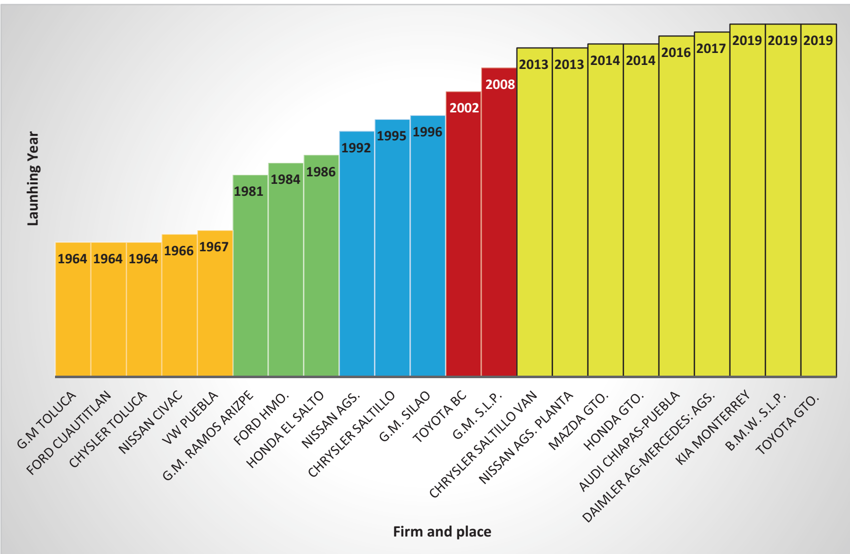

Fig. 13.1 Waves of the MAI 1964–2019. Source: Author's elaboration

tariff on imports from Mexico and threats to withdraw from NAFTA, Ford canceled a project to build a new assembly plant in San Luis Potosí. Nevertheless, it invested $2.5 billion to expand its motor capacity in Chihuahua and set up a new generation transmission factory in Guanajuato. Likewise, Volkswagen (VW) invested $1 billion to produce the Tiguan model in Puebla, and other key players, such as Land Rover, Renault, Hyundai, Seat, and MINI, disclosed plans to invest shortly in Mexico. Despite this, until the uncertainty prompted by Trump regarding NAFTA has settled, they and other global corporations like General Motors (GM), Toyota, Honda, and Fiat Chrysler Automobiles (FCA) have put their projects in Mexico on hold.

As noted, Mexico is the fifth largest auto parts manufacturer worldwide, generating $122 billion in revenue in 2017 and with facilities in 21 states. According to ProMexico (2016), the country has 1236 auto supply companies in the two first tiers, with another 1320 corresponding to tiers 3 and 4. Mexican workers manufacture parts and components for practically all systems in a vehicle (Carrillo V. 2016). Of the 100 leading auto parts and components corporations, 90 are in Mexico. Since 2015, Mexico has also been a world leader in tractor-trailer exports for the trucking industry with 92,630 units (Export.gov 2018), reflecting a well-established heavy vehicle sector. Tractor-trailers, commercial vehicles, and passenger cars are built by most of the large heavy vehicle brands, such as Volvo, Detroit Diesel Allison, Freightliner, Dina, Mercedes-Benz, and Scania. Chinese firms have also made inroads in this sector. For example, FAW Group, one of the 'Big Four' Chinese automakers, offers low-priced commercial and utility trucks in Mexico, for which, it partnered with Giant Motors Latinoamerica, a subsidiary of the financial Inbursa Group of Carlos Slim (the richest man in Mexico and one of the top ten billionaires in the world).[7]

Pursuing and Changing the North America Market

About 90% of new investments for assembly plants that have poured into the MAI since 2009 have come from Asian and European automakers (CAR 2016). The 2008 crisis of the Detroit 3 which led to a record $80.7

billion government bailout, combined with the uncertainty surrounding their future was a powerful incentive for Asian and European companies to expand their presence in North America. They were also encouraged by the ending of the NAFTA's ten-year phasing out period for trade barriers together with Mexico's broad network of free trade agreements that allow the MAI to reach more than half of the world's new vehicle market, tariff-free. Currently, six leading Asian companies—that is, Toyota, Nissan, Honda, Mazda, Kia, and more recently FAOA—, four European companies—that is, VW, Audi, BMW, and Daimler AG—, and the former Big Three, are either establishing plants or expanding operations in Mexico. This will reshape not only the footprint of the industry in Mexico but also in North America. Although the impact of this will only be fully apparent once the new facilities are operating at full speed, what is clear is that Asian and European automakers will account for a much larger portion of the MAI output, further displacing GM, Ford, and FCA who already make up less than half of its output (45% in 2017) (Fig. 13.2).

Currently, automakers operate 22 assembly plants in Mexico, producing 42 brands of cars and 500 models; they are supplied by more than 2500 auto parts facilities and supported by 1800 dealers. Plants are clustered around Central Mexico (Estado de México, Morelos and Puebla), the Northern Border (Coahuila, Sonora and Baja California), and the

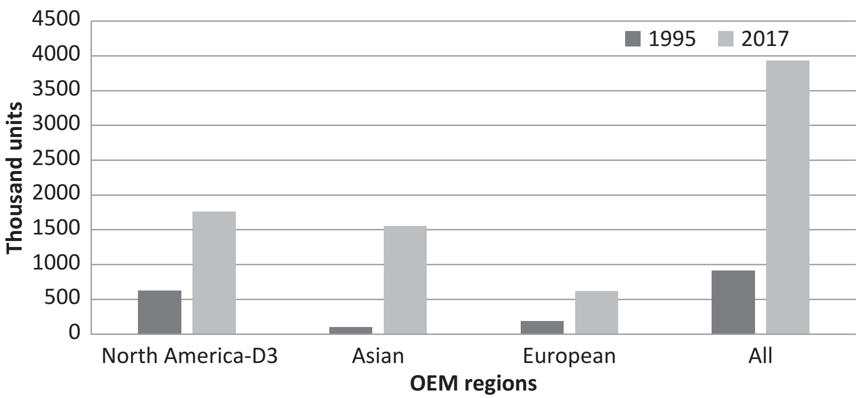

Fig. 13.2 Light vehicle production in Mexico by regional automakers. Source: Author's elaboration based on AMIA database

Bajio Region (Guanajuato, Querétaro, Jalisco, San Luis Potosí and Aguascalientes). This last region has become the largest automotive cluster in Mexico, host to eight leading automakers, and churning out 1.5 million vehicles per year.[8] Such output has placed it among the world's top 15 largest auto manufacturers worldwide.

Prior to the boom, NAFTA's impact on the industry was modest. The auto parts sector expanded and agglomerated primarily in northern Mexico, and between 1994 and 2007 only three new assembly plants were opened, namely a new Chrysler facility in Saltillo (1995), GM Silao (1996), and Toyota (2002). In contrast, since the last financial crisis almost as many assembly plants have opened as did in the industry's entire history dating back to the 1960s.[9] The implications of the MAI's boom for the North American industry are considerable, to the degree that there is some question as to whether the growth of the MAI has happened at the expense of the US industry. The fact is that over the past decade, 9 of 11 new assembly plants built in the northern hemisphere were built in Mexico, and only two of these belonged to the Detroit 3. Furthermore, while FCA, GM, and Ford plan to increase North American production between 2016 and 2020, all will be manufactured in Mexico, while their production in the US and Canada will decrease by 5% and 1%, respectively (CAR 2016: 11).

The MAI boom has also transformed the geography of auto employment in North America. During this time, jobs in the MAI have more than doubled, with its share of jobs in the NAFTA region soaring to 42%, while the US and Canada have seen a decrease to 51% and 7%, respectively (Rodriguez A. and Sanchez 2017). Similarly, the Detroit 3 have seen their share of light vehicle sales within Mexico steadily decline, falling from 65% to 32% between 1985 and 2016.

Mexico Trapped in the ICE Era

The MAI has specialized in the production and marketing of compact/small cars and light trucks propelled by traditional internal combustion engines (ICEs). Nissan, GM, and VW dominate most of the Mexican market, followed by Chrysler and Ford. The top-selling models in Mexico are Nissan's Versa, Tsuru, March, Sentra, and Tiida; GM's Aveo and Spark; and VW's Vento, New Jetta y Jetta Classic. A 2016 technical study of these cars (Covarrubias V. and García 2017) showed that all but two models of the New Jetta (which use diesel—that is, the Gear Direct Shift and Manual Shift) were gas-ICEs propelled with an average energy efficiency of 12.5 km/l. Their CO_2 emissions—the gas that most contributes to the greenhouse effect according to *Green Facts* (2017) had an average of 196 g/km. The Mexican Official Norm 163 (DOF: 21-06-2013),[10] requires that the average fuel efficiency of these vehicles be 14 km/l with CO_2 levels of 169.9 g/km. These models were thus below the Norm 163.

With only one exception, all the top vehicles exported to the US market were traditional ICE units: Nissan Versa, Chevrolet Silverado 2500, Ram 2500, Ford Fusion, and Nissan Sentra. They were gas guzzlers: most of them had eight-cylinder engines—in fact, all the GM Silverados 2500 and Chrysler Ram 2500 fell in this category. They offered an 8.3 km/l adjusted efficiency, and their average CO_2 emissions were 316 g/km. The top ten imported cars were all ICEs. They included SUVs (Renault Duster and Mazda CX-5), pickups (Toyota Hilux and Ford Ranger), luxuries (VW Passat and Nissan Altima), and Minivans (Toyota Sienna and Honda Odyssey). They had a fuel adjusted efficiency of 9.9 km/l, with average CO_2 emissions of 249 g/km.

Mexico has only just begun to produce and consume vehicles other than ICEs. In 2017 electric and hybrid vehicle sales increased by 30% compared with 2016, although they remained a fraction of the total market: 10,011 units, 270 of which were EVs. (data from AMIA 2018). The EV market in the country thus accounted for 0.018% of total sales, far below the 3% sold worldwide in 2017.

Some leading automakers have expressed interest in manufacturing EVs in Mexico, but thus far, none have committed to any specific project. Nevertheless, what is emerging in Mexico, is a cadre of local innovators and new players looking to make inroads in the EVs market. Two cases stand out.

The first is the collaboration between Giant Motors (the FAW-Inbursa-Carlos Slim alliance) and Moldex (a metal-mechanic firm that forms part of Grupo Bimbo, a Mexican food multinational) to manufacture EVs.

Their alliance began in 2015 when they partnered to build light electrical trucks for logistics companies. Their initial progress has been rather modest, with the sale of 500 units. The second case corresponds to Mexican scientists and innovators who have identified the current transition in the industry as an opportunity to develop Mexican technology and solutions to the environmental problems resulting from the combination of ICEs/Fuel Oil. They created in 2017 ZACUA, the first Mexican firm to manufacture electrical cars and the first fully-EV made in Mexico. It features a two-seat compact car assembled in Puebla in a small shop run by 15 employees.

Factors Explaining the MAI Boom

Good geography and logistics, a global network of free trade agreements with NAFTA at the center, and cheap, skilled labor are the key factors explaining the prominence of the MAI. They result in a formula that has made the MAI a reliable, qualified, and cheap export platform.

The geography of the MAI comprises 3145 km (1954 miles) of the US-Mexico border. It is filled with a network of 117 ports and terminals, 67 border crossings, and 63 international airports, allowing the country to function as a gateway between the largest western automotive market—that is, the American one—Latin America and the European and Asian countries. In addition, there is a broad and experienced network of logistics firms straddling the North American border dealing with customs, planning, purchasing, transportation, and delivery strategies to ensure timely supplies across the multiple automotive supply chains. Geography and logistics favor the mobility of both goods and people, lowering communication costs and integrating supply strategies whether by air, sea, road, or rail. It is estimated that more than 2500 auto suppliers perform more than fifty billion intra-firm transactions annually to move parts and components back and forth for the production of vehicles across the North American border (SE 2017).

Mexico has created a dense network of international free trade agreements (FTAs) that support its competitive advantage as an export platform, including ten free trade agreements with forty-five countries, thirty-two agreements for promoting and protecting investments, and nine trade agreements within the Latin American Association for Integration framework (Promexico 2017). These, together with Mexican membership in the WTO, OCE, and APEC, grant Mexican exports tariff-free access to countries that account for the majority of the worldwide Gross Domestic Product. The Center for Automotive Research (CAR) estimates that automakers can save $2500 per vehicle in tariffs when exporting from Mexico to the European Union, as opposed to from the US (CAR 2016). The latest step taken by Mexico in signing the Comprehensive and Progressive Agreement for Trans-Pacific Partnership will strengthen the position of the MAI in the Pacific region, opening access to the Australian and New Zealand markets, among others.

The core of these FTAs has been NAFTA, and corporations come to Mexico seeking access to the American market. This market, including Canada, accounts for 89% of automotive exports. South America and European markets receive 6% and 4%, respectively, of the MAI exports with the remaining 1% going to Asian markets. Still, it would be a mistake to think that the framework of FTAs has made all the difference for the MAI. Like Mexico, Canada has also been pursuing FTAs. According to CAR (2018), Canada could reach 53% of the global new vehicle market tariff-free, based on its broad FTA framework. That is, a larger global tariff-free market than Mexico's (51%), not to mention that of the US (28%). Nevertheless, the Canadian auto industry is in decline. This is where labor costs make a difference (Fig. 13.3).

Skilled cheap labor is the second key variable of the MAI's success in attracting FDI flows. In general, Mexican labor is not yet as qualified as their American and Canadian counterparts and training systems lack the consistency and quality of other emergent countries (see Sancak in this book). In regions where the MAI has seen the highest growth, such as the Bajio Region, there is a deficit of technicians, and firms are poaching skilled workers to combat this. Nevertheless, automakers value the efforts made by MAI leaders to increase the pool of skilled autoworkers. In particular, they appreciate the funding of one-year on-the-job-training provided by the Mexican government and its efforts to improve its higher education, with a growing pool of industry-specialized engineers. SE

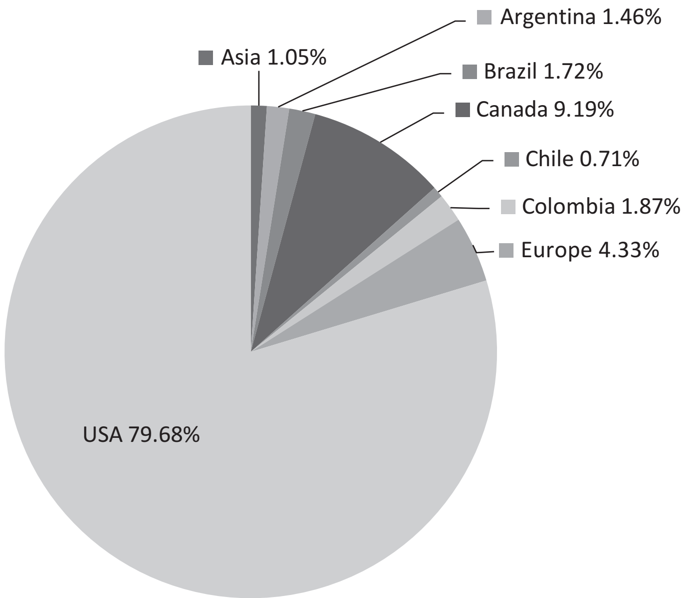

Fig. 13.3 Mexico 2016 Exports (percentage). Source: Own elaboration with International Organization of Motor Vehicle Manufacturers (OICA) data

(Secretaria de Economia) (2017) states that 90,000 engineers with such a profile graduate annually from the university system. Moreover, the productivity of Mexican workers offsets the shortcomings in their basic skills. This is especially the case for the terminal sector. Plant managers of the eight OEMs in Mexico stated publicly that 'Mexican workers rank among the most productive in the world' (Covarrubias V. 2017).

Despite this, Mexican autoworkers earn poor wages: on average, vehicle assemblers receive $2.30 per hour (Table 13.1); workers of part supplier's tiers 1 and 2 receive half of this, and workers of part suppliers 3 and 4, a third. Adding 30% for statutory and fringe benefits for total labor compensation, they earn $2.99 dollars per hour.[11]

Table 13.1 shows the daily wages of Mexican autoworkers, plant by plant, as established in collective bargaining agreements signed between management and labor unions. Several points are worth noting: the $2.30 mean wage shows that Mexican autoworkers earn less than a tenth of their US counterparts who received a mean hourly wage of $26.50 in

Table 13.1 Blue-collar workers assembly plants hourly wages

OEM/Plant (Contract year)	Mexican Pesos	USD
Nissan Civac (2016)	60	3.2
Chrysler Toluca (2015)	59	3.2
Chrysler Coahuila (2015)	59	3.2
VW Puebla (2016)	54	2.9
GM Toluca (2016)	51	2.8
Audi SJCh Puebla (2017)	50	2.7
Ford Cuautitlan (2016)	46	2.5
Toyota Baja California (2016)	46	2.5
Kia Pesqueria (2015)	46	2.5
Ford Hermosillo (2016)	42	2.3
Nissan Aguas Calientes (2016)	40	2.2
Nissan Aguas Calientes II (2016)	40	2.2
GM Ramos Arizpe (2016)	36	1.9
Honda El Salto (2016)	35	1.9
GM San Luis Potosí (2016)	33	1.8
Honda Guanajuato (2016)	31	1.7
BMW San Luis Potosí (2016)	28	1.5
Mazda (2016)	19	1
Mean hourly wage	43	2.3

Source: Collective Bargaining Agreements registered in the Labor Minister Office STPS as of February 2017. In parenthesis the year of registration. one dollar = 18.5 Mexican Pesos, March 2017

2016, according to Bureau of Labor Statistics (2017). Further, the $2.90 total compensation is far less when compared with the $47.00 made by American autoworkers (this data according to *The Conference Board International Labor Comparisons* 2017).

In short, Mexican workers make 94% less than American workers. How important is this? CAR estimates labor cost savings of $674 per car in Mexico at $8.24/h compensation rate, although based on labor costs reported in this chapter, it could be more than double that. A KPMG (2016) study demonstrated that labor represents the largest category of location-sensitive cost factors for manufacturing, ranging from 40% to 57%.[12] Given that Mexico is not competitive in terms of communication infrastructure, utilities or facilities costs, and ranks only moderately for taxes and the cost of capital according to the same study, Mexico's cheap labor has been of paramount importance in securing its place in the North American industry.

An Industrial Relations System to Please Management

The evolution of wages in the MAI during the NAFTA era challenges the basic precepts of the classic theory of wage determination, particularly regarding its equalizing function between the supply and demand of labor (Hicks 1963/1932). Even from an efficiency wage theory perspective (Leibestein 1957), it is hard to make sense of such an evolution, particularly when applying the assumption that higher wages lead to higher productivity and effort, and vice versa. As noted, employment in the MAI more than doubled during the NAFTA era. However, wages have remained practically the same. In 1994 MAI auto workers earned $1.90 on average. This means that after 23 years of NAFTA, Mexican labor has seen an increase in wages of less than a half dollar or 1.7 cents per year. In the auto parts sector, wages have remained the same, that is, at half the rate of auto assemblers. In comparison, US and Canadian auto industry wages decreased from $36 to $27 and from $34 to $26, respectively over the same period. This shows that dragging wages down became an entrenched feature of the industry in the NAFTA region (Fig. 13.4).

What happened to wages during the MAI boom? They have not only remained low, but have actually been decreasing. Covarrubias V. (2017)

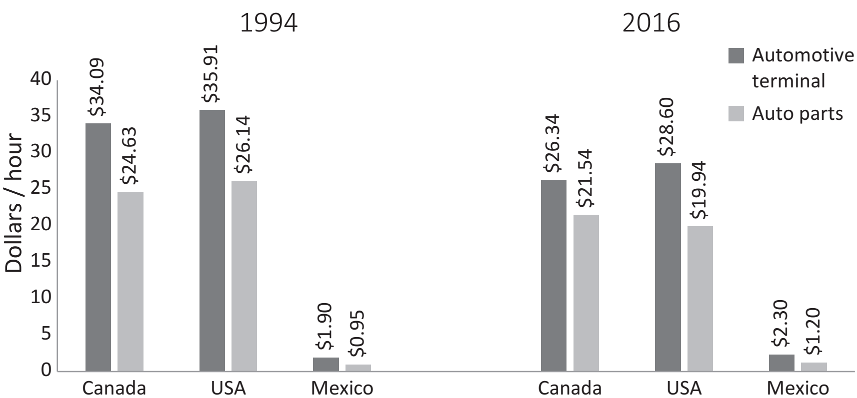

Fig. 13.4 The evolution of wages in NAFTA. Source: Based on Rodriguez A. and Sanchez (2017). Mexico's wages 1994 Pries (2000), 2016 author's

found that in 2013 autoworkers received $3.60 per hour, while Stanford (2010) noted that in 2007 they made $3.95 per hour ($1.65 more than the current $2.30). Thus, during the past 10 years of sizeable growth of the MAI, autoworkers' wages have decreased by 42%, a yearly average decrease of 4%. Paradoxically, labor productivity in the terminal sector has increased 5% yearly during the boom (Covarrubias V. 2017). If productivity is not the factor that drives wages, how can we explain wages in the MAI? The answer lies in Mexico's state-led system of industrial relations, where wages are determined politically and labor relations are geared toward pleasing management and attracting international flows of capital. Public officials, regardless of the state of the economy or the stage of a given industry, set wages low enough so as to maintain a competitive advantage in attracting firms seeking offshoring or nearshoring investment. A disheartening feature of such as system is the so-called 'protection contracts', collective bargaining agreements signed between management and state-allied unions (*official unionism*) long before a plant opens. In practice, they operate as company contracts, and thus when a plant opens and workers are hired, they are faced with a union and a contract they neither voted for nor were aware of. In addition, firms are allowed to define the rules of work and labor compensation at the plant level, so trade unions have no way to counter the 'race to the bottom', on wages, at either the company or the regional level.

A great deal of corruption is also involved in such practices. Official union leaders (commonly from the dominant *Central de Trabajadores de Mexico*, CTM) receive a lump sum and a monthly payment from management for signing a labor contract committed to keeping workers' demands for better wages and working conditions under control. As a result, the rights to freely organize and engage in collective bargaining are circumvented. Politicians have taken advantage of these mechanisms to ensure a labor movement that, rather than serving workers, serves a broad array of state-led objectives—controlling work settings, running political campaigns, backing economic policies, attracting investments, bribing labor leaders, and so on (Cook 2007; Caraway et al. 2015; Bensusán and Middlebrook 2013). It has been estimated that more than two-thirds of existing contracts in Mexico are of this nature (Bouzas Ortiz and

Cervantes 2008; De Buen Unna 2011). Most of the collective bargaining agreements in the MAI sector, both old and new, started as 'protection contracts'.

Workers are more likely to receive better wages with independent or non-state-controlled labor unions. The Nissan and VW unions are good examples of this. Traditionally, they have identified themselves as 'independent', drawing a line between themselves and the state-dependent unions, and have been at the forefront of securing better wages and benefits. However, this is not always the case, especially when independent unions face stiff opposition from management, supported by state officials.

The violation of basic labor rights in Mexico and the existence of protection contracts have been denounced in national and international forums. The International Labor Office (ILO) supervisory bodies, its Committee of Experts, and the Conference Committee on the Application of Standards, among others, have received many complaints about violations of freedom of association, as well as cases of violence and arrests of independent union leaders. International labor confederations like the ITUC and IndustriAll have also presented cases. Until recently, results from these complaints were limited and did not go beyond the standard ILO recommendations with Mexican public representatives responding with promises to take corrective action. The NAFTA labor side agreement provisions also did not help to change things in Mexico as it left each nation to enforce their own labor laws (Compa and Brooks 2015; Bensusán and Middlebrook 2013; Bensusán and Covarrubias V. 2016). During negotiations of the Trans-Pacific Partnership (TPP), Mexico committed to developing labor reforms to address the complaints raised by international organized labor and to protect collective bargaining, along with reforming the system for administering labor justice. However, it will be the USMCA approval process and the newly elected Mexican government that will finally be responsible for implementing the long-demanded transformation of industrial relations. More on this follows.

From NAFTA to USMCA in the Trump Era

During his US presidential campaign, Trump promised to correct the US trade deficit, to get rid of NAFTA, to leave the TPP (from which he indeed withdrew), and to bring back blue-collar jobs. This placed the automotive industry at the center of the political debate. A closer look at the sector's macro figures will allow us a better understanding of these issues.

In 1990, Mexico manufactured only a small portion of the North American auto output while the US and Canadian shares were 78% and 16%, respectively. Following NAFTA, the panorama changed and from then, and particularly over the last decade, the MAIs share in the region has grown. In 2017, the distribution was 20%, 67%, and 13%, respectively. Employment has followed this trajectory closely. In 1999, the US registered 1.1 million jobs in the sector, of which 380,000 involved the manufacture of vehicles. By 2009, this number had halved. Although the number bounced back in 2016, aided by the recovery of the sector and reached 945,000 (211,000 automakers and 734,000part suppliers), there has nevertheless been a net job loss of 17% over the past two decades. The Canadian industry has managed to keep jobs stable at around 125,000. In contrast, the number of autoworkers in Mexico has increased 7.1 times since NAFTA, rising from 113,000 to 800,000 jobs. As a result, after 23 years of NAFTA there is a new geography of auto employment in North America: the MAI's share of jobs in the region has soared to 42%, up from 8%, while the US and Canada have decreased theirs to 51% and 7%, down from 83% and 10%, respectively (with data from Rodriguez A. and Sanchez 2017) (Fig. 13.5).

NAFTA accelerated the flow of goods and services in the region, particularly between the US and Mexico. From 1993 to 2016, trade between the two nations multiplied more than five times and the US balance went from positive (at 1.6 billion) to a record negative (at 64.3 billion). As noted elsewhere, the automotive sector accounts entirely for this imbalance. From 1993 to 2017, the US deficit with Mexico in the sector has increased almost twenty times, with vehicles accounting for two-thirds of these figures and auto parts comprising the remaining third. Likewise,

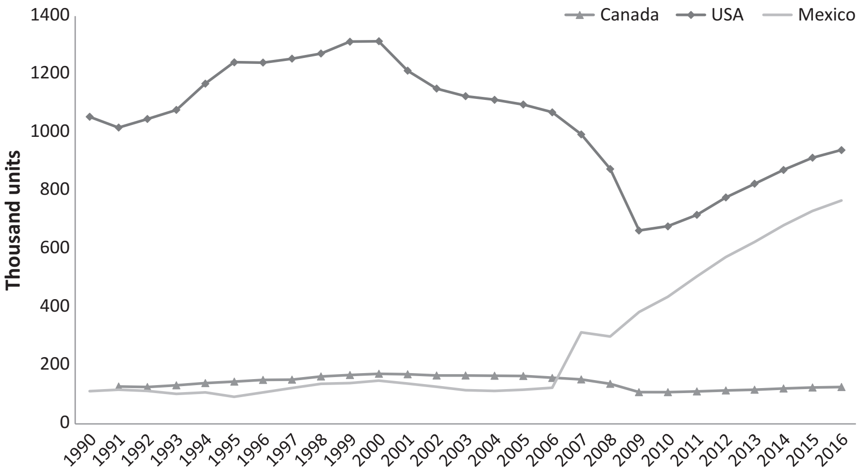

Fig. 13.5 Auto employment NAFTA region, 1990–2016. Source: Based on Rodriguez A. and Sanchez (2017)

the Canadian automotive deficit with Mexico has increased five-fold over these 23 years. All these figures show that the MAI benefited the most from NAFTA provisions and explain why the industry has become the most critical piece in NAFTA renegotiations.

The Trump administration stressed its goal to address these imbalances in its *Summary of Objectives for the NAFTA Renegotiation* (Office of the United States Trade Representative; July 17, 2017) and included labor provisions based on ILO conventions, including Convention 98. It proposed to increase the regional content for vehicles in NAFTA to 85%, up from the current 62.5%, and to set a minimum of 50% of US parts. It also included proposals on other critical issues that are beyond the scope of this paper to assess. During renegotiations, representatives of the Peña Nieto administration held to a plan of resisting and avoiding any substantial change to the original agreement, and, as had happened 25 years previously with the Salinas administration, they fiercely opposed including labor as a part of the new deal. The victory of Andres Manuel López O in the July 2018 Mexican presidential elections, representing a center-leftist opposition, changed this scenario. Although Peña Nieto officials will maintain the lead in negotiations until the end of their period in office, December 2018, a representative of the new administration was included, allowing the Mexican position to shift to accept labor provisions and new rules of origin for the automotive sector.

At the end of August 2018, Trump announced that a preliminary agreement had been reached with Mexico (and later also with Canada), renaming NAFTA the 'US-Mexico-Canada Trade Agreement' (USMCA). It comprises 34 chapters and 12 side letters. The most consequential for the auto industry are chapters 4 (Rules of Origin, with Product Specific Rules), 5 (Origin Procedures), and 23 (Labor), which includes an annex (23-A) related to *worker representation in collective bargaining in Mexico*.

They agreed on two major changes to avoid tariffs when vehicles are moved across their common border, namely that at least 40%–45% of the car must be made by workers earning at least $16 an hour, and that 75% of auto parts—that is, 12% more than the current threshold—must originate in North America. While these provisions seek to favor manufacturing in the US, the Chapter on Labor sets up a web of rules that benefit workers on both sides of the border. It is a progressive document that calls for the fulfillment of all obligations as members of the International Labor Office (ILO), including its fundamental conventions, the ILO Declaration on Rights at Work and the ILO Declaration on Social Justice for a Fair Globalization (2008). It commits parties to recognize the 'important role of workers' and employers' organizations in protecting labor rights'; the goal of trading only in goods that meet such labor obligations; and to freedom of association, linked to the right to strike and the effective recognition of the right to collective bargaining.

Other notable commitments contained in the document are the elimination of all forms of forced or compulsory labor, including child labor; the elimination of discrimination in employment and occupation; and a *Non-Derogation* commitment to not encourage trade or investment by weakening or reducing labor rights. It also includes sections on enforcement, violence against workers, migrant workers, sex-based discrimination in the workplace, public awareness and procedural guarantees, public submissions, cooperation and cooperative labor dialogue, and public engagement and labor councils, among others.

Annex 23-A mandates the incoming Mexican government to pass legislation containing these provisions and to focus on effectively ensuring workers' representation in collective bargaining.[13] It calls for laws to protect the right of workers to engage in collective bargaining and to organize, form, and join a union of their choice; to prohibit employer domination or interference in union activities; to establish and maintain independent and impartial bodies (Labor Courts) that will register union elections and collective bargaining agreements, carry out mediation and arbitration, and resolve internal disputes with the authority to sanction those who violate its rulings. It demands an effective system to ensure that the election of union leaders is carried out through a personal, free, and secret vote by union members and states that all existing collective bargaining agreements should be revised at least once every four years.

Discussion and Conclusions

During the NAFTA era, Mexico became one of the automotive industry's hottest spots worldwide. It was based on free trade, cheap and skilled export platform able to penetrate the US market primarily but also the global market. As a result, Mexico specializes in the production and marketing of cars—in this case, compact/small cars and light trucks propelled by ICEs—that the North American market demands.

Mexican decision-makers have exclusively aimed to become an open, cost-competitive export jurisdiction, able to attract growing flows of foreign direct investment and provide industrial jobs to its growing labor force. Consequently, after a century of automotive activities, 23 years of NAFTA and a decade of a boom in the MAI, the country has made no attempt to build any industry or automaker of its own, nor to take advantage of the current transition in the industry to make inroads in the emerging sector of new mobilities.

Mexico has taken advantage of its position as a nearshoring market complementing its more than 3000 km. of common border with the US with the combination of a broad framework of FTAs and cheap labor. No other emerging country forging a place in the global automotive industry has taken such a position. India, like Mexico, has cheap labor, but is following quite a different path. Like China, it is deploying an aggressive approach that combines technological upgrading, cultivating its own auto manufacturers (for instance Tata), progressing in new mobilities (for instance Ola), and developing its domestic market. Brazil represents a different case in that it has developed its internal market along with improving autoworkers' wages. Even the East Central European countries that emerged as the 'new peripheries' of the automotive industry on the European continent have experienced wage hikes as the sector grows. Thus, it is no surprise that Mexico is not a top-selling market along with being one of the top manufacturers.

From the American perspective, NAFTA was meant to ensure that Mexico would continue being the backyard of the Detroit 3. The 62.5% vehicle content rule set up by the agreement was considered to be a high enough threshold to keep Asian and European automakers out of Mexico, at least in terms of preventing them from using Mexico's export platform to gain access to the US market (Klier and Rubenstein 2017; Hufbauer and Schott 2005). The result, however, was quite different and it is worth taking a closer look at this. At the beginning of NAFTA, the Detroit 3 were producing, back to back, more than two-thirds of the MAI's output. By 2016 their share had dropped 22%, driven by Ford and Chrysler's declining shares. In contrast, Asian producers increased their contribution to the MAI's output from 12% to 42% as Nissan was joined by Honda, Hyundai, Toyota, and Mazda. Although the Europeans, represented by VW alone, decreased their share by nine points, their presence is set to grow with the arrival of the German 3 premium, namely Audi, BMW and Daimler AG. This bodes badly for other players in this vehicle segment as these three already control 90% of the US premium market.

Regardless, the most notable fact is that during the NAFTA era, the Detroit 3 lost their lead in the Mexican market. This has run parallel to their displacement in US markets, first by the Japanese, and then by other international producers, and thus these changes are part of a deeper transformation in the global automotive sector. NAFTA only came to accelerate the process of chasing and changing the North American market that began in the seventies and eighties (for a more detailed account of this, see the book's concluding chapter).

Through NAFTA, the geography of production moved gradually toward Mexico, which now accounts for one-fifth of the region's automobile output. In contrast, the geography of employment has changed radically over these years. This paper argues that nearshoring geography and FTA frameworks were necessary conditions for the role adopted by the MAI in the region, but they were not enough. Canada, like Mexico, has these two conditions, but unlike Mexico, it does not have the third condition, cheap labor. As a result, the Canadian auto industry has been shrinking. As the deciding factor in the equation of the MAI, cheap labor has provoked the emigration of thousands of jobs from the US into Mexico and dramatically changed the footprint of auto jobs in North America.

The problem facing American auto producers multiplied when Asian producers were able to outperform them in their own territory through better high production systems. They then moved to Mexico in the hope that the benefits gained from nearshoring and cheap, qualified labor would provide them the necessary leverage to beat international companies in the race for market share. Not only were the results to the contrary, but the impact of the process on the downgrading of labor has been overwhelming. Throughout the NAFTA era, wages in the MAI were frozen and even decreased during the boom of the past ten years. Still, wages in the US auto sector decreased at a higher rate, dragging Canadian wages with them. The increasing US trade imbalance with Mexico is the inevitable outcome of this all.

The Trump campaign and his subsequent administration gained salience with the promise to halt both investments and jobs moving to Mexico, as well as to end US trade deals that were resulting in trade deficits. He withdrew from the TPP and was long threatening to do the same with NAFTA. In the end, the USMCA was crafted instead, a new deal that, for the most part, contains the provisions he was looking for: a 12% rule of origin, up from that of NAFTA, and supplemented by a labor value content ruling that up to 45% of a car must be made by workers earning at least $16 an hour.

Through these provisions, the American government expects to achieve what the NAFTA failed to do, that is, regain the initiative over the industry and the American market and keep Asian and European manufacturers out of Mexico. However, again the outcome could be to the contrary. The fact that international auto companies will need to use more North American-made car parts to comply with the new rule of origin could attract more capital flows into Mexican plants. American manufacturers will also be favored but they will nevertheless eventually face greater competition from international companies. Should this be the case, not only part producers but new waves of automakers will relocate facilities to Mexico.

It is possible that the institutionalization of a new, effective industrial relations system in Mexico, that meets and complies with all ILO conventions to increase workers' rights and wages, could preclude the above from happening. Ironically, Trump's new free trade deal contains such a labor framework and mandates Mexico to begin 2019 with a law reform that puts this in place. Yet, even assuming that Mexico passes such a reform, the country's legislation remains a greater challenge. That is, who will enforce it?

Notes

1. The USMCA must still be ratified by the legislative branches of the three countries, which is expected to take place during 2019.
2. Unless otherwise indicated, Mexico's auto industry data cited here are from INEGI (Instituto Nacional de Estadistica Geografía e Informatica), ProMexico, AMIA (Asociación Mexicana de la Industria Automotriz), and OICA (International Organization of Motor Vehicle Manufacturers).
3. From 2007 to 2017 Mexico auto output grew 1.9 times (from 2.1 to 4 million units per year), China's 3.2 times (from 8.9 to 29 million units for a 225% total increase), and India's 2.2 times (from 2.2 to 4.8 million units annually for a 118% overall increase).
4. Data up to December 2017 according to INEGI-EMIM (2018). Considering indirect jobs associated to the MAI, the estimations amount to 2 million jobs.
5. In the eighties started a "new era" of the MAI (Carrillo V. 1990) featured by trade liberalization and export-oriented policies. The auto industry's decrees of 1983 and 1989 emphasized these features. Yet there were still restrictions on local content, native ownership and trade barriers that NAFTA would come to eliminate immediately (approximately 50% of them) or gradually, in a ten-year period.

6. It belongs to the Daimler-Nissan alliance to assemble Mercedes-Benz and Infiniti models.
7. Forbes 2018 ranking places him at sixth.
8. They are GM, Nissan, Honda, BMW, Mazda, Daimler AG, VW and Toyota.
9. The MAI goes back to the 1920s and 1930s when Ford, GM and Chrysler set up the first automotive facilities in Mexico. Yet they mostly assembled completely knocked down units. The decade of the 60s is identified as the full starting point of the MAI, when the D3, Nissan and VW built assembly plants in Central Mexico and Puebla following Mexican government' import substitutions policies to spur domestic production. A second phase or wave of the MAI started in the eighties, when the industry was reoriented to external markets. NAFTA brought about the third wave and the boom of the MAI came to represent a fourth stage.
10. NOM-163-SEMARNAT-ENER-SCFI-2013. CO_2 emissions cast by the exhaust and its equivalence in terms of fuel encompassing new vehicles up to 3857 Kg.
11. I estimate this 30% based on the specifics contained in the same collective bargaining agreements. The Conference Board estimates at 29.7% of total compensation the cost for benefits in the whole Mexican manufacturing sector.
12. Other location-sensitive cost factors range as follows: Cost of capital, 11–25%; taxes, 10–18%; transportation, 6–21%; utilities, 2–7%; and facilities, 2–5% (KPMG 2016).
13. It states that, for the agreement not to be delayed, Mexico shall adopt such legislation before January 1, 2019.

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14

The New Geography of the Automobile Industry: Trends and Challenges in Brazil

Roberto Marx, Adriana Marotti de Mello, and Felipe Ferreira de Lara

Introduction

Brazil has become one of the core locations of the automobile industry. In 2015, Brazil was among the world's ten largest producers of automobiles and among the largest automobile markets, despite its decline in the last two years due to an internal economic crisis. This discussion paper intends to present an overview of the Brazilian automobile industry, emphasizing national public policies.

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According to the National Association of Vehicle Manufacturers (ANFAVEA) (2016), the automobile industry has currently 65 plants spread across 51 cities in 11 states. It represents more than 20% of industrial gross domestic product (GDP) and 4% of total GDP, with revenues close to US$50 billion.

The importance of the automobile industry is even higher when one notices that it involves a huge supply chain. It includes manufacturers, parts suppliers, raw material producers, dealers, gas stations, insurance companies, repair shops and advertising agencies, among others, which provides direct employment to an impressive number of more than 130,000 employees and 1.5 million employees at the productive chain in Brazil (ANFAVEA 2016).

The Brazilian government has been, and still is, a major partner in the consolidation of the automobile industry in the country. Through tax incentives throughout history and through various programmes, such as Pró-Álcool (National Alcohol Programme) and most recently, the Inovar Auto (Incentive Programme for Technological Innovation and Densification of the Productive Chain of Motor Vehicles), the Brazilian government played, and still does, an important role in this process.

Currently, the automobile industry in Brazil is at a crossroads. In addition to declines in sales due to the national economic crisis, vehicles overcrowd the Brazilian streets, and new challenges facing sustainable urban mobility are emerging in the current scenario.

This chapter is structured as follows: first, an overview of the automobile industry, from the creation and consolidation of its industrial park until the present moment, exploring moments of crisis and growth. Then, it presents a summary of key public policies to encourage the sector in Brazil, especially focusing on the Inovar Auto programme. Finally, an overview of policies regarding innovation in electromobility is presented.

Overview of the Automobile Industry in Brazil

Years 1950–1970: Industry Creation and Consolidation

The development of the Brazilian automobile industry was initiated in the 1950s by President Juscelino Kubitschek of GEIA (Automobile

Industry Executive Group). According to Santos and Burity (1997), GEIA aimed a plan to instal the industry and promote the rapid manufacture of consumer goods (passenger cars) and production of goods (freight vehicles), with priority to the latter.

It also aimed to reduce the impact on the balance of payments due to increased imports of both passenger cars and cargo vehicles and passenger transport. The function of this group was to define the installation standards, production targets and nationalization plans, authorize projects and follow their implementation.

The federal government has produced a series of decrees that inhibit the import and established incentives for foreign exchange and tax. Only projects approved by GEIA have rights to incentives. It also established a quick nationalization programme for parts: already in 1960, trucks and commercial vehicles were at 90% nationalization, and jeeps and passenger cars at 95%.

The auto industry was seen as a priority by the government, and it was considered that the creation of this industry should have foreign capital participation, that is, international automobile manufacturers. It is important to emphasize that the strategy was to bring multinational companies to produce locally instead of investing in local businesses (Arbix et al. 2001, 2002).

However, it would promote a gradual nationalization programme. Hence, from 1967 to 1974, the time of the "economic miracle",[1] the sector was restructured and grew at average rates of 20% per year.

The government had created credit facilities for consumers for the purchase of cars, which caused the explosion of demand. It was then that it could be noticed a change in the production: passenger cars began to grow much faster than trucks and buses did. While the fleet of cars has multiplied by eight times in the span of 17 years (1957–1973), the trucks have increased 2.4 times over the same period. The average annual growth rates of the two fleets were, respectively, 13% and 5% (Santos and Burity 1997) (Table 14.1).

Years 1980–2000: Crisis and Market Opening

The economic crisis in Brazil in the 1980s and early 1990s changed the growth trend of the previous decades. Due to the closed market and

Table 14.1 Sales evolution (1957–1973)

Year	Units				Total
	Light cars	Light commercials	Trucks	Buses	
1957	10,449	1588	16,259	2256	30,552
1958	20,808	9503	26,998	3674	60,983
1959	40,171	16,283	36,657	3003	96,114
1960	70,479	20,875	37,810	3877	133,041
1961	86,437	28,654	26,891	3602	145,584
1962	118,026	33,498	36,174	3496	191,194
1963	121,666	28,495	21,556	2474	174,191
1964	132,157	27,056	21,790	2704	183,707
1965	135,041	25,187	21,828	3131	185,187
1966	157,352	32,204	31,098	3955	224,609
1967	158,362	35,319	27,141	4665	225,487
1968	185,922	46,107	40,642	7044	279,715
1969	258,675	48,777	40,569	5679	353,700
1970	319,574	54,069	38,388	4058	416,089
1971	416,563	56,264	38,868	4393	516,088
1972	482,037	72,194	50,150	5230	609,611
1973	565,221	93,371	64,828	6362	729,782

Source: ANFAVEA (2016)

slowdown of growth, the companies reduced their level of investments, which led to a portfolio of increasingly outdated products and a technologically backward industrial park.

As a response to these problems, the government opened the market to imports and initiated several measures to restore competitiveness in the industry. In 1992 and 1993, the Automotive Sectorial Chamber was established which involved representatives from the companies, unions and the government.

The government reduced taxes and stimulated loans. In turn, it demanded price reductions from the companies and guarantee of a certain employment level in the industry. Special incentives for buyers of small cars with 1.0 L engines were introduced and led to rapid growth of this market segment in the next decade.

In 1995, the Automotive Sectorial Chamber approved the so-called "Automotive Regime" which included a concept of industrial policy for the car sector. The result was rapid market expansion in the late 1990s. New investments led to the production of new models. New players, such as Peugeot-Citröen (PSA Group) and Renault, Honda, Toyota and Mitsubishi, Chrysler and Mercedes Benz (which until then only manufactured trucks and buses in Brazil), entered the market. During the 1990s, assemblers made investments in Brazil amounting to US$16.6 billion. In comparison, the investments made between 1981 and 1990 amounted to US$5.4 billion (Consoni 2004).

Moreover, from its beginning in the 1950s until the 1990s, the Brazilian automobile production was concentrated in the State of São Paulo (SP), specifically in the ABC region. The ABC region comprises the cities Santo André, São Bernardo dos Campos, and São Caetano, which are located in close proximity to São Paulo.

At that time, Fiat was the sole company to establish a production site outside of the ABC region, that is, in Minas Gerais. However, in the 1990s, the so-called "Fiscal Wars", in which state and municipal governments provided fiscal incentives in order to attract investments made by the automobile industry (Alves 2002), together with the quest for reducing labour costs, caused the production of vehicles to spread to other states such as Rio Grande do Sul (General Motors), Paraná (Renault, Volkswagen), Rio de Janeiro (PSA), Goiás (Mitsubishi) and Bahia (Ford).

The regionalization of the automobile industry in the country has also led to the decentralization of the auto supplier industry, mainly through the creation of industrial parks that integrate suppliers and automakers.

In the 90s there was a reduction of local development activities and processes accompanied by the adoption of the assembled global vehicle production strategy on global platforms, developed at headquarters or European subsidiaries (cases of VW Polo, Ford Fiesta, GM Corsa, Renault Clio and Fiat Palio, for example).

In 1990, the State of São Paulo accounted for 74.8% of the domestic production of vehicles, whereas in 2005, this number dropped to 45.5%. In the ABC region, about 52% of the jobs were cut down in the sector between 1980 and 2002: from 180,1000 employees in 1980 to 88,000 in 2002 (Marx and Mello 2008; Rodrigues et al. 2007).

Although the State of São Paulo has lost some production activity, it has retained most of the technological and engineering activities owing to the availability of qualified professionals, research centres, laboratories, technical schools and the presence of the main auto part manufacturers' development centres (Salerno et al. 2002; Consoni 2004). Only Renault established its development centre in Curitiba/PR, and PSA recently announced the intention of installing a centre in Rio de Janeiro (RJ).

Following the relocation of production to inner-Brazilian low-cost regions, new production models were introduced in the Brazilian industry, inspired by the concept of lean production and the "Japanese Model". These models included outsourcing activities and new forms of supply chain organization (such as the industrial condominiums), which were brought forward more aggressively than in Europe and the United States, taking advantage of "greenfields" and low resistance on the part of employees.

Salerno et al. (2002) characterized this period as being marked by the adoption of new supply relationships, the relocation of production activities, internal production restructuring and changes in engineering and product design activities. Brazil became a privileged testing ground for the world automobile industry.

The new investments and the following modernization of the Brazilian car industry in the 1990s were accompanied by strong organizational changes in the plants. European, US-American and Japanese companies started to implement "lean production" concepts which included new forms of work organization such as teamwork and reduction of hierarchy levels in the plants.

The relocation of production and the opening of greenfield plants in low-wage regions, like Paranà, Minas Gerais or Bahia, brought the issue of wage differences and wage competition on the top of the trade union's agenda. Besides the wage differences, the companies benefitted from the low degree of organization and the lack of industrial traditions in these regions. Workers coming from agricultural regions were expected to be more "docile" than the strongly organized workers in the ABC region. Yet, nearly a decade after the car companies moved to the low-wage regions in Brazil, a trend towards union organization in these locations has emerged, including the occurrence of strikes.

Years 2000–2014: Market Expansion

In Brazil, a huge transformation in the automobile sector began, as mentioned in the previous subsection, in the 1990s, with the arrival of new manufacturers such as Chrysler, Mercedes Benz, Renault, PSA, Honda, Toyota and Mitsubishi and investments in new plants or expansion of existing plants, as in the case of General Motors (new plant in Gravataí/RS), Ford (in Camaçari/BA), VW (new factories in Curitiba/PR, São Carlos/SP and remodelling of São Bernardo do Campo/SP factory).

Associated with this wave of new investments, the domestic industry, as well as its headquarters, incorporated new forms of production management, outsourcing activities and new forms of organization of the chain supplies, such as industrial parks.

Moreover, these changes led to an increase in industrial productivity, making it even with the increase in production in recent years, the level of employment in the sector in 2006 is the same as in 1973. Brazil led the process of implementing new forms of organizational supply chain, especially in design and operation management and the use of the configuration of Automaker and Systemist in an Industrial Condominium.

However, the financial crisis in Asia, in addition to energy rationing and the global recession after the attacks of 11/09/2001, interrupted the expected growth of the automobile market after the 1997 vehicle production record. Those numbers were reached again in 2004.

The recovery of the Brazilian automobile sector, in fact, anchored in the domestic market, began in 2004. The main driver of the process was the sustained growth of the economy.

Major automakers returned to show positive results, with first signs of exhaustion of idle capacity appearing in 2007. With macroeconomic stability in Brazil and growth since 2004, the automobile industry experienced a new period of growth of production and sales each year. The years 2007 and 2008 were the best in terms of volume of domestic sales and production in history.

A specificity of the Brazilian market, the use of ethanol as a fuel (which has reduced IPI [industrialized products tax rate]), led local development of flex-fuel engines or "flex fuel", that is, fuelled by alcohol and/or gasoline (Mello et al. 2005).

In 2006, cars and commercial vehicles with engine "flex fuel" accounted for 78% of total sales in the country. Currently, all automobile manufacturers operating in the country offer "flex" versions of their models.

Table 14.2 shows total production over the period of 2002–2014 in Brazil.

Table 14.2 Sales evolution (2002–2014)

Year	Units				Total
	Light cars	Light commercials	Trucks	Buses	
2002	1,376,219	167,767	68,354	21,450	1,633,790
2003	1,428,270	154,181	77,785	24,479	1,684,715
2004	1,777,642	216,735	104,792	25,008	2,124,177
2005	1,929,545	235,340	112,921	29,366	2,307,172
2006	2,027,305	243,666	103,297	29,412	2,403,680
2007	2,360,239	295,738	133,791	35,008	2,824,776
2008	2,498,482	350,190	163,757	38,202	3,050,631
2009	2,568,167	356,837	120,994	30,022	3,076,020
2010	2,682,924	468,747	189,941	40,531	3,382,143
2011	2,630,893	511,918	223,602	49,369	3,415,782
2012	2,763,445	469,480	133,403	36,635	3,402,963
2013	2,954,229	530,901	187,002	40,554	3,712,686
2014	2,502,293	471,191	139,965	32,937	3,146,386

Source: ANFAVEA (2016)

The domestic market has assumed greater importance among international manufacturers in view of the stagnation or reduction of international participation in mature markets like the United States, European Union and Japan. This is in addition to investments in modernization of production processes in restyling models, developing new vehicles and increased productive capacity.

However, the specific characteristics of the Brazilian market—in particular, the law of the "people's car" that granted benefits of IPI (industrialized products tax rate) reduction for vehicles with engine capacity up to 1.0 L—made local adaptations or developed products more successful in the local market than in the corresponding "world" automobiles.

It is important to note that even with the increase of production and the market, R&D investment by automakers was not significant in Brazil. In addition, the exchange hampered exports in the country. In contrast, the increased import of finished parts and vehicles with greater aggregate technology increased.

Figure 14.1 shows the relationship between sales and R&D for the period 2003–2011.

Thus, Brazil has experienced a period of great growth in car sales between 2000 and 2014, when the country was immersed in an economic crisis with great impact on the automobile industry.

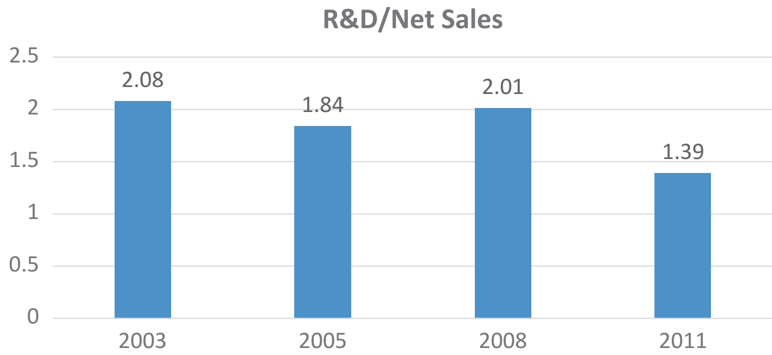

Fig. 14.1 R&D/Net sales from the automobile industry (automakers) in Brazil

Since 2003, with the Workers' Party assuming power at the government and the election of Lula as Brazilian President, unions became part of the government. This has created a privileged position for workers, since former union leaders became Ministers—former ABC Metal Union Luiz Marinho became Minister of Work and Social Security, for example. On the other hand, this situation created a kind of inertia for unions, since their willingness to confront governmental decisions and policies was restricted.

Post 2014: Crisis and Perspectives

After consecutive increases in production and sales in the last 14 years, the automobile industry slowed in 2014. According to ANFAVEA (2016), between 2013 and 2014, there was a decrease of 7.1% in the licensing of cars, light commercial vehicles, trucks and buses (from 3.7 to 3.5 million units) and a decrease of 40% in exports (from 565,000 to 334,000 units).

Among the reasons for the sector's downturn are the significant fall in domestic car sales in 2014, the economic crisis in Argentina (the main destination for Brazilian exports of cars and auto parts), increased rigour in the granting of credit by banks, worse national macroeconomic scenario and indebtedness of households.

The decrease in production is also reflected in the labour market in the metallurgical sector. Since the crisis began, several automakers made layoffs, announced shutdowns, temporary suspensions, work shifts or production reduction due to technical reasons. In 2017, a new regulation on work relations was approved, weakening the power of unions and reinforcing outsourcing of activities.

According to ANFAVEA (2016), in 2014, there was the steepest drop in occupation since 1999. After the layoffs, automakers ended the year 2015 with 129,776 employees, against 144,508 at the end of 2014.

The layoffs occurred besides the fact that several automakers has joined the Emplyment Protection Programme, as the federal government allowed the reduction of working hours by up to 30% with wage reduction at the same level. Half of the wage loss, however, is compensated by the government with funds from the Worker Support Fund.

Brazil has a lot of internal inequality in relation to vehicle use. While the South and Southeast concentrate almost all vehicles, Midwest, North and Northeast have very low motorization rates. According to ANFAVEA (2016), to reach the index of Argentina, it would take over 30 million cars, which is the equivalent of about ten years of Brazilian annual market.

Unlike other emerging countries, such as China and South Korea, Brazil has no actual national automobile industry: all automakers that produce locally are subsidiaries from foreign multinationals, and most of the first-tier suppliers are foreign companies.

Currently, the country has qualified engineering centres capable of designing a new vehicle from concept definition to product and process validation; but those competencies are still concentrated in the traditional automakers, also called “latecomer companies”. In addition, most of the innovation efforts are driven to adapting global models to local market conditions (Souza and Mello 2014; Salerno et al. 2009).

Public Policies to Support the Automobile Industry

Public Polices: 1950–2010

Automobile Industry Executive Group—GEIA

In order to coordinate the implementation of industry the Automobile Industry Executive Group (GEIA) was created. According to (Santos and Burity 1997), in the 1950s, trucks were responsible for most of the cargo transport in Brazil and were, therefore, priority for GEIA. However, the passenger car was considered emblematic by the government of the time.

The federal government produced a series of decrees that inhibited the import and established incentive and exchange tax. It also established a rapid nationalization programme for parts: already in 1960, commercial trucks and vehicles reached 90% of nationalization, and jeeps and passenger cars reached 95%.

The effort to produce inputs in country led to the need to fund and encourage the auto parts industry by BNDES (Brazilian Development Bank) and establish greater involvement in national manufacturing.

In the first years of GEIA actions, after several government measures, 18 companies submitted projects. Eleven of those implemented the projects. Despite the diversity of products (trucks, utilities, jeeps and passenger cars), market was too small to give efficiency to the plants, especially if we consider that the economic scale (300,000–500,000 per year) was much higher than what it is currently.

National Alcohol Programme—Pró-Álcool

The Pró-Álcool programme was created in 1975 in order to stimulate the production of alcohol in order to meet the needs of domestic market and the needs of automobile fuel policy. The production of ethanol derived from sugarcane, cassava or any other input was encouraged by expanding the supply of raw materials, with special emphasis on increasing agricultural production, modernization and expansion of existing distilleries and installing new production units and storage units.

The decision to produce ethanol from sugarcane, plus the price of sugar was a political and economic one and it involved additional investments. This decision was taken in 1975 when the federal government decided to encourage the production of ethanol to replace pure gasoline in order to reduce oil imports with a large weight in the external trade balance. At that time, the price of sugar in the international market was declining rapidly, which made it convenient to change sugar to alcohol production.

According to Rico et al. (2010), alcohol production in Brazil in the 1975–1976 period was 600 million litres, in the 1979–1980 period was 3.4 billion and in 1986–1987 was 12.3 billion litres. The programme began to crumble as the international price of oil lowered making the use of alcohol as fuel disadvantageous both for the consumer and the producer.

Successive supply disrutptions, combined with higher ethanol consuption rate and lower gasoline prices, led to general distrust among pro-alcohol consumers and automobile manufacturers to the point that most automakers do not offer more new models running on ethanol (Rico et al. 2010).

In the context of Brazilian pioneer in the ethanol industry, the technology of flex-fuel engines gave new impetus to the domestic consumption of alcohol. The cars could run on petrol, alcohol or a mixture of the two fuels, and this technology was introduced in the country in 2003 and won the consumer quickly.

Today, the choice is already offered for almost all models of the industries, and the demand for flex-fuel vehicles exceeded over the gasoline-powered vehicles for the first time in the internal market (ANFAVEA 2016).

The current price relationship makes the users of flex-fuel models give preference to alcohol, and the rate of consumer acceptance of dual fuel, or flex-fuel, vehicles in the last years was much faster than the auto industry had expected.

Economic Opening

The opening of the Brazilian economy in the 1990s affected deeply the automobile sector. The plan was to modernize the industry, promoting open competition. However, it did not establish any defence mechanism against imports and no preparation was done by national companies.

As a result, the market opening required a complete redesign of strategies in order to adapt to the new market rules. During the period, local production models were implemented creating a huge technological gap.

The restructuring and modernization of Brazilian companies may be considered as defensive and conservative since the main objective was to defend market share, but for this, there was still betting on outdated technology products.

With the economic opening, the automobile industry reformulated its strategy and started to prioritize changes, such as the adoption of new management methods, automating various processes, investing in qualified labour work and in forming partnerships.

However, this restructuring led companies to review the entire supply chain, leaving the small and medium entrepreneurs hurt more than ever. Most of auto parts makers had no capital to modernize their plant, and therefore, forced to close or sell them to foreign capital.

"Popular" Cars

According to Consoni and Quadros (2003), between 1992 and 1994, representatives of the government, trade unions, companies and automakers met to discuss the problems faced by the sector with the economic opening and define specific policies. The end result was an agreement to reduce the rates and prices of Brazilian vehicles to ensure increased production and internal demand for automobile vehicles.

One of the most important actions adopted in this period was the exemption of the IPI (Excise Tax) for vehicles up to 1000 cc, called cars 1.0. This policy gave rise to the concept of "people's car" or "popular cars" that led to the era of simple and popular vehicles.

As a result, there was an explosion in the sale of popular vehicles in Brazil, which led to recovery in automobile production and created a segment in the Brazilian automobile market. Sales of 1.0 vehicles, which represented 4.3% of total sales in 1990, increased to 50% in 1996, the year when new policies were drawn up for the automobile industry, and they continued to grow in response in 2002 to 70% of all cars sold in Brazil (Consoni and Quadros 2003).

It is important to highlight that this process had, however, its dynamics largely determined by the evolution of their own local market, the process of regional integration and the national economic policy. With a particular emphasis in the latter case, the creation of tax incentives for popular cars has played a crucial role in domestic sales in recent years.

Flex Fuel

The Brazilian automobile industry has developed vehicles that are flexible in the type of fuel that they run on. They are popularly known as "flex" in Brazil. The flex-fuel vehicle engine works with any proportion in the mixture of gasoline and alcohol fuel (ethanol), stored in the same tank.

The injection is adjusted according to the blend detected by electronic sensors, which in the case of Brazilian technology, is implemented with automobile software developed in the country, which does not need additional sensors that increase the cost of the vehicle.

The Volkswagen Gol 1.6 Total Flex 2003 model was the first flex-fuel vehicle developed in Brazil capable of operating on any blend of gasoline (E20-E25) and ethanol (E100).

Two months later, the Chevrolet provided the Corsa 1.8 "Flexpower" with an engine developed in partnership with Fiat, called "PowerTrain". In 2005, several automakers producing flex-fuel cars included Chevrolet, Fiat, Ford, Peugeot, Renault, Volkswagen, Honda, Mitsubishi, Toyota and Citroën.

For Amatucci and Spers (2012), flex-fuel technology involved in this mix brings to light a national production system innovation, which can be divided into three phases: phase I increased ethanol production to meet availability and Pró-Álcool targets: phase II involved adoption of pure ethanol (both by the industry and the market—included resolutions of the distribution problem); and, after the end of phase II, a phase III consisting of the adoption of the flex-fuel technology (each previous stage strongly influenced later):

1. *Phase I—Pró-Álcool programme*: the first phase was characterized by the impulse of historic national dependence on sugarcane and as a form of response to the oil crises of the 1970s, thus being an important part of systemic transformation. The first phase was not really an innovation (at least in regards to improving the mix and quality of ethanol) in both the technological aspect as well as in the social sense.
2. *Phase II—pure ethanol*: the second phase, in turn, presented technological and social innovations involving regulations, private companies and other social entities, such as associations, which were widely adopted by Brazilian consumers. This solution decreased due to fluctuations in the availability and supply breakdowns that severely penalized owners of vehicles powered by pure ethanol.
3. *Phase III and beyond—flex fuel*: the third phase also involved technological innovation and social mobilization in order to bring commercial viability. With the flex-fuel vehicle, the consumer could choose the best fuel from a price perspective and also a sustainable perspective. This flexibility promoted actions to deal with the more smoothly supplied fluctuations. The Brazilian economic growth of the 2000s brought a large proportion of the previously excluded population in the market and has sold a record number of vehicles.

For Amatucci and Spers (2012), all three phases had some common elements. First is the strong perception of a social problem that must be solved urgently, or a belief that things cannot continue as they are. The second is the availability of a technology that, when combined with social logistics solutions, could make for viable social solutions. The third common element was that the social arrangement needed to be catalysed by the action of the private sector and by government incentives.

Government incentives are needed in the early stages of the transition. However, they can be removed when the scale, productivity and consumer confidence levels reach those at the same level as the normal market.

A fourth element common to all the above phases could still be observed for the initial fragility of the situation, which required the customer to circulate paying a higher price at the beginning, in parallel, even tolerating a lower performance, until either technology improved.

Inovar Auto: Increasing Competitiveness

Aiming to increase the competitiveness, technology and security of vehicles produced and sold by the Brazilian Automobile Industry, in 2012, the Brazilian Federal Government established the "Inovar Auto" by executive law. It is an industrial policy that provides tax reduction benefits to assemblers that meet or exceed certain goals.

Overall, the goals involved (Ibusuki et al. 2014) a minimum number of productive activities conducted in the country (mandatory for all companies intending to adhere to the programme), and the improvement in energy efficiency indicators, measured in CO_2 emission/fuel consumption (mandatory for all companies intending to adhere to the programme).

Additionally, each company had to choose two of the following three objectives:

1. A minimum percentage of investment in R&D
2. A minimum percentage of investment in engineering
3. Adherence to the national programme of vehicle labelling related to energy efficiency

The programme was valid for the period 2013–2017 and was to be reviewed at its end. During this period, companies were encouraged to continuously improve the objectives expected to maintain tax reduction benefits over the period.

Before the Inovar Auto Law, the automobile companies had already used the tax incentives from "Lei do Bem" (Law of Goodness), which allows tax deduction for R&D spending. The mechanical and transport industry represented 24% of the total value declared as tax deduction in 2014, but this number had already doubled by 46% of the total in 2008.

The “Lei do Bem” was emphasized by Brazilian companies as the first significant step that helped to adapt the accounting system for registering R&D expenditures regarding Inovar Auto Law.

Theoretically, Inovar Auto was considered the most comprehensive and well-designed of all previous incentive initiatives established for the sector. Although companies may be considered to be still adjusting their policies in order to meet the programme goals, it should be emphasized that by 2014, about 44 assemblers (which already had operations in Brazil and others that plan to do so) had already joined the programme, aiming to make use of the benefits offered.

Inovar Auto Law is an opportunity for companies to benefit from the government incentives. The vehicle efficiency goal in Brazil was 1.82 MJ/km until 2017. This goal is based on Europe 2015 target for new Light Road Vehicle of 130 gCO_2/km and considering differences in driving cycle, vehicle, fuel and road specifications.

The main opportunity opened the by Inovar Auto Law is the motivation for the automobile industry to internalize international technology decreasing the existing gap in Brazil.

This task is a challenge considering the peculiar characters of the Brazilian market as compared to the assembler headquarters: the road conditions are substantially different from those in developed countries; Brazilian fuel characteristics are also different with a higher blend of ethanol in gasoline; and the main peculiarity is the flex engine.

These conditions require additional developments and investments to adapt the technologies developed outside Brazil to work here. Before the Inovar Auto Law, there was a wide gap regarding technological developments in developed countries.

Companies postponed the internalization of technologies into the Brazilian market because of the costs involved. Regulations and requirements of the Brazilian market did not encourage bridging the gap.

The need to reduce the engine size and weight was also an attractive factor for companies to hire Institutes of Science and Technology (ISTs) for developing new technologies in order to meet the demands of higher energy efficiency.

Overall, statistics do not clearly show these improvements in R&D spending, and it is still early to connect them as a direct result of the Inovar Auto Law. Also, it is still early to talk about sustainable results because the law has been in force for only three years.

In 2014, the Ministry of Science, Technology and Innovation report stated that all assemblers had their R&D spending approved as a result of the uncertainties of R&D classification. Nevertheless, the trend is clear: assemblers sought more partnerships with their suppliers and ISTs to adapt and to absorb the technologies used in developed countries.

Key Initial Impressions of Inovar Auto Results

According to the Ministry of Development, Industry and Commerce, there were a total of 36 companies that qualified for the Inovar Auto programme in April 2015 (including manufacturer and importer qualifications). Considering that each organization would have to opt for two goals from the three existing alternatives, the present frame shows the following:

1. 19 companies opted for attaining the goals in R&D
2. 35 companies for Engineering goals
3. 26 companies for Vehicle Labelling

Traditional companies (latecomers) attained the rates of resource application to engineering and to local content. The investments in R&D were made at different intensities by the assemblers. The smaller the size and the number of development centres of assemblers in the world, the greater was the change in the projects being developed in the country.

The newcomers (Chinese, Japanese, Korean and French) generally had more difficulties with engineering and R&D. For this reason, they sought to study partnerships with Systemists and research institutions to attain the Inovar Auto goals.

Assemblers that were newcomers focused on attaining the minimum rate of investment in R&D and started to establish partnerships with ISTs to develop projects. This was a fast-access path for conducting research in companies that did not count on installed structure in Brazil but intended to have one in the medium term. Only time will indicate the maturity, sustainability and the effective results of these relationships.

The latecomers' behaviour, in turn, was not even. There were more aggressive companies, others that have done little so far in terms of taking more advantage from and of increasing the quantity and the quality of the R&D initiatives. The most aggressive company introduced the following initiatives:

1. It formalized a specific structure to account for the programme, for the initiatives and procedures bonded to it.
2. Formal procedures were established to record the engineering and R&D activities that may be considered for the effects of the programme, and hence, facilitate and record these hours in the company accounting system.
3. Substantial investments in laboratories and in partnerships with Brazilian universities to develop engineering applications formerly subcontracted abroad or developed in other company offices.

Problems in understanding what can or cannot be considered R&D expenses still remain. These doubts were much greater in the beginning but have largely been reduced with the aid of the Automotive Engineers Association (AEA, which provides technical support and training in the area) and of a private consultancy specializing in fiscal benefits.

This support was repeatedly mentioned as being fundamental to make Inovar Auto clearer and to better guide the companies' actions. Structuring a group with representatives from the government, from AEA, from the consultancy and from the companies to follow-up and to adjust may be considered as a recommendation to make viable future actions with a magnitude similar to that of Inovar Auto.

The cycle considered in the first stage of Inovar Auto (2013–2017) was considered too short. More ambitious and long-term projects eventually did not fit the span of time established for this stage that had no guarantee of continuity.

It would be important for a new version of the legislation to incorporate this modification, with medium- and long-term goals; it would be important for directing the sector efforts.

The smaller-sized auto parts manufacturers are out of the Inovar Auto programme and can be stimulated to contribute by means of invitations/incentives made by the assemblers, besides support from the government and from institutions in the sector.

The existence of public initiatives concerning its role on competitiveness, in general, and in innovation, in particular, is currently very widely recognized. Differently from a couple of years ago, the discussion is now concentrated in what the characteristics and nature of relevant public action would be concerning incentives and subsidies to firms so as to improve—in the long term—competitiveness and innovation.

In the last 12 years, a myriad of public policies were proposed by the federal government, with different tools and oriented to different industries. In many cases, the initial goals were not pursued and the agenda of competitiveness and innovation results was far from being completely achieved. In the case of the Inovar Auto Law, it is possible to point out at least two different characteristics:

1. The focus is on raising energy efficiency; hence, the innovation is oriented to this specific form of product innovation.
2. The type of other investments in R&D that may be considered to give access to subsidies is much more precise if compared to previous initiatives such as the so-called "Innovation Law" (from 2004).

Moreover, the symbolic aspect of the Inovar Auto Law programme is also important; assemblers, in particular, and the automobile chain, in general, started to discuss very specific details, such as what R&D is and what it is not, what the difference is between engineering and R&D.

Electromobility in Brazil

Overview and Initiatives

Yet, if Brazil wants to be a market in which an important part of the automobile industry game is played in the future—not only producing but also developing products that can be sold worldwide, it is mandatory to develop competencies in electric-powered passenger cars.

The Brazilian government has not yet decided what kind of incentives would be granted to the electric car industry. One of the issues the electrical mobility places in the strategic map of the industry is the possibility of other players, who dominate electricity applications, entering the market, in association with new capitalists.

The automobile industry located in Brazil has been developing very few competencies in this field locally, and there is concern about Brazil becoming a mere importer in this segment, missing an opportunity to consolidate its position as a relevant global developer and producer in the automobile supply chain.

In the quest for environmental and economic sustainable energy sources for mobility, Brazil has the only commercial and technical successful case regarding the use of alternative fuels for internal combustion engines: sugar cane ethanol. Since the 1970s, a complete value chain to produce, distribute and use sugar cane ethanol as an automobile fuel has been developed, showing that it is possible to artificially build a market with institutional support that is sustainable, competitive and profitable.

Only in 2012 did the first hybrid or electric vehicles (EV) start to run in Brazil, some aiming at dissemination, and in other cases, a result of introducing a symbolic number of taxis, as from incentive programmes coordinated by municipal governments, such as that of São Paulo.

Toyota, Renault and Ford, for example, trade hybrid models in Brazil, but due to taxes, the prices reach about US$30,000.00, which makes its large-scale trade unfeasible.

In the urban transportation area, there are older initiatives, timid though, as compared to those occurring in other countries. This is an area in which there would be greater potential for developing and producing national vehicles.

Two hydrogen bus prototypes are under development in Brazil. One of the projects is being developed by the Metropolitan Company of Urban Transport of São Paulo (EMTU-SP) in partnership with the Ministry of Mines and Energy by means of a consortium involving some important energy related companies.

Anyway, except for some outstanding initiatives, the EV scenario in all its variants makes clear that Brazil is far behind USA, Europe and Japan besides China and Korea, for example, regarding technological development or the number and relative importance the EV fleet represents to the country. This scenario must be kept for the coming years.

Prospects for the Future in Electromobility

In order to map and prospect what kind of competencies are being developed concerning electric mobility in Brazil, data on patent applications in Brazil from 2002 to 2011 were researched in the World Intellectual Property Organization database, using the Patentscope search engine. Marx and Mello (2008) searched for all the patents granted in Brazil, regarding EV core technologies, and within the results, for patents whose applicants were Brazilian residents.

The authors also conducted 11 interviews with different actors involved in this field.

The main conclusions that arose from the interviews were the following:

1. Various specific competencies are spread across the country. Initiatives for investing in different areas (batteries, embarked control systems, electric engines, etc.) are not integrated. The initiatives depend on individual interest, and there is a lack of a strong integrator or an actor that can align efforts more effectively to create local EV projects, including the design and/or production of a complete EV;
2. In some cases, niche market products could be developed with a group of companies and institutions with different competencies acting and working together. This may be the most probable outcome (low-volume niche products) if no important entrepreneur takes the initiative to integrate a major programme to develop and/or produce EVs in the country.
3. There seems to be no public interest in investing more heavily in the development of technologies for EVs. According to the interviewees, this lack of interest is the result of the strong influence that the major auto assemblers and Petrobras, the powerful Brazilian public energy company, play in the auto industry.

4. Auto assemblers and traditional auto parts suppliers do not seem to be interested in having local EV development and production; some of them are making investments in their headquarter design centre. A possible exception is Fiat, which supports an EV project developed with electric companies.
5. Petrobras also does not seem to be very interested in EVs, except for some small initiatives. Almost all of its investments are focused on petrol, gas, ethanol or biofuels. On the other hand, in 2011, the Brazilian government created a fund for granting resources to product development projects for EV. After six months, no project was presented for funding, indicating the low level of local development and the poor coordination of the actors so far involved in the sector.
6. There is still no significant societal concern about emission and pollution levels related to the use of vehicles in Brazil, and the electric solution for automobiles is still more expensive than traditional internal combustion engines. These two factors mean that the market for EV is not very attractive for investments, at least in the short term for the major players in the sector.
7. The country would most likely not exhaust its oil resources in the next 30–50 years, given that huge oil reserves have been recently discovered. Thus, the interplay of the presence of petrol resources, the availability of ethanol, the lack of interest from the market and the political interest of Petrobras and the main automakers and traditional auto parts producers might explain the absence of a more integrated set of initiatives (both public and private) towards an investment in EVs design and production in the country.

Final Considerations

The Brazilian automobile industry evolved over the past 60 years through four clearly defined steps:

1. Import of cars, no local assembly, supply chain and development
2. Local assembly of cars from four large major players supplied by local auto part makers and no local development, restricted importations

3. Local assembly of cars by all major global players supplied by global auto parts makers, pushed by liberalization and foreign investment incentive policies, resulting in the participation of local engineering in some global projects, import of cars from specific segments (luxury and newcomers)
4. Same as above, but with rapid increase in the number of factories locally installed (manufacturers aiming at locally producing models that were so far imported, e.g. Toyota, Hyundai or newcomers, e.g. Chinese makers JAC, Chery).

In fact, undergoing these steps has been related to market importance and attractiveness, government influence through regulations and the development of the "global" strategy of the main manufacturers, as confirmed by Salerno et al. (2009).

The automobile industry is one of the most important economic sectors in Brazil not only by quantitative measures but also due to its significant political and social relevance. This industry shows the most developed form of labour union organization and firm-level interest representation in Brazil. Furthermore, the automobile industry originated the introduction of new production models and new forms of work organization spilling over into other sectors (Marx and Mello 2008).

The Inovar Auto initiative was clear in the sense of improving the incentives enforced until then for increasing the capacity building of local assemblers and auto parts manufacturers so as to root design activities, strengthen local research and development, and mainly, focus such initiatives on the quest towards having a more modern fleet, less aggressive to the environment, driver of the most important and necessary incorporations and improvements in new automobile technologies. However, there is no explicit mention or any type of incentive to the use of hybrid and/or electric motoring.

The country could take advantage of this window of opportunity to develop local competencies or even establish a local player in the sector. It became clear that this could occur through the development of local electric mobility.

Thus, unlikely to happen in the short term and in a "leapfrogging" strategy, an evolutionary approach from "locked-in" (or importer) to "local producer" and "co-developer", could be the best way of inserting the country in future global markets. Yet, this depends on public policies and regulations to enhance market, competencies and infrastructure to develop it.

In its first version (it is expected to be extended and improved in 2018), the programme underwent an understanding and adjustment stage, which lasted almost two years. Only late in 2014 did it actually start to have its actions developed by the companies interested in adhering.

This is a recurrent trend in the Brazilian automobile industry. In periods of crisis, most of the investments yielding results in the medium and long terms undergo cuts or are even frozen independently of the benefit forecast. There are signs that this has already been occurring in several cases in the organizations and in ISTs.

It will only be possible to observe and to comment on the materialization or not of this more pessimistic vision for the future and of innovation in the automobile chain in some months when the effects of the economic crisis on the organizations' investments can be more concretely perceived. In the current scenario of growing competition among subsidiaries and countries, technological uncertainties, economical crises, arrival of new players in the Brazilian market, changes in the workforce social profile and changes in government orientation (Extreme Right won the general elections in 2018), the role of unions and employee representation agenda in order to maintain and create qualified and well-paid jobs in the long term remain a big challenge.

Note

1. The period of the history of Brazil between 1969 and 1973 was marked by strong growth of the economy. At this time, Brazil was a military dictatorship. The term "miracle" is related to a rapid and exceptional economic growth that it has gone through in this period. This period was marked by a growth in GDP between 7% and 13% per annum; significant improvements in the country's infrastructure; increased employment levels provided mainly by investments in infrastructure and industrial sectors and significant industrial development. On the other hand, as the economic development was funded mainly with foreign loans, this debt hindered

the development of Brazil creating a dependence on the creditors and the International Monetary Fund. Although the economy has grown considerably, there was no distribution of income and thus further increased social inequalities in the country with increasing concentration of income in the hands of the wealthiest.

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15

Automotive Industry Dynamics in Central Europe

Robert Guzik, Bolesław Domański, and Krzysztof Gwosdz

Introduction

Organizational and technological changes in the global automotive industry are accompanied by a shift in the geography of automotive manufacturing. One of the more important trends is a considerable expansion of the automotive industry in Central European countries (CE) and its integration into Europe-wide production networks. This development is driven by massive foreign direct investment and has led to spectacular growth in exports making the Czech Republic, Poland, Hungary, Slovakia, and recently Romania significant exporters of motor vehicles and automotive components (Fig. 15.1). In relative terms, Slovakia is presently the world's leading manufacturer of passenger cars with 174 vehicles produced per 1000 inhabitants, Czech Republic (133 vehicles) is

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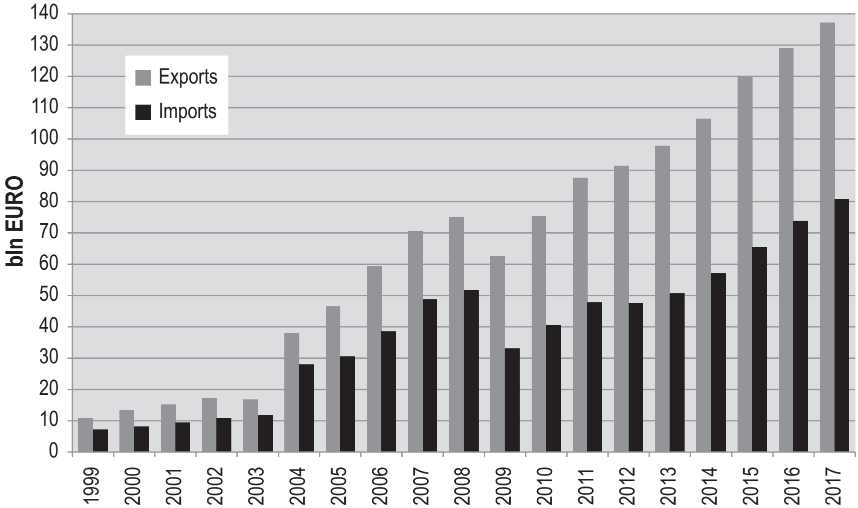

Fig. 15.1 Automotive exports and imports of six Central European countries, 1999–2017

second, leaving Germany (68 vehicles) third (ACEA 2017 data). Similarly, Poland is the top bus producer and Hungary is the largest manufacturer of car engines. The automotive industry has become the most important part of CE manufacturing and entire economies. Motor vehicles and automotive components accounted for 21.6% of the total exports from CE countries in 2017. Their share reaches 31.3% of Slovakian exports; the corresponding value for Germany is 18.8%. In comparison, in 2003 the share of the automotive industry in the exports of CE countries was only 9.3%.

The growth of the automotive industry in CE countries has been widely documented and discussed in the research literature (e.g. Radosevic and Rozeik 2005; Jürgens and Krzywdzinski 2009; Pavlínek et al. 2009; Domański et al. 2013; Pavlínek 2017). The discussion of this process has been linked with the debate on the global commodity chain/global value chain (Gereffi et al. 2005; Coe et al. 2008; Sturgeon and Van Biesebroeck 2011; Ravenhill 2014; Pavlínek and Ženka 2016), the role of transnational corporations (TNCs) and the state (Drahokoupil 2009; Nölke and Vliegenthart 2009) as well as industrial upgrading and territorial embeddedness of TNCs (Faust et al. 2004; Fuchs 2005; Frigant and Layan

2009; Pavlínek 2017). The concept of localized capabilities as a product of the dynamic interaction between the activity of foreign firms and the changing local environment may also be helpful in interpreting these processes (Domański and Gwosdz 2009).

The aim of this chapter is to shed light on the current position of Central Europe[1] in European automotive production networks in the context of the outlined discourse, with particular emphasis on Poland. Special attention is given to the emergence of non-production functions, especially research and development (R&D) centers and design capabilities. In addition, the position and role of local (domestic) producers are explored. Prospects and determinants for further development and upgrading of the automotive sector in CE are discussed to conclude this chapter.

Role of Central Europe in European Production Networks

In 2016, employment in the automotive industry in the European Union (EU) stood at 2,505,758, more than one-quarter of which was accounted for by CE countries (706,300 jobs) (Fig. 15.2). Poland, with 187,600 employees, is the third largest country in the EU in this respect, after Germany (853,858) and France (213,253), and is followed by Romania and the Czech Republic, which after the crisis of 2009–2010 have overtaken Italy, Spain, and the UK (Fig. 15.2). It is worth noting that in 2003, a year before these countries joined the EU, their share in EU automotive employment was below 15%, with just 305,000 people employed. This means that employment in the sector in CE has more than doubled within 12 years.

This strongly reflects the remarkable growth of the automotive sector in this new European semi-periphery. Similarly, tremendous growth in passenger car production in CE countries has been observed (Fig. 15.3). Between 2004 and 2017, car production tripled or even quadrupled in most CE countries, in contrast to Western Europe where, after a slight increase before the crisis of 2009, it stabilized at the 2004 level. The

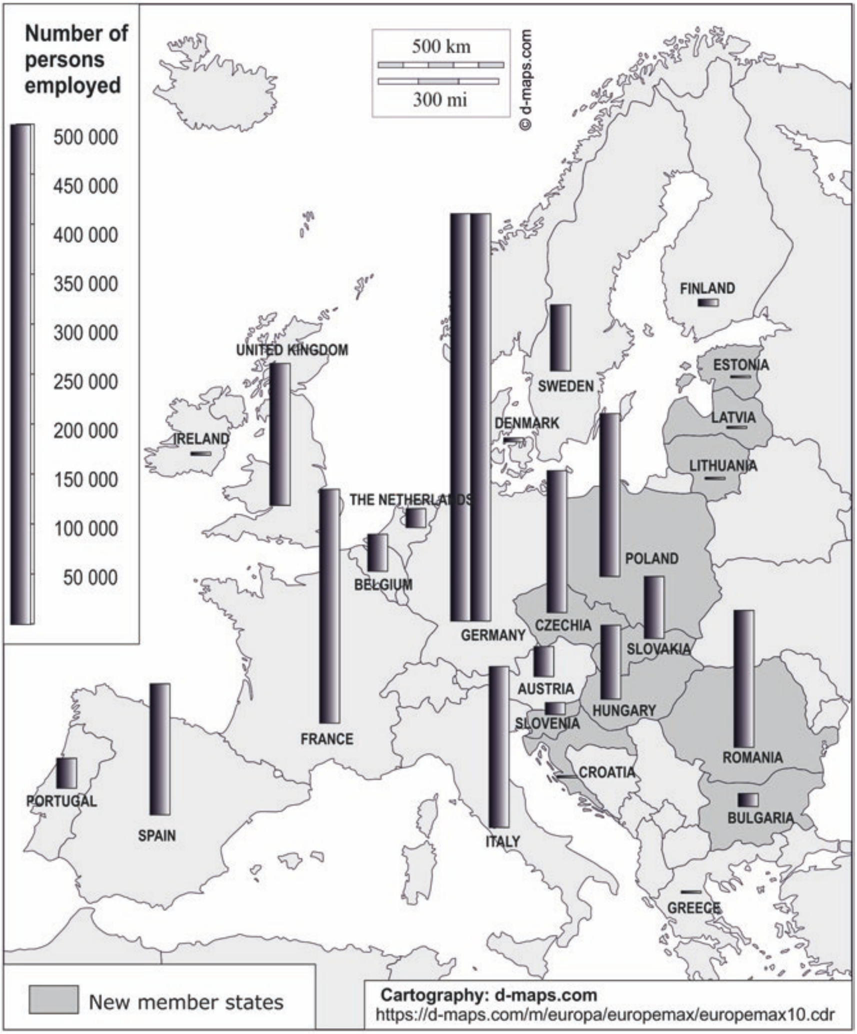

Fig. 15.2 Employment in the automotive industry in EU/EEA 2016

exception was France, which now produces only half of the number of cars it had made in 2004. In 2017, 3.7 million passenger cars were manufactured in CE countries, representing 21.9% of total EU production. Most of these cars were manufactured in the Czech Republic (1.41

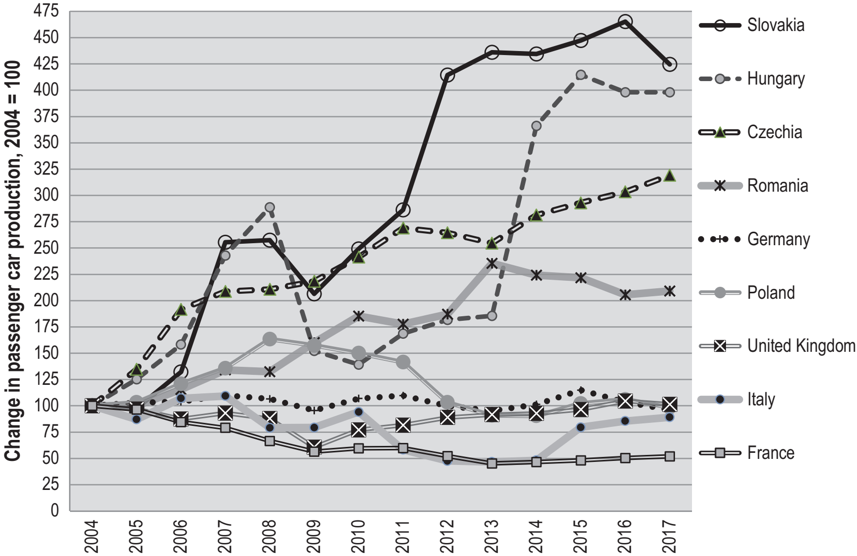

Fig. 15.3 Changes in passenger car production in selected European countries, 2004–2017 (2004 = 100)

million) and Slovakia (0.95 million), both dominated by the VW Group (Skoda, VW, Audi, and Porsche), with main plants in Mlada Boleslav (Czech Republic) and Bratislava (Slovakia), but recently also with a growing share of Korean plants manufacturing Hyundai in Nosovice (Czech Republic) and Kia in Zilina (Slovakia) as well as PSA with plants in Trnava (Slovakia) and PSA jointly with Toyota in Kolin (Czech Republic). The newest production facility is being constructed by Jaguar/Land Rover, which is now a subsidiary of the Indian Tata Group. The plant is to start production in late 2018, with an initial capacity of 150,000 cars per year. This will make the Slovakian economy even more dependent on passenger car manufacturing.

Assembly plants in Romania and Slovenia belong to Renault. A more diversified structure is characteristic of Hungary with production plants of Audi in Györ, Mercedes in Kecskemet, and Suzuki in Esztergom, as well as Poland with an Opel plant in Gliwice, Fiat in Tychy, and VW in both Poznań and Września. An ownership change affecting Opel taken over from General Motors by the PSA Group may reshape its presence in this part of Europe.

A substantial part of the automotive industry in CE countries, especially in the Czech Republic, Poland, Hungary, and increasingly Romania, is the manufacturing of automotive components. This provides a supplier base for local assemblers, but is strongly exports-oriented at this time. There are a large number of new plants with high-volume production, which enjoy economies of scale.

The position of Central Europe in the automotive sector finds its expression in the growth of exports, the value of which reached 137 billion euros for the six CE countries in 2017 (Fig. 15.1). By comparison, it was only 38 billion euros in 2004, not to mention 1990, a year after the collapse of communism in the region, when it was less than 1 billion euros. All CE countries have shown a positive foreign trade balance since the end of the 1990s, which in Western Europe has been experienced only by Germany and Spain (Fig. 15.4).

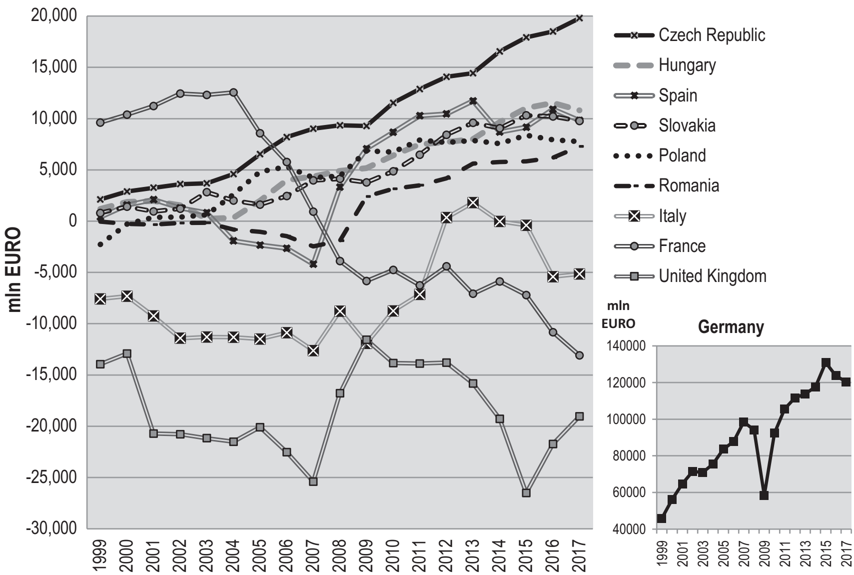

Fig. 15.4 Automotive foreign trade balance for selected European countries, 1999–2017

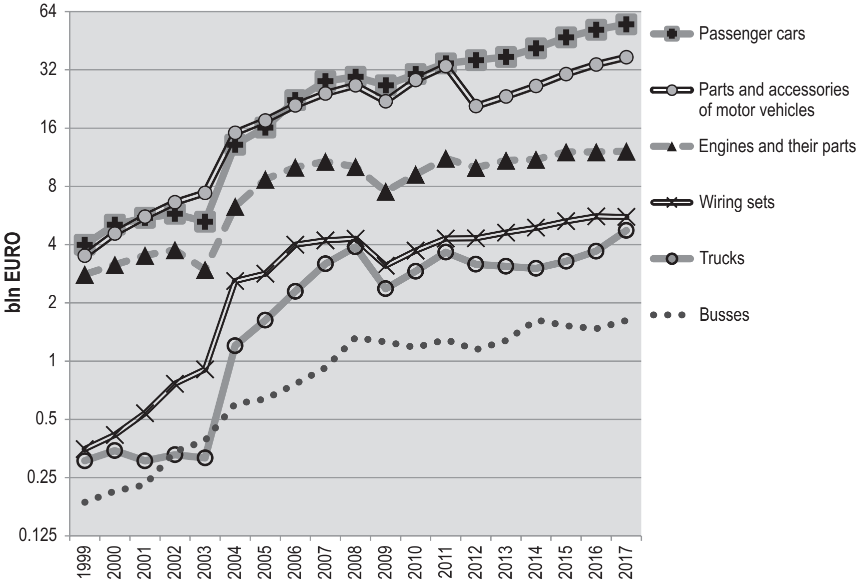

Fig. 15.5 Exports of major automotive products for six Central European countries, 1999–2017 (logarithmic scale)

The share of Central European countries in total EU28 automotive exports (including intra and extra-EU trade) was 20.5% in 2017 and varied considerably across different product groups (Fig. 15.5). It was higher in low value-added and labor-intensive products, but it was also significant in the case of some more sophisticated and high value-added ones. It exceeded two thirds (84.4%) of EU exports of small gasoline engines (less than 1000 cm^3), seat belts (71.8%), air conditioning systems (66.6%), and wiring sets (67.1%). More than half of EU-exported airbags (51.9%) and car seats (54.6%) came from CE countries. Other important exported product groups were small passenger cars (gasoline engines smaller than 1000 cm^3), with the Central European share of exports at over 40.9% (e.g. Fiat 500, Toyota Aygo), buses (33.5%), and diesel engines and large gasoline engines, with the share exceeding 25%.

Figure 15.6 shows the dual role of CE in the international division of labor in Europe. The share of high value-added and low value-added

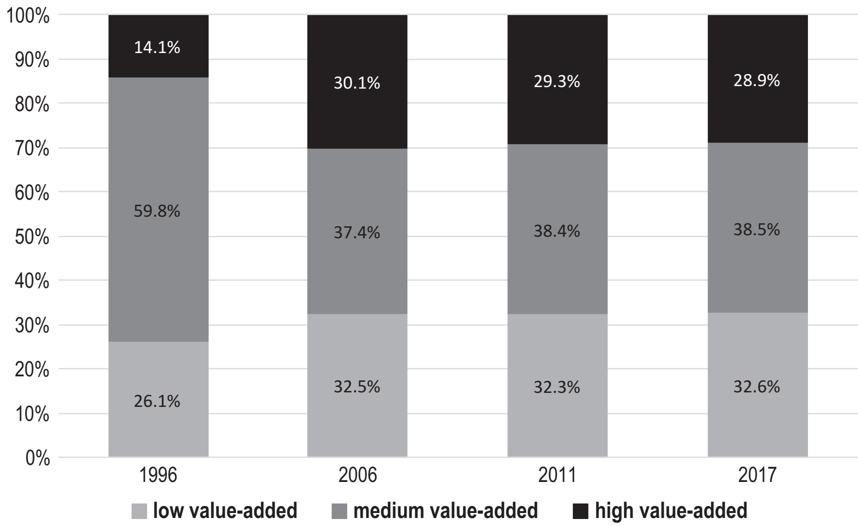

Fig. 15.6 Structure of Central European exports of automotive components by value added, 1996–2017

components in CE exports has remained stable at about 30% in the last decade.

Due to geographic and cultural proximity, German automakers and suppliers have dominated the inflow of foreign investment in Central Europe. Today, however, the vast majority of first-tier global automotive suppliers from Western Europe, North America, South Korea, and Japan are present in Central Europe. These include Bosch, Delphi, Tenneco, Lear, Johnson Controls, Magna, TRW, Valeo, Faurecia, Toyota, Eaton, GKN, Isuzu, Denso, Sumitomo, and many others. Most operate several large factories in the region.

The scale of the expansion of the automotive industry in CE is well illustrated by a large number of new plants opened since 1990. A total of 325 new automotive factories were built in Poland alone by June 2017. About 80% of plants open since 2000 were built as a result of foreign investment. Moreover, it has to be emphasized that foreign-owned factories are usually much larger than domestic ones.

In addition, the strength of foreign producers in the automotive sector is shown by the number of plants with valid ISO/TS 16949 quality certificates. Only 157 out of 600 such plants (26.2%) in Poland in 2016 were domestically-owned, while their share in employment was less than 13%.

Functional Upgrading and Growth of Local Automotive Producers

The vital issue is whether industrial upgrading is accompanied by functional upgrading, by which we understand the development of non-production functions such as product design and development, purchasing/sourcing, marketing, accounting, and so on. Purchasing and marketing are competences relatively rarely found at Central European subsidiaries of TNCs. There is a new trend to establish financial services in the region.

There are more than 150 R&D centers in the region, most of which were established in the twenty-first century. The majority are medium-sized R&D centers located next to manufacturing plants and performing mainly routine product development functions. In Poland, more than 100 engineers are employed at 11 out of 69 R&D centers, including four centers with more than 300 engineers. The largest technical center of Delphi (Aptiv/BWI now) in Krakow is one of the few with global competencies and 1900 employees now.

In general, broader prospects for the growth of R&D in the region exist in the component sector, especially among first-tier suppliers with a broad production base in CE. More comprehensive R&D functions are usually found at US-owned subsidiaries, which have established their new European R&D divisions in Central Europe. There is far less motivation to pursue such investment among Western European corporations, which have well-established R&D units at home (Pavlínek 2012). For example, in Poland, American TRW's operations (now part of German ZF) include seven factories and three technical centers; Aptiv/BWI has three plants, one global R&D center and shared services, while French Faurecia has ten manufacturing plants and one R&D center in Poland.

There is no doubt that further industrial and functional upgrading of the automotive sector in Central Europe will be determined by the ability of domestic companies to grow and attain a more prominent role in the value chain. It has to be emphasized that the majority of large and medium-sized manufacturers of automotive components, which had existed in CE in the 1990s, have been taken over by foreign firms. The rise of new domestic producers supplying foreign Original Equipment Manufacturers (OEMs) and tier-1 and tier-2 firms was a gradual process. There are approximately 500 locally-owned automotive firms with valid ISO/TS 16949 quality certificates in the region. Most are medium-sized second- and third-tier suppliers, while a limited number of companies directly supply OEMs or serve as producers of final niche products.

The international success of CE automotive manufacturers requires considerable capital investment and/or taking advantage of a 'window of opportunity', which may emerge due to technological or market changes. This may be illustrated using the example of three Polish companies: Boryszew, Wielton and Solaris.

The Boryszew Group developed as an industrial group, established by Roman Karkosik, a successful stock exchange investor, who built over the years his industrial conglomerate with two major divisions: non-ferrous metals and industrial chemicals including plastic products, antifreeze, and brake fluid. In 2010 and 2011, the Boryszew Group acquired several German and Italian manufacturers of plastic auto parts and automotive tubes (e.g. Maflow), with factories in Italy, Germany, France, Spain, Poland, Brazil, Mexico, China, and India as well as R&D centers in Italy and Germany. Thus, the 2008 global economic crisis became a window of opportunity for the international expansion of the Polish company as a global automotive supplier specializing mostly in plastic components. It recently built five new greenfield plants in India, Russia, Mexico, Poland, and Germany. Boryszew with its 21 factories in 11 countries is now a first-tier supplier for BMW, VW, Audi, Mercedes, Fiat, and other OEMs. Total sales of the Boryszew Group reached 1.5 billion euros in 2017.

Foreign acquisitions also served as the road of international expansion for Wielton, the Polish manufacturer of semi-trailers. It took over Fruehauf in France, Rimorchi in Italy, and Langendorf in Germany. Now Wielton runs five plants in Poland, France, Italy, Germany, and Russia, becoming the third largest producer of semi-trailers in Europe after the German companies Schmitz and Krone.

Solaris was a family-owned company and the largest bus producer in Poland. It began operations with the simple assembly of German Neoplan buses at a leased facility with just 36 employees in 1996. After the acquisition of Neoplan by MAN in 2001, which had its production facility in Poland, the company developed its own brand: Solaris. In 2006 the manufacturing and exports of the Solaris Urbino Hybrid bus were launched as the first serial production of hybrid buses in Europe. Since 2008 Solaris has been the third largest city bus supplier in the German market after Mercedes and MAN, with a particularly strong position in the hybrid bus segment (Gwosdz et al. 2011). The production of fully electric buses began in 2015. Today Solaris employs more than 2000 people and supplies buses to more than 600 cities in 22 countries on four continents. Solaris built up its brand step by step in the Western European market at a time of general consolidation in the bus manufacturing industry in Europe and the disappearance of independent manufacturers. The company adopted an uncertain, but innovative strategy to capture a new 'green' niche of environmentally friendly buses, which again may be interpreted as a window of opportunity. The company's success was based on combining high quality and relatively low costs with a high level of flexibility and willingness to meet specific customer needs in terms of design and time of delivery, which were crucial in a fragmented bus market, with varying technical and environmental requirements of European cities. Solaris was taken over by Spanish CAF in 2018.

Factors Behind the Enhanced Role of Central European Automotive Producers

The spectacular growth of the automotive industry in Central Europe has been based on a special relationship between the strategies of foreign automotive manufacturers and the characteristics of Central Europe: its economy and the labor market as well as the institutional environment and public policy. Lower wages are often presented as a major driving force behind the shift of manufacturing activity from Western Europe to Central Europe. In the latter, wages in the automotive industry tend to be higher than those in other manufacturing sectors, but these locally high wages are relatively low in comparison with countries in Western Europe. The full-time equivalent labor cost per hour in the automotive sector was 79.0 euros in Germany, 45.5 euros in Spain, but only 20.2 euros in the Czech Republic, 16.1 euros in Poland, and 11.7 euros in Romania in 2016, according to Eurostat. However, this is also related to slightly lower productivity in Central Europe, which is increasing every year. Even if the productivity of factories located in CE countries were half compared with their Western European counterparts, wage-adjusted labor productivity would still be almost twice as high as that for Western Europe, which is confirmed by Eurostat data. For example, the indicator of apparent labor productivity per average personnel costs (in %) was 141% for France and 160% for Germany, whereas in Poland, Slovakia, Hungary, and the Czech Republic it exceeded 200% in 2016.

Another important factor, especially significant in the case of the automotive industry, is quality. This requires certain attributes of the labor force connected with skills and work culture in order to meet the highest standards of quality. Research studies including broad company surveys and interviews conducted by the authors indicate that quality standards here may even exceed those in Western Europe today. This partly reflects the fact that much of the production in Central Europe is carried out in recently designed and newly built factories. The generally good level of education together with technical skills in some areas of the Central European region is also important here. The local labor force demonstrates a high degree of motivation, adaptability, and flexibility, which allows for a fast response to customer demands (Domański et al. 2008). The sector is generally characterized by stable and non-conflicted industrial relations.

The growth of the automotive industry in Central Europe can be interpreted in terms of dynamic localized capabilities, which were created, reproduced, enhanced or eroded by relationships between foreign investors and the region, namely its firms, workforce and institutions underlain by earlier social and institutional structures (Domański and Gwosdz 2009). Foreign automotive companies brought to the region, among other things, new technologies and organization of production; at the

Table 15.1 New car registrations in Central Europe and the EU, 2012 and 2017

Country	2012	2017	Dynamics (2012 = 100)
Poland	273,589	486,352	178
Czech Republic	174,009	271,595	156
Hungary	53,059	116,265	219
Romania	66,436	105,083	158
Slovakia	69,268	96,085	139
Slovenia	48,648	70,892	146
6 CE countries	**685,009**	**1,146,272**	**167**
22 other	11,366,883	13,991,460	123
European Union 28	**12,051,892**	**15,137,732**	**126**

Source: authors' elaboration based on ACEA data

same time, they found industrial traditions, technical culture as well as adaptability and motivation of local labor. The interaction between these elements brought about dynamic localized capabilities, which underlay the success and industrial upgrading of automotive manufacturers in the Central European semi-periphery.

Last but not least, Central Europe enjoys the significant advantage of close proximity to Western European markets, especially Germany, which means shorter just-in-time deliveries and lower transportation costs in comparison to, for example, Turkey and North Africa.

What made Central Europe different from Brasil, Russia, India and China (BRIC) countries was limited car sales at home, which was related to the massive imports of second-hand vehicles within the EU. Hence there was no link between the domestic market and growing car production, which became more and more export-oriented. However, the local market has begun to change. New car registrations have increased from 685,009 to 1,146,272 units in CE countries for the last five years, that is, by 67% in comparison to the growth of 23% in the rest of the EU (Table 15.1).

The Role of New Technologies, Business Innovations, and Labor Issues

The prospects of the automotive industry depend on broader trends in economy and society. The impact of new, especially digital, technologies and related novel business models underlay by changing mobility patterns and lifestyles, for example, the shift from car ownership to car use in various forms of sharing economy, has to be taken into account. Moreover, increasing environmental awareness of society finds expression in national and local 'green' regulations.

The recent rapid modernization of the Central European countries has made adoption of certain innovations more widespread than in Western Europe, for example, electronic banking and contactless payment. The popularity of mobile solutions and applications in the region encourages the development of companies introducing new models of mobility and car sharing. The early success of Uber caused a hostile reaction of local taxi companies and brought about government regulations leading to the total suspension of Uber's activity in Hungary in 2016 and in some parts of the Czech Republic, for example, in Brno. Since 2017, the existing law in Poland is interpreted in the way that Uber drivers are required to hold a license and report the income for taxation accordingly. At the same time, there is growing popularity of other mobile applications such as My Taxi and Taxify. Taxify, which is one of the leading ride-hailing businesses present in 25 countries, was founded in Estonia in 2013 and is headquartered in Tallinn; it became a target of the investment of Didi from China in 2017. The world largest ridesharing service BlaBlaCar based in France is fast expanding in Poland since 2012, in Hungary since 2015 and in Czechia and Slovakia since 2017. It is currently testing a new BlaBlaLines service, which may offer to commute to work and/or schools; Central European rural areas with poor public transportation can be a very promising market for such a solution.

Car sharing is a new form of mobility, for example, reaching 7800 free floating cars in Germany in March 2017 (Bundesverband CarSharing 2018). There is also its dynamic growth in Central Europe. The largest operator in Poland Trafficar has a fleet of 2000 vehicles in 16 main urban agglomerations. There are also local operators in every city with 200–300 cars each. Car sharing is increasingly related to the promotion of electromobility. For example, Trafficar increases its fleet of electric cars (Renault ZOE), Vozilla operates 200 electric vehicles only (Nissan Leaf) in Wrocław, and Panek Car Sharing has 300 hybrid cars (Toyota Yaris) in Warsaw. In Budapest, there are two competing systems of GreenGo (200 electric cars) operating since 2016 and MOL Limo which started with 200 petrol and 100 electric cars (VW Up) in 2018.

The idea of car sharing started very early in the Czech Republic. The first company offering such services Autonapul was established in Brno in 2003 and operates in the whole country now. The system in which individuals can offer their cars and/or rent them from others through a special application, providing a mobility solution as part of sharing economy, are quite advanced in the country. In July 2018 a merger of two operators SmileCar and HoppyGo took place creating a new platform HoppyGo, which is a joint-venture of Škoda Auto DigiLab and Leo Express (a private transport group operating railway and bus lines in Czechia, Slovakia, Poland, and Austria).

All these solutions reduce the number of cars in the streets, allow to avoid parking difficulties and reduce costs for individual users as well as diminish demand for car purchase.

The sales of electric cars have been very limited in Central Europe so far in comparison to Western Europe, however, this may change in the recent future. More and more town authorities in the region introduce incentives for electric vehicle (EV) users, for example, dedicated and/or free public car parks in the city center, the right to use bus lanes, and so on. Still, there is no doubt that only national policies can really boost the move toward electromobility. The Plan for Electromobility Development announced by the Polish government has an ambitious target to install 6000 charging points for 1 million electric cars by 2025. Tax incentives and subsidies for private consumers together with the vast purchase by public institutions are meant to create a consumer market for electric vehicles. A new entity Electromobility Poland was established by the four energy companies in order to finance the construction and launch of large-scale EV production. The implementation of the plan requires substantial financial and organizational effort.

The situation is quite different as far as the electrification of public transportation is concerned. In 2016 and 2017, Poland was the fourth largest European market for electric buses following the UK, France, and the Netherlands, while much smaller Czech Republic was among the top ten markets (Zeus e-bus report 2017). This is related to well-developed production competencies in the region in this domain. Polish firm Solaris became the European leader in the manufacturing of electric buses; there are also smaller producers, for example, SOR Libchavy in Czechia and Ursus Bus in Poland, as well as Škoda Electric with a well-established position in the trolley-bus market.

It is important to consider the potential consequences of the expansion of electric powertrain for the geographical pattern of the industry. A significant part of the European production of diesel and petrol engines is located in Central Europe at the moment, in Hungary and Poland in particular, so the technological shift represents a challenge for their position. So far, Audi in Győr, Hungary, began the production of electric engines in 2018 and Toyota announced launching the manufacturing of hybrid powertrain in one of its Polish engine plants.

Recent investments of Korean and Chinese firms seeking inroads into European markets indicate that the region may benefit from current technological trends. In 2017, LG Chem decided to build the largest European lithium-ion battery factory near Wrocław in southwestern Poland, which was followed by the location of the manufacturing facility of lithium-ion battery materials by Shenzhen Capchem Technology and Guoatai-Huarong from China and the first European cathode materials plant by Umicore from Belgium in the same area.

Finally, labor issues have to be taken into consideration. What is a relatively new phenomenon is increasing difficulty in securing human resources reported by companies due to the demographic situation in Central European countries. At the same time, there is more and more workforce from abroad, especially from Ukraine. The fundamental question is whether foreign workers are just a temporary remedy for the short supply of labor force or a long term solution in the form of permanent migration. The consequences of the labor market situation for the future strategies of automotive companies in Central Europe are even more important—to what extent this may lead to delocalization of production to other areas, or on the contrary to faster upgrading toward capital-intensive production and greater automation. At the moment, even though the automotive sector has the largest number of robots among the CE manufacturing industries, the automation levels in the region are still significantly lower than in Western Europe.

Conclusions

In general, the development of the automotive industry in less developed countries is usually explained by three types of factors: company strategies, country characteristics, and public policies (Humphrey et al. 2000; Carrillo et al. 2004). All of them have been significant for the expansion of the sector in Central Europe.

The region, which used to be an isolated periphery of the global economy until the 1980s, has become a new semi-periphery strongly integrated with Western European production networks. The growth of the automotive industry in Central Europe has been part of the process of 'Europeanization' of the sector, that is, an alternative to the sourcing of components and vehicles outside of Europe. The process of gradual industrial upgrading leads to an enhanced role of CE in global value chains. This primarily took place through the move of foreign subsidiaries to the manufacturing of more complex products as a result of evolutionary corporate strategies. Consequently, the region plays a dual role in the European automotive sector now, supplying both simple labor-intensive parts and advanced high-value-added components. There are numerous new plants in the region characterized by large-volume production and hence economies of scale, good quality, and flexibility, which are embedded in a broad regional network of suppliers. All this is underlain by dynamic localized capabilities developed through the interaction of foreign companies and the attributes of the region including skills and attitudes of workers, managers and entrepreneurs as well as the reliability of suppliers and local institutions, together with lower labor costs, macroeconomic stability, public incentives and close geographic proximity to Germany.

There is also some functional upgrading within certain foreign automotive component makers, which combine design and manufacturing and/or develop their R&D centers in Central Europe. On the whole, the scope of functional upgrading in the automotive industry in the region is relatively limited in comparison with its role in production. What seems crucial for broader functional upgrading in the future, including decision-making powers, design, purchasing, and distribution competencies, is the enhanced position of domestic CE enterprises in European and global markets.

The dependence on foreign firms and the secondary role of locally-owned ones is an important weakness of the Central European automotive industry. Domestic component producers from the region have proven to be capable of providing high product quality and reliability of deliveries, gaining the increased trust of OEMs and first-tier suppliers and enhanced autonomy in manufacturing processes. However, advanced manufacturing capabilities of domestic firms are rarely accompanied by the development of their design competencies. There is a sort of vicious circle, which limits the functional upgrading of domestic suppliers: the lack of design competences constrains their profitability, which in turn reduces their investment and product development capabilities. Barriers to the growth of domestic producers from the semi-periphery as European/global suppliers are stronger now than 10 or 20 years ago due to a shift of design requirements toward suppliers, high sunk costs related to large capital and human investment needs, growing complexity of supply networks and the need to be present in various regional markets (Asia, America, Europe).

What is a new phenomenon is the emergence of Central European automotive firms capable of expansion in the global markets. Opportunities for their success can be found in niche products, the involvement of non-automotive enterprises and/or the acquisition of enterprises in Western Europe and foreign-owned plants in Central Europe. Expansion through the acquisition of Western European firms may allow to capture well-established brand names, market share as well as design, technological and organizational competencies. Local producers form CE have improved their position particularly in the manufacturing of plastic and aluminum components, which gain in importance due to growing pressure for car weight reduction.

All in all, the position of the Central European semi-periphery cannot be understood without its relationships with the Western European core, and in a static manner; it is dynamic and relational in nature. The discussed trends in technology, business models and labor market situation suggest we are approaching a turning point, when the Central European automotive industry may begin to lose its comparative advantage unless it undergoes significant change enhancing its position through further upgrading. Among other things, new challenges are related to changing conditions in the labor market of Central Europe. The growing scarcity of human resources in the region means that one of its fundamental advantages, that is, the availability of a motivated and skilled workforce, is being eroded. On the one hand, this can lead to the stagnation of production capacity or its relocation outside the region. On the other hand, it can stimulate a move toward more sophisticated high-value-added products, greater automation, as well as stable core employment.

Note

1. Post-communist countries of Central Europe taken into account here are six member states of the European Union: Poland, Hungary, Czech Republic, Slovakia, Slovenia and Romania. The automotive industry is very small in Estonia, Latvia, Lithuania and Bulgaria, and hence was not part of the analysis.

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Part IV

Institutional Constraints on Upgrading: The Case of Vocational Education and Training Systems

16

Skills on Wheels: Raising Industry Involvement in Vocational Training in the Czech Republic, Slovakia and Hungary

Vera Šćepanović

Introduction

The recovery of industrial production in East Central Europe (ECE)[1] after the fall of socialism is a poster story for development through foreign direct investment. In just a few years, the socialist "rust belt" on the European Union's (EU's) eastern border, once populated by uncompetitive firms with outdated technologies has been replaced by one of the fastest growing industrial clusters in Europe. The automotive industry has led the way. Since 1990, the majority of new car factories in Europe have been planted east of the former Iron Curtain, resulting in vertiginous production growth of about 200,000 units per year. In 2017, the region churned out more than 3.5 million vehicles, or 21% of total EU production—up from just 5% in 1997 (OICA 2018).

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The expansion in volume has been accompanied by significant product and process upgrading. The average value of a vehicle exported from East Central Europe rose from about 30% of the average German export in the early 1990s to about 60% in the mid-2000s, about the same level as Spain or France.[2] The ECE still specialises in small, compact vehicles, but in recent years, premium producers such as Mercedes and Jaguar Land Rover have begun to settle in the region. The same trends are evident in the component sector. In the 1990s, the region specialised in exports of simple, labour-intensive parts and imported the more complex components; by the mid-2000s, the volume of component export had increased ten-fold and the production profile looked very similar to that of the "core" European producers (Pavlínek et al. 2009; Bernaciak and Šćepanović 2010).

Despite these successes, however, the automotive industry remains a challenge for the region's policymakers. Their countries have grown increasingly dependent on the sector, which makes it all the more important to preserve the investment momentum and ensure that the industry continues to adapt to new technologies and invest in research and innovation. At the same time, there is little they can do to influence the direction of its development. Headquarters in which the decisions are made are nearly all located outside of the region: foreign firms account for over 90% of production value in the automotive industry and constitute an overwhelming majority in all supplier tiers (Pavlínek and Janák 2007; Rugraff 2010). This is partly why the upgrading of the region's industry was accomplished in such a record time: instead of having to develop capacities from scratch, the lead firms simply transplanted their supplier networks, shortening the catch-up period (Šćepanović 2013). The downside is that implementing any kind of industrial policy in these circumstances is exceedingly difficult, as the capital, technology, supplier relations and product placement are all decided independently from the constraints or opportunities of the local institutional environment.

This is one reason why the policy efforts of the recent years have focused on the only locally produced input: the labour force. The other is the growing dissatisfaction of employers, who have for some time been complaining about the quality and availability of skilled workers in the region.

This trend is all the more worrying as skilled and affordable manufacturing workforce had been considered the region's "secret ingredient" and was uniformly praised by investors as one of its main attraction factors. From the late 2000s, however, the investor surveys began to cite the lack of skilled workers as one of the main obstacles to expansion (Rutkowski 2007; Dokoupil 2007; DHIK SK 2008). The supply squeeze accelerated wage growth, adding to the investors' worries. Even the outbreak of the global economic crisis only marginally dampened the demand, and the complaints about skill shortages returned with a vengeance, alongside the pressure on the governments to do something to improve the labour supply.

The governments have multiple reasons to respond to these demands. On the one hand, they worry that skill shortages and rising labour costs will drive away the investors. Despite the improving performance of labour markets overall significant pockets of high unemployment remain in most countries, and foreign companies still contribute the most to employment growth. On the other hand, they hope that improvements in human capital might also convince the investors to move towards more skill-based production that would allow them to accommodate higher wages in the long run. The concern has become even more pronounced in recent years with the realisation that most of the jobs created by foreign investors in the previous decades are highly vulnerable to automation: According to a recent OECD study, the risk of automation for a median worker in the Czech Republic and Slovakia is around 48% over the next decade, higher than anywhere else in Europe (Arntz et al. 2016).[3]

As a consequence, a number of countries in East Central Europe have recently initiated reforms of vocational education to raise the level of manufacturing skills and to match them better to the labour market demand. The problem, however, is that the governments can almost never accomplish such reforms on their own. Vocational education is notoriously expensive as it requires specialised equipment and training staff, and if not organised in close cooperation with industry, it is unlikely to deliver up-to-date skills required by the employers. However, securing the employers' cooperation has proven to be extremely challenging. Many of these firms had come to East Central Europe in search of lower costs, and have little interest in investing in workforce skills. And even where the interest exists, the lack of institutional superstructure to prevent free-riding and coordinate skill needs across the sector acts as an impediment to training (Hancké and Kureková 2008).

This chapter explores the strategies which the ECE states have deployed, with varied success, to overcome these challenges, reform their vocational training systems, and increase employer participation. Their experience will be of practical interest to decision-makers in many countries that find themselves in a similar position, but it also raises an interesting challenge to the institutionalist arguments in comparative political economy and political economy of development. Developing countries are frequently instructed to "get the institutions right", but the specifics are usually lacking, especially when it concerns institutions that require extensive public–private coordination. Meanwhile, the literature on comparative capitalisms mainly catalogues the clusters of existing institutions and the way in which they facilitate certain patterns of cooperation without asking how similar mechanisms can be recreated in countries that lack similar institutional preconditions.

In attempting to address some of these problems, this study draws on the empirical evidence from three East Central European countries: Czech Republic, Hungary and Slovakia. These countries were the first to experience acute labour shortages, and this is where the pressure for vocational training reform has been the greatest. In all of these countries, automotive industry has spearheaded the demands for training reform, which probably explains the authorities' responsiveness: the sector plays a huge role in their economies, accounting for 20%–25% of all exports.[4] Nevertheless, the early institutional responses showed a wide variation, depending on the local conditions and the strategies undertaken by the lead firms. It was only after the shock of the global economic crisis in 2008–2009 that the reforms in all three countries began to converge towards a more uniform model of skill provision. Partly under the influence of the German investors and investor associations which provided expert advice and supported policy learning through connections to home-country firms, these reforms have been roughly modelled on the German dual vocational training system. Nevertheless, as company involvement remained unsystematic, adaptation to the local institutional conditions continues to require heavy public involvement and policy innovation: some promising, but some potentially counter-productive.

The paper is structured as follows: the first section summarises the early employment model in the East Central European automotive industry and explores the factors behind the emergence of skill shortages. The second section traces the early attempts to reform the skill provision system by increasing employer participation, and the cooperation failures that resulted in very limited reform outcomes. Section "Policy Experiments to Increase Employer Participation in VET Provision" then analyses the most recent wave of reforms and the transnational coalitions that provided support for their implementation. The conclusion offers a short assessment of their achievements to date and the lessons that can be drawn from the East Central European experience.

Where Did All the Skills Go? The Successes and Failures of the ECE "Model" of Skill Production

The literature on employment models usually distinguishes between two options: the "high" road, in which the workers are highly skilled and productive, but also compensated by high salaries and stable employment relations, and protected by well-organised worker associations; and the "low road" of relatively unskilled, but also cheap and flexible workforce (Jürgens 2004; Jürgens and Krzywdzinski 2008). The reason that these go together is that investments and incentives in the two models are aligned in such a way that they reproduce the same pattern of relations. The workers are willing to invest in highly specific industrial skills if they know that their investment will be adequately compensated, and the employers are willing to concede higher salaries and invest in workforce training in order to obtain the required skills, and will prioritise internal flexibility to easy firing policies in order to protect their investment (Iversen 2005; Finegold and Soskice 1988). Conversely, if the production does not require high levels of skill, low cost and flexibility become the priority, and neither employees nor employers have an incentive to invest in training.

However, when the automotive investors arrived in East Central Europe in the early 1990s, they were met by a workforce that appeared to combine the best of both worlds. The collapse of socialism had left behind a large pool well-educated manufacturing labour: the percentage of the workforce with completed upper secondary education exceeded even the levels of some West European countries. Much of this was technical education. In the late 1990s, vocational schools still accounted for over 70% of secondary school graduates in the Czech Republic and Hungary, and over 80% in Slovakia. This did not necessarily mean that the skills they produced were exactly of the kind needed by the employers. After all, one of the reasons that the socialist industries proved to be so uncompetitive was that they were operating with outdated technologies and organisation models that favoured strict hierarchies and narrow skill profiles and were difficult to adapt to the requirements of lean, flexible production. But they nevertheless ensured that the workers had high levels of average technical education that could be quickly adapted to the requirements of the new workplaces.

More importantly, foreign investors did not have to rely on the average. With the oversupply of labour left behind in the wake of industrial restructuring, with only slightly higher wages they could attract the best and the brightest. The automotive firms, especially the flagship carmakers, counted among the most attractive employers on the market: well into the mid-2000s, Škoda was the sixth best-paying employer in the Czech Republic, and wages at VW Slovakia were only below those in the banking sector (Janovskaia 2008; Mikulikova 2002). For the investors, this was small change. In the mid-1990s, the hourly rates in the automobile industry in East Central Europe were eight times lower than the West European average, and about ten times lower than in Germany (Table 16.1).

However meagre by the international standards, higher wages in the automotive industry were further balanced by long hours and flexible working practices. The governments in the region were working overtime to liberalise employment regulations in the hope of stemming high unemployment. The unions, when not completely absent, were also eager to secure jobs, and often traded internal flexibility for promises of future investment (Bernaciak 2010). By the end of the 1990s, continuous, 24-hours production in three or four shifts became standard practice in the region (Sperling 2004; Meardi et al. 2009). Working Saturdays and

Table 16.1 Key characteristics of the ECE automotive workforce, 1997

	Hourly labour costs (EUR)[a]	Workers below 30 years of age (%)	Workers with at least upper secondary education (%)	Hours per worker (annual, 000s)	EPL[b]
Czech Republic	3.5	29.4	88.8	1.92	1.9
Hungary	3.5	33.6	82.8	2.05	1.3
Slovakia[c]	2.2	47.5	95	1.67	1.8
EU7 average	22.3	27.9	56.4	1.76	2.6
Germany	34.1	23	78.2	1.51	2.8

Sources: Column1-VDA (adapted from Blöcker and Jürgens 2008); Columns2/3: EU Labor Force Survey (LFS); Column 4: KLEMS; Column5: OECD
[a]Including taxes and contributions
[b]Employment Protection Legislation (EPL) of the whole economy
[c]LFS data reference year 1999

Sundays are also more common in ECE than elsewhere in Europe (Krzywdzinski 2008), resulting in overall longer working hours. Adding to the greater flexibility was also the age of the workforce: in East Central Europe, over 30% of all workers in the late 1990s were younger than 30.

Table 16.1 summarises some of the key characteristics of the original employment model in ECE. In short, until the mid-2000s the region offered a workforce that was far cheaper and more flexible, but nearly as skilled as anywhere else in Europe. The results were spectacular: between 1995 and 2005, productivity increased at an average of 30% per year, or from about 17% to over 50% of West European levels. It is no wonder that the investors were impressed, and some even found the ECE school-based skill provision with minimal on-the-job training to be superior to the German dual training system which demanded so much more investment from the employers (Bluhm 2007: 271).

The only problem with this configuration was that it was not really a "model" at all, but the result of unique, and temporary, historical circumstance, and could thus not be smoothly reproduced. In fact, the same features that have made it so attractive to investors—the instability and oversupply of industrial labour—were discouraging the new generations of workers from investment in manufacturing skills. Even though by the early 2000s the end of post-socialist restructuring and the steady investment inflows had finally succeeded in bringing down unemployment, the view of vocational training as a second-rate educational choice had become fully entrenched in the region.[5] Enrollment at universities and in the general upper secondary schools increased, while the numbers in the vocational education and training (VET) schools fell. The reduction was especially pronounced in the VET tracks that result in a vocational certificate that does not grant the student a possibility of entry into higher education[6] (Bükki et al. 2014a; Šímová and Czesaná 2014; Vantuch and Jelínková 2014a).

The shrinking supply of graduates and falling unemployment led to a fierce competition for skilled workers and with that an upsurge in prices. The employers who not long ago could cherry-pick the best recruits for little money, now had to spend far more in order to attract average-skilled candidates. Suddenly, the region's skill profile no longer looked so attractive. A survey by the American Chamber of Commerce in Slovakia found than 50% of respondents faced difficulties in finding qualified workforce; in the Czech Republic, two-thirds of German investors in manufacturing reported similar problems, especially for positions requiring skilled manual workers (AmCham SK 2009; AHK 2008). The investor associations bewailed the state of regional vocational schools, which according to them churned out outdated skills that were of no use to the investors, and demanded an overhaul of vocational training to better match the graduates' skills to the labour market requirements.[7]

The speed at which their countries' greatest asset had turned into a source of dissatisfaction was clearly unnerving to the ECE governments, and it also put them before a peculiar conundrum. On the one hand, many policymakers accepted the need to reform their vocational training, if for no other reason in order to keep up the region's good reputation with the investors. Some of them also hoped that improved training would help to increase the chance of employment for the less skilled workers. Despite the falling unemployment and the employers' complaints about the "lack" of workforce, they were not exactly scraping the bottom. Unemployment levels remained stubbornly high precisely among the demographic that was supposedly in such high demand—manual industrial workers with a vocational certificate. In 2013, graduates of ISCED 3C vocational programmes had far higher unemployment rates than their colleagues in the more general ISCED 3A vocational tracks, and both groups were more likely to be unemployed than the graduates of general upper secondary programmes, the majority of whom continued their studies at the tertiary level (Fig. 16.1).

On the other hand, the ECE states were already spending a disproportionate amount of money on the vocational programmes that were neither popular with students nor producing good labour market results. Before 1989 vocational training was organised by state schools in cooperation with the large industrial conglomerates, which provided practical training for the students. After these were privatised or dissolved, practical training moved to the school workshops, whose maintenance proved to be a significant drain on resources. Around 2000, Hungary, Czech Republic and Slovakia were spending close to 0.7%–0.9% of their GDP on upper secondary VET, about a fifth of their total public spending on education. According to the OECD estimates from the same period, an upper secondary student in the vocational track cost the government between 10% and 30% more than a student in the general programme (OECD 2007, 2008; Canning et al. 2007). Moreover, this was nowhere near enough. Faced with the lack of funding, the schools were allowing the equipment to become outdated or skimping on the training

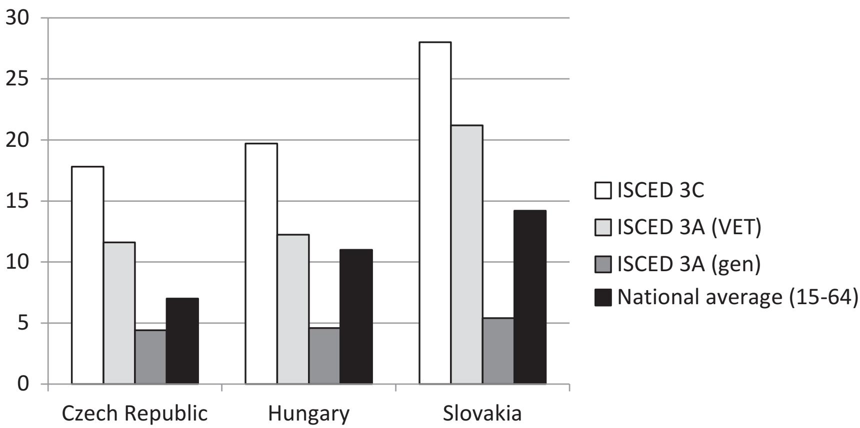

Fig. 16.1 Unemployment rates of graduates by educational programme, 2013. Data for Hungary 2011/2012. Source: CZ: Úlovec and Vojtěch 2014; HU: Horn 2016; SK: Vantuch and Jelínková 2014a, b

altogether—various national surveys documented a steady decline in the practical content of school curricula (Strietska-Illina 2001; Vantuch et al. 2009). According to estimates of the European Centre for the Development of Vocational Training (CEDEFOP), the ECE states would need to invest 50%–100% more of what they were already spending to bring the VET education up to date (ETF 2006). They pay-offs, meanwhile, remained uncertain. Despite the revival of a handful of export industries, the ECE economies have been moving steadily towards services, and the international experts have urged the governments for some time to redirect their efforts at the general and higher education. The EU's 2004 "Lisbon agenda" also advised the member states to raise the rate of university enrollment among youth to 40% as a step towards a competitive "knowledge economy", and the ECE's dogged commitment to traditional vocational training and low levels of university education had begun to look decidedly antiquated. The World Bank experts had flatly advised doing away with the secondary level vocational education altogether, and ensuring that the beneficiaries bear the cost of its provision (Canning et al. 2007).

Few policymakers in the region would have agreed to do away with the VET so easily, but the fact was that the ECE states were already doing all they could to produce "specific" manufacturing skills. To raise the state of vocational education and align it with the needs of the industry, they now needed the help of employers—not only to co-finance the provision of practical training, but also to assist the authorities in predicting the skill requirements at specific occupational level, and to support the transition of VET graduates from training to employment. The early responses to the skill shortages in the region thus all focused on increasing employer participation in VET, but the form they took varied widely, depending on the local circumstances and the strategies of the lead firms.

Policy Experiments to Increase Employer Participation in VET Provision

While the automotive employers in ECE agreed on the need to improve the skills of the future workers, and some were even willing to invest in their training, getting them to participate more systematically in vocational education proved to be a difficult challenge. The first problem was of cost. Many firms in the automotive sector had come to the region in search of lower costs, and while some had taken advantage of the initially favourable workforce profile to upgrade production, many of them still prioritised savings. Their concern was further compounded by competition for labour which raised a very real danger of other companies free-riding on their investments (Becker 1993; Hancké 2012). For this reason, it made far more sense to train current employees instead of the future ones, and it also allowed the firms to focus on a narrow set of skills they immediately required instead of setting aside time and equipment to provide more general and comprehensive training. A 2005 Europe-wide survey of enterprises found that only 7% of large manufacturing firms in Slovakia and 15%–16% in Hungary and the Czech Republic engaged in the training of students, compared to an average of 40% in Western Europe and 80% in Germany (see Fig. 16.2).

In countries with developed "dual" vocational training, where the practical training takes place in firms, such coordination problems are resolved through the intervention of powerful industry-level employer associations, which negotiate the content and practice of training with the governments and worker organisations, collect information on the

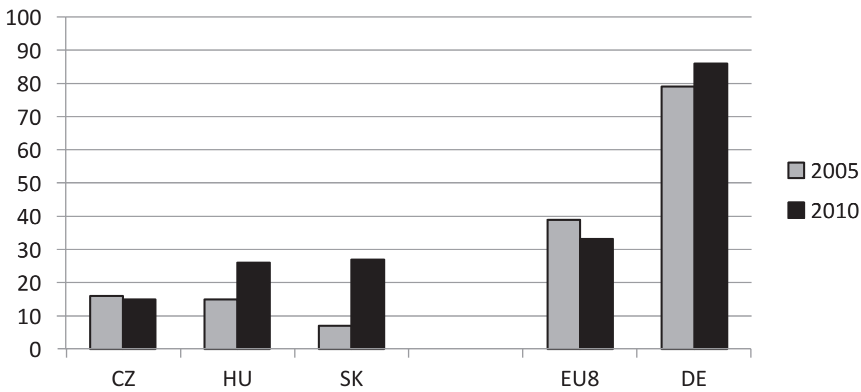

Fig. 16.2 Percentage of large manufacturing enterprises involved in initial training. Source: Eurostat Continuous Vocational Training Survey; CVTS3/CVTS4. Only shows large enterprises with over 250 employees

skill needs, ensure effective sharing of the costs, and supervise the quality of training (Busemeyer and Trampusch 2012). In the ECE, however, such organisations are extremely weak. Part of their work is done by the investor associations such as the German or American chambers of commerce and industry, but these act rather as lobby groups, lacking both the comprehensiveness and the status of social partners that would allow them to become directly involved in the education process.

The lack of strong employer associations makes it more difficult not only to involve industry actors in training but even to secure less investment-intensive forms of participation such as contribution to the identification of skill needs and curricula development. Although firms have repeatedly called for more involvement of industry in the development of VET content, the lack of resources and capacities of peak organisations makes such involvement difficult to implement in practice.

Since the lack of interest and organisational capacities of employers precluded the full transition to a dual VET system, the early attempts at reform simply tried to open up the school-based system to employer involvement, without expecting comprehensive, industry-wide participation. The selection of tools ranged from setting up structures for information exchange at the sectoral level to enabling local cooperation with schools and devising special incentives for in-house training. But the degree of government commitment depended on how vulnerable they felt their labour markets to be, and on how strongly the industry mounted the pressure for reform. As a result, despite the fundamental similarities of their industrial sectors, before the breakout of the global economic crisis in 2008, the Czech Republic, Hungary and Slovakia found themselves pursuing rather different reform paths.

Czech Republic: No Reform, No Problem

Of all the East Central European countries, the Czech Republic experienced the least change in the structure of its training system. University attendance has expanded very slowly, regulated by strict quotas, and in the late 2000s, the share of persons with university degrees in the age group 25–35 years was only about 15%—less than half of the EU average and only slightly higher than that of the general population.[8] Meanwhile, the vocational education remained the fundamental pillar of the Czech economy, with over 75% of all secondary school graduates still coming out of the VET tracks in 2013 (Šímová and Czesaná 2014).

Several factors allowed the Czech Republic to continue upholding its "traditional" approach to VET system despite the international advice to the contrary.[9] One was a long-established industrial tradition and a developed network of national-level educational institutions that did their best to keep the skill profiles and curricula up to date. The other was a low rate of unemployment, at least by regional standards, that convinced the authorities that there was no need to rush into reforms.

But while the low unemployment reassured the Czech government, it also meant that the country was among the first to experience the skill "shortages". Shortly after the foreign investment took off in the late 1990s, the investors began to complain about the shortage of students in certain key trades, the state of equipment in vocational schools, outdated curricula, and the lack of support for the companies that did offer training (Bluhm 2001). For the most part, these complaints were quite justified. The Czech Republic kept up its spending on vocational schools at a more or less stable level of around 1% of GDP, but the funding was insufficient to cover the complete needs of equipment maintenance and the schools were expected to cover the rest from their own resources. This often meant that the schools either let the equipment depreciate or reoriented teaching towards less equipment-intensive service trades.

Perhaps ironically, the pressure from the industry never reached sufficient leverage on the government because the leading player—Škoda Auto—had decided early on to take care of its own skill needs. Škoda was privatised to Volkswagen in 1994, and unlike in all other cases of privatisation across the region, Volkswagen decided to keep the industrial school affiliated to the former Škoda concern in Mladá Boleslav (Dörr and Kessel 2002). The school is owned and run by the company and all practical training takes place at Škoda. The school offers more than a dozen specialisations in automotive-related professions and takes in approximately 300 students per year. In 2000, Škoda also opened a University that trains engineers and specialists in automotive management. While the majority of graduates are absorbed by the company itself, some find jobs in Škoda's suppliers, and since 2006, Škoda is also running a training programme for secondary school teachers in order to disseminate new skills and technologies.[10]

Škoda's decision to take the training matters into its own hands has served to diffuse the pressure on the government, and also created a template for other companies. None has taken on the training to the same extent, but many automotive companies have established some form of cooperation with the local schools. Such cooperation has been facilitated by the 2004 School Act which allowed individual schools more autonomy in defining the VET content, in order to respond better to the needs of employers in their region (Kuczera 2010). Since 2006, consultative sectoral councils have been formed at the national-level that allow employers to provide input for development of VET curricula, qualifications, and final exams. Nevertheless, cooperation remained highly uneven, both across regions and across sectors, and the system is still firmly based around school training.

Slovakia: Industry in the Driving Seat

In Slovakia too, the VET system remained unchanged for a long time, but for very different reasons. The country's delayed transformation had resulted in a spiralling economic crisis, vocational training was far from a priority for the reform government that took the helm of the state in 1998. But unlike in the Czech Republic where the spending had at least kept up to maintain the existing structures, the lack of investment in Slovakia accelerated the deterioration of VET training. By the mid-2000s, the country had the lowest overall spending on education in the region—around 3.5% of GDP, compared to 4.5% in the Czech Republic, and over 5% in Hungary. As in the Czech Republic, an internal shift was rapidly taking place within the VET from ISCED 3C (secondary technical VET without graduation certificate) to ISCED 3A (secondary technical VET with certificate and possibility of university entrance) tracks, and within these from metal-processing trades to retail and services (Vantuch 2002). Importantly, the latter were not only in greater demand by the students but also required far less investment in equipment.

None of this bothered the investors at first. Unemployment in Slovakia had reached nearly 20% in the early 2000s, and the Slovak labour market was still definitely a “buyers’ market” where the wealthy foreign companies could easily find the skills they needed. This was especially true of the country’s largest and until 2005 the only carmaker—Volkswagen. Unlike in the Czech Republic, where Volkswagen continued to run the company school after it took over Škoda, in Slovakia the firm showed little interest in training. It was not until the late 2000s that it set up a training centre in cooperation with the technical school in Bratislava, but even then, the scale of company involvement remained limited to a dozen of apprentices per year.

The situation changed in 2005–2006, with a sudden influx of new automotive investments that quadrupled the vehicle production capacity of the country from 200,000 to 800,000 units. The accession to the EU, together with the governments’ aggressive investment promotion campaign had piqued the investors’ interest and landed the country two new car factories—PSA (Peugeot-Citroen) in 2005 and Kia in 2006, as well as two new production lines at Volkswagen. A wave of investment from suppliers followed and with them the rapidly growing demand for labour.

The rapid shift from high unemployment to labour shortages had found both the government and the companies unprepared. Some, like Volkswagen and PSA, attempted to solve the problem locally by setting up cooperation with the nearby schools, but the real initiative for change came from the Slovak Automotive Industry Association (AIA). This was somewhat unusual, as the AIA is not an employer association and thus has no formal standing within the Slovak system of social partnership, but unlike employer organisations (and most industry organisations across the region), it is also a rare case of a strong business association. AIA’s influence and activism is something of a historical accident, which it owes to its founder Jozef Uhrik. At the time of Volkswagen’s takeover of Škoda in 1991, Uhrik was the deputy Minister of Industry in the Czechoslovak government and the commissioner in charge of the development of the automotive industry. It was his insistence that secured Volkswagen’s investment in the tiny Slovak vehicle works, and the German multinational “bought” the government official together the factory (Studeničová and Uhrik 2009). Uhrik became a spokesperson and later a CEO of Volkswagen Slovakia, but from his position as the chairman of AIA, he continued to promote policies that he believed to be in the interest of the sector as a whole.

This is how instead of the localised solutions that became prevalent in the Czech Republic in 2009 Slovakia introduced a major reform of its vocational training system, more or less tailored to the desires of the automotive industry. The policy documents have been drafted by AIA and focused mainly on the changes in VET governance. Representatives of professional or employer organisations were to sit on the national VET council, as well as on the newly established regional and sectoral councils, where they could influence the development of curricula and the forecasting of skill needs, including identification of "shortage" occupations. The new educational act also envisaged establishment of regional "VET centres", selected schools whose workshops would be upgraded and enlarged through a combination of public and private investment. It also substantially increased the autonomy of these schools, especially in curriculum development, to enable them to adapt teaching to the needs of employers in their area (Act no. 245/2008 on Education and Act no. 184/2009 on VET).

Employer involvement, meanwhile, remained strictly voluntary. A proposal by the Slovak government to introduce mandatory training levy to support the new schools was rejected by the industry association and eventually abandoned. The employers even lobbied to abolish mandatory reporting of vacancies in the interest of "reducing the red tape", even as they complained about the lack of tools to identify the labour market needs. As a consequence, implementation of the new policy remained patchy. Experts criticised the demand forecasts drafted by the sectoral councils as being too reliant on insider preferences, and many employers found training at the newly established VET centres to be of limited quality and biased in favour of needs of certain employers or sectors (Vantuch and Jelínková 2012). The 13 "pilot centres" set up by the automotive industry performed rather well, but less organised sectors failed to produce skill plans or become involved in training altogether.

Hungary: Government-led Innovation

Unlike both the Czech Republic and Slovakia, Hungary took an activist approach to the VET reform early on. In line with the recommendations of the World Bank and the EU-funded PHARE programme, the country simplified the occupational classification and expanded general education. This meant that in ISCED 3C programmes, vocational training only began at 16 (instead of 14 as in the Czech Republic and Slovakia), and in ISCED 3A programmes, it was moved to the post-secondary level. Following the international experts' advice to "make beneficiaries pay", in 1995 Hungary even introduced a small mandatory training levy on firms to help fund its VET programmes. From 2004, it also attempted to streamline the costs of VET provision by moving practical training out of individual schools into the regional "integrated training centres" that would pool the equipment and service several schools at once (Benke 2010). In exchange, these centres were given substantial autonomy to adapt their curricula to the needs of the regional labour markets and involve employers in the provision of training.

As in the other two cases, the interest varied from one employer to another, but for the most part, it remained quite limited. The largest automotive firm in the country, Audi, set up cooperation with a local vocational school in the west of the country in 2001, providing it with up-to-date equipment and offering short-term internships to the students. The number of placements remained quite low for many years, but even so, Audi, by far, outpaced the second-largest carmaker Suzuki, which shunned any form of training cooperation, even if it meant having to import workforce from neighbouring Slovakia (Galgóczi 2003; Audi Hungaria 2011). Overall, the number of apprenticeships was shrinking, despite the government offering various incentives to the companies willing to offer placements to the VET students, such as the possibility of exempting them from the training levy (Köpeczi Bócz and Bükki 2006; Bükki et al. 2009).

By the mid-2000s, the complaints about skill shortages had also spread to Hungary, but in absence of either a strong industry association or the shock of a sudden increase in demand, the employers in Hungary remained quite passive. It thus fell to the government to find a way to boost the state of vocational training, and in 2007, it launched another round of reforms to correct the labour market mismatch and motivate employers to contribute to training. Similar to the Czech Republic and Slovakia, one of these measures was to create regional VET councils featuring representatives of employers to identify and predict labour market needs. These councils have even more power than those in the neighbouring countries, as they decide on the numbers of students that can be enrolled in specific professions at the regional level, which considerably impact the funding allocated to the schools. The councils can also designate up to ten shortage occupations, for which the government provides special financial incentives both to the students who opt to train for these trades and to the employers who offer them apprenticeships (Bükki et al. 2011).

The Crisis and the Renewed Zeal for Vocational Training

It is difficult to judge which of these early attempts was the most successful at strengthening employer participation in training—other factors, including the severity of workforce shortages, certainly played a role. There is some indication that the more activist approach in Slovakia and Hungary did yield results, increasing the rate of employer involvement in initial training, although the levels in both countries remained below the EU average (Fig. 16.2). Nevertheless, the most valuable achievement of these policy experiments was to put the VET reform firmly on the agenda of all countries in the region, as well as to demonstrate the possibilities and limits of the reform in the ECE environment. Most importantly, they showed that it was not enough to simply open up the system to employer participation—effective co-production of skills required capacities for coordination, planning, and quality assurance that the industry side could not or would not provide on its own.

The global economic crisis and its aftermath brought these tensions sharply to the fore. To the governments, it offered a stern reminder of how dependent their economies had become on a handful of transnational industries, and how quickly their fate could turn. Despite all the prior grumbling about workforce shortages, at the first signs of the crisis, the automotive industry laid off more than 10% of its employees in just a few months (Bernaciak and Šćepanović 2010). Even if most of them were soon re-hired, the episode highlighted the fragility of the ECE employment model. The employers, on the other hand, soon faced an even greater squeeze in the labour market. Labour emigration accelerated after the expiry of the seven-year moratorium which many of the "old" member states had imposed on the accession of the ECE countries to the EU. The prolonged recession in Western Europe, meanwhile, had the perverse effect of driving investment eastwards, as the manufacturers looked to reduce costs by prioritising production in the ECE facilities.

The crisis also precipitated a shift at the supranational level, where industrial policy was now undergoing a renaissance. In 2012, in a show of support to the "real" economy, the European Commission announced plans to boost the manufacturing share of EU's GDP back to 20%. Among the proposed measures were support to vocational training and apprenticeships, embedded in the so-called "Youth Guarantee" Schemes (EC 2012a, b). The crisis had taken an especially high toll on youth employment, and a number of comparisons across the EU member states consistently pointed at lower unemployment and a better transition to the labour market in countries with "dual" vocational training (Eichhorst et al. 2013). Suddenly, a model that until yesterday was ridiculed as an anachronistic remnant of a bygone era and criticised for obstructing transition to the "knowledge economy" began to be praised as the new ticket to economic revival.

The rhetorical shift was accompanied by institutional and technical support. The EU member states with a long tradition of dual vocational training—Germany, Austria and Switzerland—also joined in, funding pilot projects for the implementation of dual training or providing expertise to the government officials in charge of drafting the reforms (Bükki et al. 2014b; Vantuch and Jelínková 2014a). The EU provided funding that smoothed out conflicts over the financing of vocational training and also allowed for policy experimentation to determine the best solutions to the problems of training coordination. The Hungarian regional integrated training centres, originally established with support of the EU structural funds in 2008, were relaunched again in 2015, following a few institutional adjustments and a new round of funding. Slovakia and the Czech Republic drew on the same source to fund exploratory projects whose aim was to try out different models of collaborative VET provision and identify best practices that could then be generalised at the national level.[11]

The result of these renewed efforts was another round of VET reforms in the region. Once again, the reforms were more extensive in Hungary and Slovakia, which tried to move further towards employer-provided practical training. In the Czech Republic, similar proposals remained at a draft stage, but the government strengthened the connection between schools and firms through programmes that provide in-company training to the teachers of VET and allowed company representatives to teach vocational subjects without having to acquire full pedagogical qualifications (Šímová and Czesaná 2014). Meanwhile, Hungary capitalised on the arrival of a big investor to stake out new ground in vocational training. The investment agreement with Mercedes featured "cooperation clauses" in which the investor promised to cooperate with the government in the development of VET. As part of the incentive package, and partly drawing on the available EU funding for training, the Hungarian government upgraded the regional training centre near the factory to prepare it for full cooperation with Mercedes and its suppliers. The arrival of Mercedes was also used to launch a pilot project in post-secondary dual training, as a cooperative enterprise between Mercedes, Knorr-Bremse and the Faculty of Mechanical Engineering at the Kecskemét College in Southern Hungary. These two initiatives blazed the path for other similar projects. Audi quickly followed in Merdeces' footsteps, setting up a training centre with over 50 instructors for both present and future employees, and stepping up cooperation with the local school university. Since 2011, the Hungarian government has been signing similar "strategic cooperation agreements" with all investors in the country, exchanging promises of support for their pledges to invest in skills and research.

Slovakia too moved a step closer towards "dual" training in 2015, with a new act on VET.[12] The act envisages increased involvement of employers at the school level, especially in exams and curriculum development, but also includes provisions to correct for the lack of experience and capacity among employers. The sectoral councils for curriculum planning set by the previous legislation have been abolished, as they failed to produce plans of reliable quality, but the employers' interests are still represented in the national and regional councils. Meanwhile, to simplify the terms of employers' involvement, the State Institute for Vocational Training prepared "model" teaching plans for different specialisation to be used by the employers interested in taking on apprentices. To secure some quality assurance, such firms also have to be pre-certified by the government (Vantuch and Jelínková 2014b). A similar measure was also introduced by the Hungarian VET Act of 2011, which requires company practice instructors to have passed a master craftsman exam.

If the new reforms tried to impose more regulation on the employer-provided training, they also offered more generous incentives to draw in companies. Hungary had already introduced tax credits and reimbursement scheme for employer-incurred training costs in 2008; in 2012, these were further increased by 20%–25% depending on the occupation. The country also offers subsidies for the development of company workshops: according to the estimates of the participating companies, the combined subsidies cover about three-fourth of the training costs (Bükki et al. 2014b). Slovakia too introduced subsidies for company training facilities, as well as tax deductions for the costs incurred in apprentice training. Even the Czech Republic passed amendments to the VET financing act in 2014 that allows tax deductions for training assets as well as for direct training, in the amount of 200 CZK/h, about four times the minimum wage.

Conclusion

This chapter set out to explore the possibilities for building a system for collaborative provision of manufacturing skills in an environment that was both cost-sensitive and lacked the institutional preconditions for effective employer involvement. Its conclusions, based on the overview of experiences of three East Central European countries, are moderately hopeful. In a decade from the mid-2000s to mid-2010s, some of these countries have indeed managed to convince a large number of firms to join in vocational training, and thus presumably created a system that not only provides the students with more up-to-date skills but also eases their transition into the labour market.

There are, however, many reasons to consider this a very partial victory and one that will be difficult to replicate in many other environments. For one, the ECE is in many ways the "best case scenario" for such development. Even though it was originally meant to serve as a low-cost production platform for West European multinationals, its inherited advantages allowed the upgrading to progress quickly to a level at which workforce skills, and not only its cost, became an important consideration for the investors (Hancké 2012). It also benefited from an unprecedented influx of investment which created the pressure on firms to cooperate with the government, as the individual solutions would have been much costlier.

But even under these conditions, setting up employer-provided training turned out to be, above all, a lot of work for the governments. Skill shortages may have forced some firms to experiment with training, but as the Czech example shows, without greater initiative by the governments such involvement remained sporadic and highly uneven. Even where the private actors appeared to be leading the reforms, as in Slovakia, the state had to step in to correct coordination failures, to create governance structures that allowed employer participation while not demanding too much input or initiative from them, to develop quality control mechanisms that would not impose too much "red tape", and eventually, still bear the lion's share of the training costs, directly or through various incentives and subsidies. In this too, the ECE states have been fortunate to be able to draw on the EU's transnational network of institutional support, which not only offered technical assistance but also provided the kind of funding that allowed reformers to avoid intra-governmental conflicts over the allocation of resources to VET. In this way, the ECE got enough policy space to try out different institutional solutions, and thus perhaps increase the likelihood of success.

The resulting ECE variant of "dual training" is for the moment less a case of successful transfer of the famed German model, and more an extension of ECE's own state-based VET system with some more employer involvement. Given the recent nature of reforms, it is too early to say whether the system will actually lead to more skill-intensive production and protect the region from the vagaries of cost-based competition. But insofar as the demand for workforce remains high, there is some hope that these policy measures will secure the commitment of a critical mass of employers, and thus lay the foundation for a more participative system of skill provision.

Notes

1. “East Central Europe” usually refers to Czech Republic, Hungary, Poland, and Slovakia. This chapter does not deal with Poland, whose educational system has pursued a different adjustment path.
2. Authors’ calculations based on COMTRADE database.
3. No comparable data is available for Hungary, but given that the economic profile of the country is fairly similar, the risk estimate is likely to be comparable.
4. Author’s calculations based on the UN COMTRADE database.
5. For example, a 2005 Eurobarometer survey found that the citizens in the new East European member states were much less likely to recommend a vocational training track as a career choice than those in the “old” EU members (EC 2005).
6. Despite small variations in programme organisation, vocational education and training in the Czech Republic, Hungary and Slovakia is organised along the same basic lines. The schooling systems distinguish between vocational programmes at ISCED 3A levels that offer a high school diploma that provides access to the university level, and ISCED 3C programmes that sometimes end in a vocational certificate and are usually of shorter duration and have a higher proportion of practical training. Graduates of ISCED 3C programmes can in principle also qualify for university entry, but only after completing an additional year or two of schooling. While the proportion of students in ISCED 3A VET programmes has remained almost stable over the years, the share of those in the more basic ISCED 3C programmes has declined rapidly since the 1990s, and in 2013 it stood at 27.6% of all secondary school graduates in the Czech Republic, 20.1% in Slovakia and 25.3% in Hungary.

7. Authors' interviews with representatives of the German Chambers of Industry in the Czech Republic, Hungary and Slovakia. In each of these countries the German industrial chambers acted as lobbying points, organising conferences on vocational training reform and tabling policy proposals.
8. Author's calculations based on data from the European Labour Force Survey.
9. A proposal for a roll-back of vocational training prepared by the EU and world Bank experts under the EU-financed "PHARE" programme (institution building support to future member states) was politely shelved in 1997 and apart from a few minor adjustments the system remained unchanged (Bluhm 2007: 120).
10. Author's interview at Škoda Auto a.s. 2015, company and school website.
11. "Development of Secondary VET" (RSOV) was implemented in Slovakia in the period 2013–2015 and involved 21 pilot schools across all Slovak Regions. In the Czech Republic, project "Pospolu 2012–2015" (Together) tested different forms of cooperation in 38 schools and involved around 100 firms.
12. Act no. 61/2015 on Vocational Education and Training.

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17

Finding Skills: Strategies of Local Auto Parts Supplier Firms in Mexico and Turkey

Merve Sancak

Introduction

The automotive industry has been very crucial for the development of many middle-income countries (MICs) including Mexico and Turkey. Most later-industrialisers managed to attain high growth rates at first via utilising the availability of large and cheap workforce for labour-intensive production. Nonetheless, to be able to continue growth and move out of the middle-income trap, they need to move their economy towards higher value-added sectors requiring investments in technology and skills. For this, manufacturing in medium technology-intensive goods became significant for most MICs. Automotive production is especially important in this sense, as it mainly requires workers with medium-level skills, which can be obtained by vocational training and on-the-job learning (Barrientos et al. 2011).

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Mexico and Turkey are two of the MINT countries (Mexico, Indonesia, Nigeria and Turkey) classified by the economist Jim O'Neill, who suggested these as the next fastest growing economies after Brazil, Russia, India and China. Manufacturing has been a significant industry for development in both countries and focused on labour-intensive production, such as textile and garments at the start of their industrialisation. However, wanting to keep growing and benefiting from their proximity to advanced industrialised countries, capital-intensive production gained importance in both Mexico and Turkey and the states in the two countries have put an emphasis on higher value-added production. As a result of the similarities in their development experience and economic structures, Mexico and Turkey have been described as the "mirror image of each other" by Mexico's Finance Minister, José Antonio Meade Kuribreña in 2014. With the aim of continuing their economic growth (via higher value-added production), both Mexican and Turkish governments have focused on improving the automotive sector. However, both Mexico and Turkey have lacked the workforce with necessary skills for production in the automotive industry and have been classified as countries in a "low skills bad jobs trap" (Schneider and Karcher 2010). This chapter addresses this challenge for the Mexican and Turkish automotive industries and explores how the *local* firms in the automotive industry, namely the local firms producing auto parts, find *production workers* with necessary skills. For this, it scrutinises firms' strategies to find workers with necessary skills, namely their "skilling strategies", which include their recruitment and training practices. The chapter discusses how the Mexican and Turkish auto parts suppliers' institutional environment affect their strategies to find workers with necessary skills. In this regard, it investigates the public vocational education and training (VET) systems as well as other regulations and arrangements that affect firms' training and recruitment practices. The research in this chapter is based on in-depth interview data with eight auto parts suppliers in Mexico and Turkey, as well as interviews with various stakeholders of the VET system and the automotive industry in August 2014–November 2015 in the two countries.

The next section starts with a brief discussion of the automotive industry's development in Mexico and Turkey, its current situation and the role of local suppliers in it. Later, the methodology of the research is discussed and the characteristics of firms in the sample are explained. The following section explains the institutional environment for skill generation, which is complemented by the discussion on the patterns of skill generation among the local firms in the traditional automotive clusters of Mexico and Turkey. The last section summarises the results and concludes the discussion.

The Automotive Industry in Mexico and Turkey in a Comparative Perspective

The automotive industry, encompassing the "auto parts-automotive chain" (AAC) (Peters 2012), has been crucial for the development of later-industrialisers as it influences their balance of trade, employment and technology structures (Humphrey and Oeter 2000). The global original equipment manufacturers (OEMs) play an important role as they shift their activities to different MICs in search for high-quality and low-cost production, which in the end has substantial effects on the local economy. The global and local dynamics in the "auto parts and automotive industry" (AAI) have resulted in a number of similarities as well as differences in the Mexican and Turkish AAIs. Such similarities and differences are expected to shape the structure of the AAI in Mexico and Turkey and AAI firms' strategies to generate the necessary workforce.

The Start of the AAI and the Arrival of First OEMs in Mexico and Turkey

Automotive manufacturing started in a closed economy under the state control both in Mexico and Turkey. During this period of "import substituting industrialisation", the governments aimed improving the local economy through measures such as trade restrictions as well as minimum local content requirements. A number of global manufacturers set up their first plants in this period and these OEMs also benefited from trade protection as well as the cheap labour force and large domestic markets. Although the trade restrictions and minimum local content requirements mainly aimed to improve the capacity of local producers, the OEMs perceived this as an obstacle due to the low capacity of local suppliers. The restrictions on the OEMs together with the low-capacity suppliers have resulted in OEMs producing those parts in-house (Jordaan 2011). The restrictions on trade and investment were lifted in the latter years and in the 1990s, both Mexico and Turkey have become a part of the regional free-trade areas involving advanced capitalist countries, namely the North American Free Trade Agreement for Mexico and the Customs Unions for Turkey. The proximity of these two countries to the advanced capitalist markets, the free-trade agreements, as well as low labour costs have made them perfect investment locations for new OEMs and their first-tier component suppliers, and both countries have attracted substantial amount of investments in the AAI.

Despite the similarities between the historical development of the automotive industry in Mexico and Turkey, there have also been some differences. The development of Mexican automotive industry started in central Mexico and the first automotive company arriving to Mexico was Ford which opened its first plant in 1932 (Lauridsen et al. 2013). Ford was followed by the two other American "big-three": General Motors in 1935 and Chrysler in 1938 (ibid). Later in the 1960s, Volkswagen and Nissan also opened their first plants in Mexico (ibid). In Turkey, in contrast, while Ford tried to set an assembly line in 1929, the project was cancelled because of the economic crisis in the 1930s (Emiroğlu 2001). The arrival of first OEM plant did not happen until 1959, when Ford formed a joint venture with the Koc Group, the largest family conglomerate in Turkey, and established Ford Otosan. Later in 1968, Fiat formed a partnership also with the Koc Group and founded TOFAS, while Renault constructed its plant in 1969 in partnership with Oyak. In this period, these companies enjoyed the benefits of the closed economy while trying to construct their supplier base.

Current Situation and the Role of the Industry in the Mexican and Turkish Economies

The historical development of the automotive industry in Mexico and Turkey, the state policies applied throughout the evolution of this industry, as well as country-specific characteristics, such as geographical size and proximity to advanced capitalist economies, have had an important impact on the current situation of both the Mexican and Turkish AAI. First, the AAI has grown significantly in Mexico and Turkey has become a major industry in both countries: the production in the AAI constituted 3 per cent of the total GDP in both countries in 2016 (OECD 2017; Milliyet 2017). Moreover, the AAI constitutes a major share in both countries' exports: AAI products formed the second largest share in the exports of both countries in 2016 (25 per cent of all exports in Mexico and 15 per cent in Turkey) (UNCTAD 2017). The AAI also constitutes the major share in manufacturing employment in both countries (Interview Notes).

In addition to the importance of the AAI for the Mexican and Turkish economies, both countries' links with the global AACs have been similar. For example, although both countries have had substantial investment inflows in the AAI, neither could develop its national OEM as opposed to other fast-growing later-industrialisers such as China and India. In addition to the OEMs, the supplier industry has also become dominated by foreign firms in Mexico and Turkey, while the local firms are pushed into lower tiers in the production chain (Lauridsen et al. 2013). Furthermore, both countries have focused on producing auto parts with some assembly functions and have joined global AACs through similar activities. As a result of similar activities in the global AACs, the length index of the AAI, which is used to measure the level of production stages of a GVC and the share of local and foreign content in one country, has been very similar for Mexico and Turkey (De Backer and Miroudot 2013). Last but not least, the two countries have developed competitive advantage in similar types of products (according to their value-added): the medium value-added goods comprise the largest share of auto parts exports in the AAI exports of both countries while the share of high value-added goods is the lowest (Lauridsen et al. 2013). Similarly, medium value-added goods form the highest share in both Mexico's and Turkey's imports, and the shares of low value-added imports are also the close in the two countries (Figs. 17.1 and 17.2).

Despite similarities between the Mexican and Turkish AAIs, there are also some important differences which should be explained. A main difference concerns the geographical size and location of the two countries.

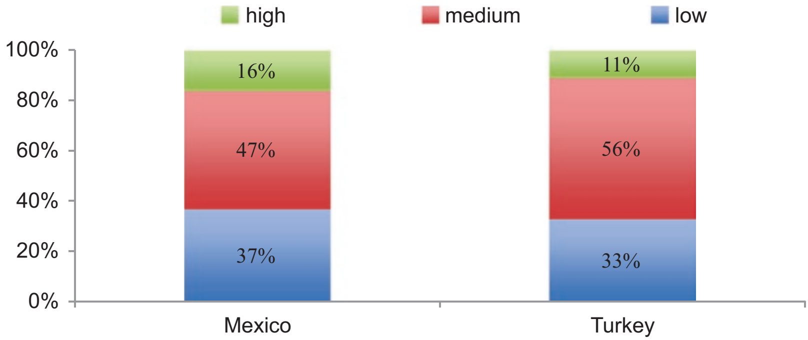

Fig. 17.1 Mexican and Turkish auto parts exports according to their value-added (2010). Source: Self-calculated using UN Comtrade Data and the method developed by Pavlínek et al. (2009)

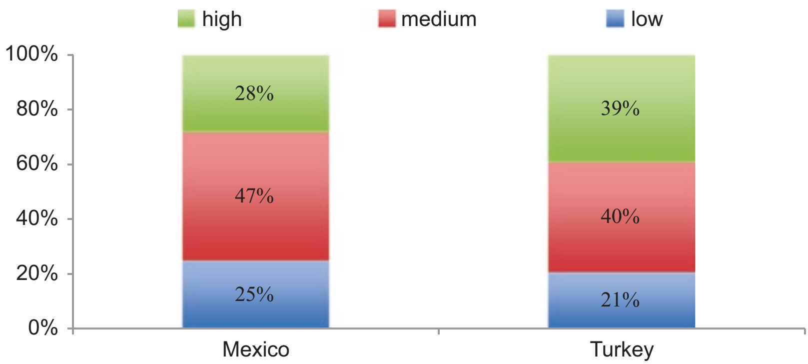

Fig. 17.2 Mexican and Turkish auto parts imports according to their value-added (2010). Source: Self-calculated using UN Comtrade Data and the method developed by Pavlínek et al. (2009)

First, because Mexico is a much larger country than Turkey (Mexico's land size is more than twice of Turkey), the size of the automotive industry is much bigger in Mexico and takes place in different regional clusters. In Mexico, there are 14 clusters while the northern and central ones have been the main ones (Lauridsen et al. 2013). Furthermore, there has been significant competition between different state governments to attract new OEMs, which has shaped the structure of those clusters (Rothstein 2005). The federal state structure and the variation among policies of different states, as well as the geographical differences of those states, have resulted in automotive clusters with different characteristics. For instance, the central region's focus has been on producing for the local market and most investments in this region were made with the aim of selling to the local market (Lauridsen et al. 2013). The northern region, especially the cities located at the border with the US, such as Tijuana, have attracted investments from foreign companies aiming to produce for the OEMs located just across the border (ibid). In contrast to Mexico, the industry in Turkey has been mainly clustered in one region, Marmara in the northwest of the country. Although there are clusters emerging in the centre and south of the country, these still do not constitute a major share in the country. This mainly happened because of the centralised government structure, where state policies mainly focused on the development of industry in this region.

The differences in geographical sizes and location have impacted Mexico's and Turkey's participation in the global automotive value chain. While Mexico has a significant advantage for being the only later industrialiser located at the US, Turkey has faced important level of competition from the Central and Eastern European (CEE) countries when selling to the European market. Although Mexico's situation was challenged by China in the last years, it still maintains the advantage of geographical proximity to the US. Twenty-four per cent of auto parts imports of the US were from Mexico in 2016, which had the largest share among those imports, followed by Canada (UNCTAD 2017). The new OEMs have continued investing in Mexico, where companies like BMW, Audi and Toyota made billions of investments in Mexico in the last five years (Althaus and Boston 2015; Bernstein and Alper 2015). Turkey, in contrast, does not have a geographically dominant position and did not attract large OEM investments in recent years. The OEMs aiming to sell to Europe choose between the CEE countries and Turkey, which has impacted the level and types of OEM investments in Turkey. Table 17.1 shows the current main OEMs and their establishment year in Mexico and Turkey.

In addition to the variation regarding the OEM investments, there are also important differences between Mexico's and Turkey's auto parts exports. While both countries currently have comparative advantage in

Table 17.1 Main OEMs in Mexico and Turkey

Mexico			Turkey		
OEM	Location	Year	OEM	Location	Year
Ford Motor	Hermosillo, Cautitlan, Chihuahua, Irapuato, San Luis Potosi	1932	Ford Otosan	Kocaeli	1959
Dina	Hidalgo	1951	BMC	Izmir	1964
Kenworth	Mexicali	1959	MAN	Ankara	1966
Volkswagen & MAN	Puebla, Silao, Queretaro	1964	Karsan	Bursa	1966
Nissan/Daimler	Aguascalientes, Cuernavaca	1966	Mercedez-Benz Turk	Istanbul, Aksaray	1967
Fiat/Chrysler	Toluca, Saltillo	1968	Mitsubishi (as Temsa)	Adana	1968
General Motors	Ramos Arizpe, Silao, Saltillo Toluca, San Luis Potosí	1979	Fiat	Bursa	1968
Chrysler/Fiat	Saltillo, Toluca	1981	Renault (with Oyak)	Bursa	1969
Nissan	Aguascalientes	1982	Isuzu (Anadolu)	Istanbul	1984
Honda	El Salto, Celaya	1995	Hyundai Assan	Istanbul	1990
Volvo	Mexico City	1999	Toyota	Sakarya	1990
Daimler (Freightliner and Mercedes-Benz)	Mexico City, Saltillo	2003	Honda	Kocaeli	1992
Toyota	Tecate, Celaya	2004			
Hino Motors	Silao	2009			
Mazda	Salamanca	2013			
Audi	San José Chiapa	2016			
Kia Motors	Pesquería	2016			
BMW	San Luis Potosí	2019			

(medium value-added) auto parts exports, the Turkish auto parts industry has experienced much higher improvement in the last two decades while Mexico has developed comparative advantage in this industry much earlier. For example, Turkey's exports in the auto parts industry more than tripled in 1990–2015, while the Mexican exports grew by only 1 per cent. Moreover, Turkey has improved its comparative advantage (calculated as Revealed Comparative Advantage [RCA] index) in auto parts exports by three times in the same period, while Mexico's improvement was 6 per cent (MIT 2017).

Strategies of Skill Generation for Local Suppliers

Despite the differences explained in the last part of the previous section, Mexican and Turkish AAIs focus on the production of very similar goods, namely the low and medium technology-intensive products, which would require similar types of skills in firms from both countries (Baldwin 2012). In the following sections, I explore how the local auto parts manufacturing firms develop skills for low and medium technology-intensive production.

Method and Data

The data to analyse the practices of local firms to generate the workforce with necessary technical skills was collected via face-to-face in-depth interviews with local supplier firms. In addition to questions about firms' skilling practices, which were responded by representatives from the human resources (HR) departments or shift supervisors, general information about firms' characteristics and management structures was collected. This study comprises interview data from four companies in each country, making a total of eight companies. The companies were selected from the firm databases provided by the Union of Chambers of Commerce and Industry and Commodity Exchanges of Turkey (TOBB), and the Mexican Secretary of Economics and the National Industrial Association for Auto parts (INA). The companies were selected based on their location, product and size. Later, eight companies were selected randomly and in order to draw more causal relations, specific attention was paid to include companies with similar characteristics, that is similar products, size and regions. In the end, four companies from the traditional automotive clusters (i.e. the State of Mexico and Puebla in Mexico; and Bursa and Gebze in Turkey) and producing similar types of auto parts (i.e. metal parts and plastic producers) were included. Additionally, interviews with other stakeholders of the skill system and the AAI, such as representatives from education ministries, labour unions and business associations, were carried out. The interviews were transcribed and analysed using the software ATLAS.ti. Table 17.2 summarises the characteristics of firms interviewed for this research.

Firms' Strategies

The Mexican and Turkish supplier firms vary first in terms of the organisation of the production workers, which brings differences between their methods to generate those workers. In Mexico, the workers related to production, or non-administrative workers, are organised in two groups according to the skills they require and the ways to develop them: opera-

Table 17.2 Summary characteristics of firms interviewed

	Sector	Level	Location	Workers employed	Year	Main customers
Mexico						
M1	Metal parts	Tier-1	State of Mexico	567	1981	GM, Chrysler, John Deere
M2	Plastic parts	Tier-1 & 2	Puebla	256	2002	VW (85%), also Fiat, GM and Nissan
M3	Metal parts	Tier-1 & 2	Puebla	383	1980	VW (80%), Magna, Benteler and Leer
M4	Metal parts	Tier 2	State of Mexico	200	1970s	American Axel, Molten, Neapco
Turkey						
T1	Plastic parts	Tier-1	Bursa	750	1979	Toyota, Daimler, VW, Ford
T2	Metal parts	Tier-1	Gebze	265	1970	Ford (90%), also Isuzu, Honda and Hyundai
T3	Metal parts	Tier-2	Bursa	569	1981	Bosch, Daimler, Delphi and Denso
T4	Metal parts	Tier-3	Gebze	85	1978	Subcontractor

tors and technical workers. Operators are the ones working in the low-skill production process while the technical workers, or technicians, are mainly the ones in charge of maintenance and quality. Additionally, workers with management duties, such as team leaders and group leaders, can also be considered in this group for some firms. In contrast in Turkey, the division between operators and technical workers is not as clear-cut and similar requirements are applied when generating workers at both levels.

The discussion in the fields of institutions and organisation studies have shown the national institutions as a major determinant of firms' behaviour, including their patterns of recruiting and training workers. Therefore, this chapter provides general information about the vocational education and training systems, as well as other institutional arrangements that affect firms' decisions regarding recruiting and training workers.

Mexico

Institutional Environment for VET

In Mexico, VET has not occupied a substantial part in the public education system throughout its history. Especially with the liberalisation of the economy in the 1980s, the VET system has been deregulated and decentralised (OECD 2017), where the state wanted to maintain a technically trained workforce via being the "driving force, adviser, and controller" of the skill system, rather than its "executor" (Casalet 1994: 729). The state has left the responsibility of training to firms with the Federal Law of Labour in 1978 and obliged firms to provide training to their workers (Mertens et al. 2005). Furthermore, firms are required to upload a document showing their training programmes to an online portal of the Secretary of Work and Social Policy (STPS), the STPS aims to ensure the implementation of training through firm inspections.[1]

In Mexico, at the upper-secondary level, there are a number of technical schools, or subsystems established at different times to address the needs of different industries and regions (Mertens et al. 2005). The main two subsystems are the Technological Baccalaureate (*Bachillerato Tecnologico*) and

Technical Professional Baccalaureate (*Educacion Profesional Tecnica*). The schools managed by the Directorate General for Industrial Technological Education (DGETI), within Technological Baccalaureate, and the National College of Technical Professional Education (CONALEP), within Technical Professional Baccalaureate, are the ones that concern the firms in automotive production, yet the share of VET students in Mexico at upper-secondary level has been very limited. In 2015, 38 per cent of students at upper-secondary education were in VET schools (including both the CONALEP schools and the DGETI institutes with more general training), while the rate in Turkey was 49 per cent (OECD 2017). An important development in the Mexican initial formal VET is the project called Mexican Model of Dual Training (MMFD). It is a project to promote dual training model similar to the one in Germany in CONALEP schools in Mexico and modify it according to the realities of Mexico.[2] The project started in 2013 and is still in the process of development and dispersion to more companies. However, it has included mostly German firms and very few Mexican firms have been involved so far in the programme (Interview Notes).

Other than the initial formal VET, there are some further training programmes in Mexico. The Secretary of Public Education (SEP) runs two main programmes for continuing education in scope of training for work (*capacitacion para el trabajo*). The one from which the supplier firms in the auto industry can benefit more is the Work and Training Institutes (*Institutos de Capacitacion para el Trabajo-ICAT*) run by the state and financed by the both state and federal governments. Additionally, the STPS has been running the programme called *BÉCATE (Becas a la Capacitación para el Trabajo -Scholarships Programme for Job Training)*, offering financial resources to the unemployed receive training and experience. There are four sub-programmes in BÉCATE and the one that mostly concerns the auto parts suppliers is the joint training (*capacitación mixta*) programmes. In this, firms carry out training for the unemployed at their premises, which include both theoretical and practical training. The main beneficiaries of the BÉCATE programme have been the large foreign firms while smaller Mexican firms' use has been limited (Interview Notes). In the end, although the CVET programmes exist in Mexico, the state's commitment to such programmes has been marginal, which has restricted Mexican firms' use of these programmes as a method to generate skills (Tables 17.3 and 17.4).

Table 17.3 Institutional environment for skill generation in Mexico

	Labour Law requirements	Initial formal VET	Further formal VET
Name of institution/ law	Labour Law Article 153	CONALEP (*El Colegio Nacional de Educación Profesional Técnica*- National College of Technical Professional Education) MMFD (*Modelo Mexicano de Formación Dual*- Mexican Model of Dual Training) DGETI (*Dirección General de Educación Tecnológica Industrial*- Directorate General for Industrial Technological Education)	ICAT (*Instituto de Capacitacion para el Trabajo*- the Work and Training Institute) BÉCATE *(Becas a la Capacitación para el Trabajo* -Scholarships Programme for Job Training)

Table 17.4 Institutional environment for skill generation in Turkey

	Labour Law requirements	Initial formal VET	Further formal VET
Name of institution/ law	Law 4857 Article 85	Apprenticeship system; Industrial VHSs	UMEM (*Uzmanlaşmış Meslek Edindirme Merkezleri*- Specialised Vocational Training Centres); Accredited institutions

Recruitment Patterns

The types of workers the companies need vary according to the products they produce, and hence the product types constitute an important determinant influencing firms' strategies to generate the necessary workforce. For instance, mould changers are mentioned as the workers that require technical skills only for M2, which is a plastic parts producer. Furthermore, in all companies except M4, the production is organised as groups carrying out different activities, which are led by team leaders. The team leaders are expected to have certain skills such as leadership and team management, as well as a minimum level of education, which is upper-secondary for all companies. Although operators can become team leaders, these leaders are mainly recruited externally, as most operators do not comply with the minimum education requirement.

At the Level of Operators

All companies interviewed in Mexico recruit an operator at entry level. These workers are very likely to be individuals with secondary (or lower) education and without any experience. They develop necessary on-the-job skills via learning-by-doing as well as within-company training. When an operator enters the company, they participate in a training programme that includes an induction about the company, health and safety training and basic skills training. The induction and health training last about one week while the skills training can take about one month. The operator develops the necessary on-the-job skills while some training is also provided by internal personnel, such as a more experienced operator or a team leader. After learning one task, the worker becomes “certified” for that task, which means that the worker has the necessary skills but does not signify a standardised skill certification. Later, the operator also learns other tasks and continues receiving training. All this information is recorded in a skills matrix for each worker. After the initial training is completed, which is done in the trial period, the supervisor and the HR official conduct an evaluation. If the person passes the evaluation, a permanent contract is provided. The operator continues learning as a permanent worker and participates in additional training, such as quality training. The skills matrix of each worker is updated based on the additional training and skill development. Most firm representatives stated that the training programmes are organised and recorded because of the requirements of the Labour Law, as well as the ISO/TS16949, which is a quality certificate most OEMs require from their suppliers. Recruitment of experienced operators is very unlikely for all firms interviewed for this research.

Production Workers with Higher Technical Skills

The technicians in all interviewed firms comprise a much smaller group of workers. They have higher levels of education, most of which is technical education at upper-secondary and post-secondary levels (e.g. *universidades tecnológicas*). Although there can be an opportunity for operators to move to positions requiring higher skills, it is very rare as the operators need to have some general skills, complete the required minimum level of education and receive additional training by their own means. As a result, workers at this level are mainly recruited externally and have technical degrees. Technicians in all firms are the employees working at maintenance and quality departments while workers with some specific skills, such as lubricators for M1 or mould changers for M2, are also considered as workers requiring higher technical skills. Finding workers for the maintenance departments, mainly electricians, and the quality departments has not been difficult for any of the interviewee firms. Nonetheless, some firms stated that it can be difficult to find workers doing some specific tasks. For example, finding trained workers for changing moulds has been challenging for M2 since this type of training did not exist in any technical school in Puebla. Therefore, M2 had to carry out within-firm training to generate the necessary skills.

Links with the Public VET Programmes and Legal Requirements

All Mexican firms in the sample have very limited contact with the public VET programmes. While they would prefer their technicians to have technical training, they employ these workers directly from the labour market rather than through a VET institution. In terms of the initial formal VET, M1 stated that they currently do not have any interns from any type of technical school at a lower tertiary level. The HR representative of M1 stated that in the past they had interns from a CONALEP school, yet it was for a temporary project. In contrast, M2 had interns from a CONALEP school at the time of interview although the number of interns was very low. M3 and M4 form interesting examples regarding the links with the public VET system. Although M3 currently does not have any trainees from any public VET institution, it is in the process of participating in MMFD. Furthermore, M4 has already participated in the MMFD and has had ten trainees from it by the time of interview. M4 has also had trainees in a dual training programme called ALCRATEC (German-Mexican Alliance for Technology Transfer), which is a three-year programme supported by Mercedes-Benz (iMOV 2012).

Despite the low level of participation in public VET programmes at secondary level, all Mexican firms have links with and hire trainees from technical schools at post-secondary level, namely *Universidades Tecnológicas* and *Politécnicos*. While some of these interns stay at firm as regular employees, a significant share leave after the completion of internship to continue their education.

None of the Mexican suppliers have taken part in the public further training programmes for the unemployed. While M1 did not know about the programme BÉCATE, M2 stated that they have heard about it but did not participate because the programme requirements were not suitable for their company. Only M3 had workers in the past coming via the BÉCATE programme, although a very small number, while M4 also heard about it but did not participate.

Turkey

Institutional Environment for VET

The public IVET and CVET systems as well the labour regulations regarding employment of certified workers constitute the main institutional elements affecting Turkish firms' recruitment and training practices. VET has constituted a significant part of the Turkish education system. IVET in Turkey is under the control of the Ministry of Education (MEB) and is provided through two main ways: the apprenticeship system and the Vocational High Schools (VHSs). The former is a dual system in which individuals completing the mandatory basic education can participate. The apprentice spends most of the time in the firm (five days a week) while also getting theoretical learning at a school (one day a week). In the end, he/she takes an exam and in case of success, moves to the level of journeyman. The share of this system in the general education system has been very low and apprenticeship constitutes the smallest share of the Turkish VET system (Kenar 2009).

The VHSs are the upper-secondary education institutions and have a number of sub-categories based on different sectors. The VHSs directly relevant to manufacturing, and especially the automotive sector, are the

Industrial Vocational High Schools. In their last year, the students of these schools must have a 300-hours' practical training at a firm related to their study area in order to complete their degree (MEB 2000).

Retraining programmes for the unemployed have started developing important skills since 2009, and the Specialised Occupation Centres Programme (UMEM) has constituted the main part in this. In the UMEM, the TOBB determines the courses to be opened and assures practical training in its member firms while the MEB organises the theoretical teaching at schools and the Turkish Employment Agency (ISKUR) links the unemployed with the schools and firms. In the end, the participants take an examination and receive a certificate that is approved by the MEB and is valid throughout the country. Similar to BÉCATE, firms cover the costs of firm-level training while ISKUR pays a daily allowance to participants.

An important regulation that affects the auto parts supplier firms' skills and training activities is the Article 85 of the Law 4857, which brought a certificate requirement for workers carrying out "dangerous and heavy work". According to this, employers cannot employ workers without a valid occupational certificate for these positions. "A valid certificate" means that it needs be approved by the MEB or the Vocational Qualification Authority (MYK). Graduates of relevant vocational schools and the ones holding a relevant apprenticeship certificate are automatically qualified for these jobs. There are also various institutions certified by the MYK that carry out the examination and provide certificates. This regulation has had a substantial impact on the firms in the AAI, as most occupations in it are covered by this regulation.

Recruitment Patterns

The institutional environment in Turkey has a major impact on firms' recruitment and training practices and most firms prefer recruiting the graduates of public VET programmes. Therefore, and in contrast to Mexico, the education and training levels of operators and technicians in Turkey are not very different from each other for most firms. Both operators and technicians are graduates of public VET programmes, although the types of programmes vary across the firms. The majority of non-administrative workers enter the company as operators and with experience they can become team leaders, group leaders, supervisors and even administrative staff such as production or quality managers.

At the Level of Operators

All interviewed firms in Turkey employ the graduates of public VET programmes at operator level. These programmes still vary across firms according to the availability of programmes near the plant's location, as well as firms' capacity to recruit (better) workers. Especially the certificate requirement increased the demand for workers already holding certificates, mainly for the VHS graduates, which has made it very difficult for firms to find such workers. Therefore, the Turkish auto parts suppliers have developed various measures to recruit VET graduates, where employing VET students as trainees during their studies has become a major strategy.

T1 uses both the initial and further public VET programmes to generate the necessary workforce at operators level. First, it employs students of VHSs as trainees in their last year at school. Some of these students stay in the firm when they complete their studies while many of them continue their education at a higher level or leave the company to complete the military service.[3] Still, most of these former trainees apply to work at the company after completing their studies or the military service and the company gives a preference to those workers in the recruitment process.

With the introduction of certificate requirement, it became more difficult for the Turkish auto parts suppliers to find workers that already hold a certificate. Because of this, T1 has employed trainees within the UMEM. In addition to the daily allowance paid by the ISKUR, T1 has paid additional amount, which has helped to increase the trainees' motivation commitment to the company (Interview Notes). The HR specialist from T1 stated that they have recruited all UMEM trainees as full-time permanent workers after the completion of the programme and it has been a significant tool for them to find workers with necessary skills while also complying with the requirements of the Law.

T2 also prefers workers from public training programmes not only because of the certificate requirement, but also because they are more prepared to carry out the specified job. Therefore, T2 mainly tries to employ workers already holding a VHS certificate yet it has been difficult to find such workers. T2 also employs trainees from VHSs; however, these usually leave after the completion of their internship to continue education. Some of these previous trainees return after completing their studies and apply for permanent positions, and they are preferred in the recruitment process. Although it was difficult for T2 to find workers holding a certificate, it did not participate in the UMEM because the programme was not suitable for the company. Therefore, T2 has preferred employing workers without a certificate but with some experience, sending them to participate in accredited training programmes and getting them certified.

While T3 and T4 also prefer employing workers with a VHS degree, they have developed different strategies to address their skill needs and comply with the certificate requirement. T3 stated that they initiated an apprenticeship programme to comply with the requirement. The people attending the programme are usually individuals who could not complete high school. In the programme, they work five days at the firm and spend one day at school where they receive theoretical training. At the time of the interview, T3 had 28 apprentices. The company also receives trainees from VHSs, who spend three days in the company and two days at the school. Their traineeship lasts for nine months. Although some trainees have stayed to work at the company upon completion of their traineeship, most preferred continuing education at higher levels. Although T3 benefited from the UMEM in the past, the apprenticeship system has become the main method for skill generation and the company did not later participate in the UMEM programme.

The apprenticeship system has been a significant tool for T4 to generate the necessary workforce also before the introduction of the certificate requirement. The company has been hiring workers at a young age and these workers are registered in the apprenticeship school located in the same industrial zone. While the apprenticeship system has been the main tool to generate production workers and individuals coming through this system currently constitute about 60 per cent of those workers, graduates of VHSs are employed more in the maintenance and quality departments. The representatives of T4 mentioned that knew the UMEM but did not participate it because it did not address their needs.

Production Workers with Higher Technical Skills

All Turkish firms in the interview sample prefer upgrading their current employees to positions requiring higher technical skills, such as team leaders, group leaders, supervisors and technicians. The workers who have entered the company as operators, and who have some general skills and theoretical knowledge about production processes thanks to their education in a public VET institute, develop experience and firm-specific skills during their employment. With such training and experience, they become skilled workers eligible to work in positions requiring higher skills. Especially in companies that are applying lean management principles, T1, T2 and T3, the operators have high chances of upgrading and can become team leaders or group leaders. External recruitment of workers for these positions is possible yet happens very rarely for all companies. Only T4 mentioned that they applied external recruitment for positions requiring higher skills, namely for the maintenance and quality departments.

Links with the Public VET Programmes and Legal Requirements

The public VET system and labour regulations have substantial impact on the Turkish suppliers' recruitment and training practices, as well as their links with the public VET system. All firms mentioned that they prefer the graduates of public VET programmes, especially the VHSs, because workers from these programmes have the necessary skills. In order to recruit such workers, firms have developed links with VET institutes and have been recruiting trainees with the hope of hiring them as full-time employees upon their graduation. However, the certificate requirement for workers in the AAI, has substantially increased auto parts' suppliers demand for the graduates of public VET programmes. To attract the graduates of these programmes, the interviewee firms have developed different strategies: While the T1 has participated in the UMEM, the T2 has preferred employing workers without a certificate getting them certified, and T3 used the apprenticeship system. T4 did not go through big changes in their methods, as they were already bringing up certified operators through the apprenticeship system and employing VHS graduates.

Conclusion

The auto parts-automotive industry has been a crucial sector for Mexico and Turkey and the economic development of the two countries. Despite some differences, this industry went through similar processes in the two countries, which have resulted in some similarities and made both countries to develop comparative advantage in producing medium value-added goods. This similarity has made the comparison between Mexico and Turkey crucial for understanding firms' strategies to generate the workforce with necessary skills, which will be especially important for the discussions on the middle-income trap, as the scarcity of necessary skills has been a vital obstacle for countries to get out of this trap. Therefore, finding out the mechanisms to overcome this obstacle can inform the policymakers and firms in other countries, as well as encourage future research in this regard.

This chapter shows that the institutional environment in which the firms are embedded is a fundamental determinant of firms' strategies to generate the necessary skills for their company. The scarcity of public VET programmes in Mexico, and hence the scarcity of workers with technical training, has resulted in firm-level skill development in Mexico, which has led to a non-standardised skill system and a separation between workers with lower and higher skills. The low-skill operators enter the firms without any prior knowledge and experience and develop skills via on-the-job as well as some firm-level training. In contrast, workers for positions requiring higher skills come from technical schools, which are mostly at post-secondary level.

The institutional environment has a high impact also on the Turkish firms' skill generation practices. First, because of the higher availability and accessibility of public VET programmes, firms in Turkey utilise those programmes more compared to their Mexican counterparts, although the type of VET programmes varies across firms. A common method to recruit skilled workers for all Turkish companies is employing interns of VHSs. Moreover, two firms located in industrial zones with a VET institute (i.e. a vocational training centre for apprenticeship) use the apprenticeship system to generate operators. Other two firms also participate in continuing formal VET programmes, either the UMEM or the ones organised by accredited VET institutions. Additionally, the occupational certificate requirement has also had substantial influence on Turkish firms' strategies to generate technical skills. Three out of four firms in the sample have changed their recruitment methods completely because of this regulation, and two of those have started participating in continuing VET programmes.

Notes

1. Interview with Ahumada-Lobo, I., Mexico City, 19/06/2015.
2. Interview with an expert on VET in German-Mexican Chamber of Trade and Industry (CAMEXA), Mexico City, 19/03/2015.
3. In Turkey, it is obligatory for men to do a military service of 15 months when they are at the age of 20, unless they are studying.

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Part V

Conclusions

18

Wrapping Up: The New Geographies and Frontiers of the AI have Arrived. Who is Taking the Lead?

Alex Covarrubias V. and Sigfrido M. Ramírez Perez

We crafted this book to offer a fresh and comprehensive account of the far-reaching transformations experienced by the automotive industry (AI). We called for studies and frameworks that better help us to decode the nature and internal logic of such transformations along with the reconfiguration of the industry's geographical, technological, organizational and institutional footprints. The 18 country cases analysed allow us to find out a set of common tendencies across national frontiers, coloured by the embedded nature of players, government institutions and local market environments. In what follows, we reflect on these findings around five thematic issues, namely changing geographies (relocating production centres, displacing markets and product cycle revitalization),

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actors' strategies (power geometries and struggles for the industry leadership), industrial relations systems (wages and labour relations), industry transitions and government policies.

Changing Geographies of the AI

Relocating Production Centres

There is now a new geographical distribution of the automotive industry with the main manufacturing capacities found in emerging countries (ECs). In the last few years, this phenomenon has been so profound that its causes and effects are of paramount importance. In 2017, the ECs' share of vehicle production was 57%, while developed countries (DCs), led by the G7 (United States, Japan, Germany, France, Canada, United Kingdom and Italy), made up the rest (Fig. 18.1).

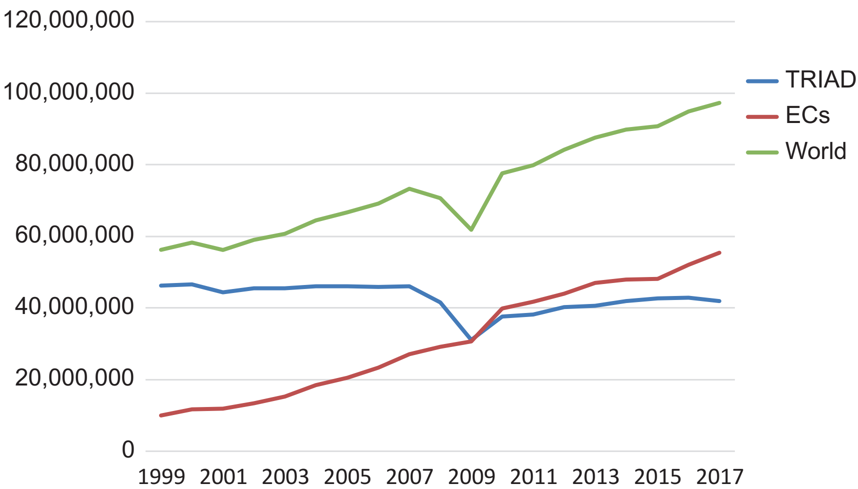


Fig. 18.1 Motor vehicle production. Source: Author's elaboration based on International Organization of Motor Vehicles Manufacturers (OICA) database

The shift is a feature of this century: in 2000, DCs were the dominant manufacturing centres accounting for 80% of total output. While ECs began to progressively capture the auto output share, DCs remained stagnant. The tipping point where production by ECs surpassed that of the DCs occurred in 2009, in the midst of the global financial crisis, after which the migration of industrial capacities to ECs accelerated dramatically. This was led by China who jumped from manufacturing 2 million vehicles in 2000 to 29 million units in 2017, representing almost one-third of the global output. India, Mexico and Thailand have the next highest growth rates, followed by Central and Eastern European (CEEs) countries.

In contrast, the auto production of the DCs in 2017 was down by approximately 5 million units, from the 46.6 million they had manufactured in 2000, despite their slight recovery after the 2008–2009 financial crisis. Among the largest DCs, the auto outputs of Canada, France and Italy have decreased the most—by 28%, 30% and 33%, respectively. Germany, the United Kingdom, Spain and Japan have mostly maintained the same levels, while the United States decreased its auto output by 14%.

South Korea is the only DC that has increased its auto output over the past two decades, with a 32% rise. However, Korea is a case of a former emerging country, in fact the only one who made it into the developed world precisely during this period through the creation of its own strategic industries, starting with the auto industry led by Hyundai-Kia. young-suk Hyun's contribution in Chap. 9 details the unique story of how it was able to catch up and then lead the Korean car sector. The Korean case, forged upon an idiosyncratic combination of going it alone and a state-led strategy, questions the mainstream theories of upgrading and catching up, particularly regarding the role of global value chains (GVCs) and foreign direct investment (FDI). This is discussed in greater detail below.

Against this Korean backdrop, the automotive industries of DCs such as Belgium, Australia, Austria, Finland and the Netherlands have had the opposite experience, that is, they are developed economies with automotive industries that have either ceased to exist or have experienced a dramatic loss of capacity (Clibborn et al., Chap. 11). At 63%, 69%, 28%, 63% and 48%, respectively, their auto production is now lower than it was at the turn of the century. Canada is another case in point: a top twentieth-century producer without its own original equipment manufacturer (OEM), it closed the century producing more that 3 million vehicles and now only produces 2.2 (Sweeney, Chap. 3). Stephen Clibborn et al., in their contribution in Chap. 11, look specifically at the Australian case, following the recent announcement by Ford, General Motors (GM) and Toyota to terminate their operations in these countries, and, in particular, at the causes for the decline of its automotive industry. They identified these to be declining profitability, the rising value of the Australian dollar and reduced government support for the industry.

Currently, the top ten auto-producing countries include China, India, Mexico and Brazil, all of which continue to develop their industrial capacity. In contrast, in the case of the DCs that form a part of the top ten list, all except Korea are experiencing a decline in their industrial capacity. Given these tendencies, it can be anticipated that France will be the next DC to fall from the list of major producers, following the example of the United Kingdom and Italy. Pardi's contribution (Chap. 5) enlightens on the structural decline of France as a manufacturing country. These countries may well be replaced by various others with the potential to appear on the top ten list, including Thailand, Russia, Turkey, Iran and Indonesia outside of Europe, and the Czech Republic and Slovakia within it.

Displacing Markets

In 1950, 50 million vehicles were registered worldwide, of which 76% were in the United States. Currently, the number of automobiles stands at 1.3 billion and only 18% of them are located in the United States. This reflects the other face of the industry's changing geography: the move of vehicular consumption towards ECs.

In 1964, 22 million vehicles were sold globally. Half of these were in North America, 7 million in Europe, 1 million in Japan and the remaining 3 million, less than 14% of the total, in other countries, all of which were developing countries. In 2017, 99 million cars were sold, of which consumers in the United States accounted for 17.6 million (the largest

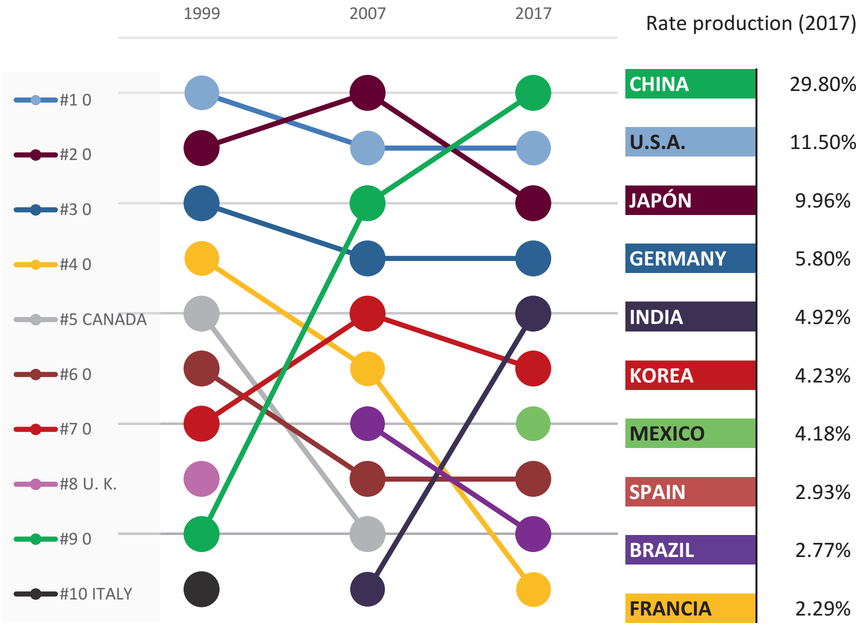


Fig. 18.2 The evolution of the top ten country auto producers. Source: Author's elaboration based on the OICA database

share amongst DCs, as noted by Klier and Rubenstein in Chap. 2), Canada for 2 million, high-income European countries for 16.5 million and Japanese consumers for 2 million, meaning that 45% of auto purchases in 2017 occurred in DCs, including Australia and Korea (Fig. 18.2).

Thus, emerging countries currently consume the majority of vehicles produced in the world, that is, the remaining 55%. Similar to the relocation of production centres, the transfer of consumer markets to the ECs has accelerated in this century. Over the course of the last two decades, while sales in North America, Europe and Japan have stagnated (at .9, 1.4 and −.5, respectively), those of the ECs have increased, particularly in China where sales tripled just in the last decade. Seen from a different point of view, from 2005 to date, global auto sales have increased at an annual average rate of 3.5%, of which more than two-thirds correspond to EC markets, with China, India and Brazil now appearing in the list of the top ten largest markets. Although Mexico appears as one of the top

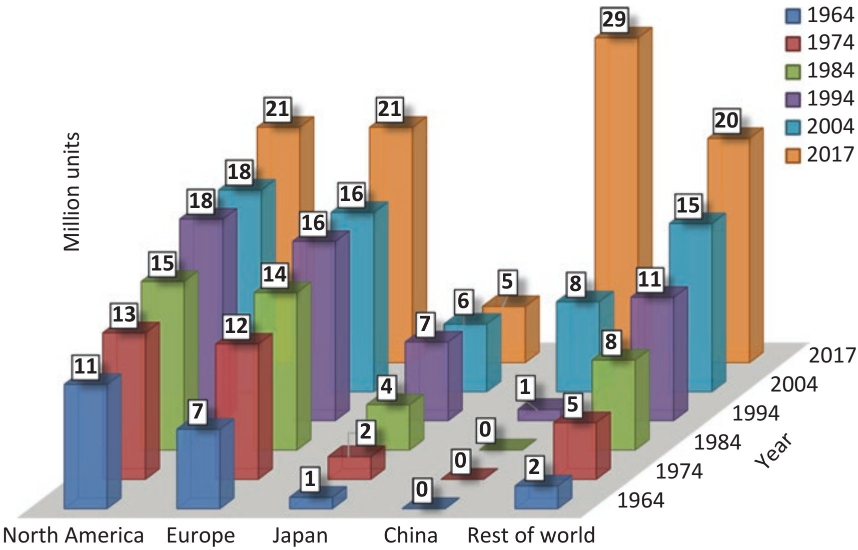


Fig. 18.3 Vehicles sales 1964–2017. Source: Own elaboration based on Gao et al. (2014) and the OICA database

producers, it is not a major market given its condition as an export platform, with low salaries and a limited market (Figs. 18.3 and 18.4), as has been analysed by Covarrubias in his chapter.

From Maturity to Revitalization of Product Cycle

When looking at the product life cycle (Levitt 1965; Anderson and Zeithaml 1984) of the automotive industry, its changing geography is predictable. After a century of the industry, motor vehicles are products with massive sales that have reached a state of maturity and are declining in the markets in which they were born. OEMs have found, in emerging markets, a formula for survival with relocation providing an opportunity to restart the cycle (in virgin markets) or reinvigorate them (in already established markets). Annual growth rates of 3.5% for almost two decades, nearly twice the growth of the world's population, are not bad for an industry that has been a major global player for 100 years.

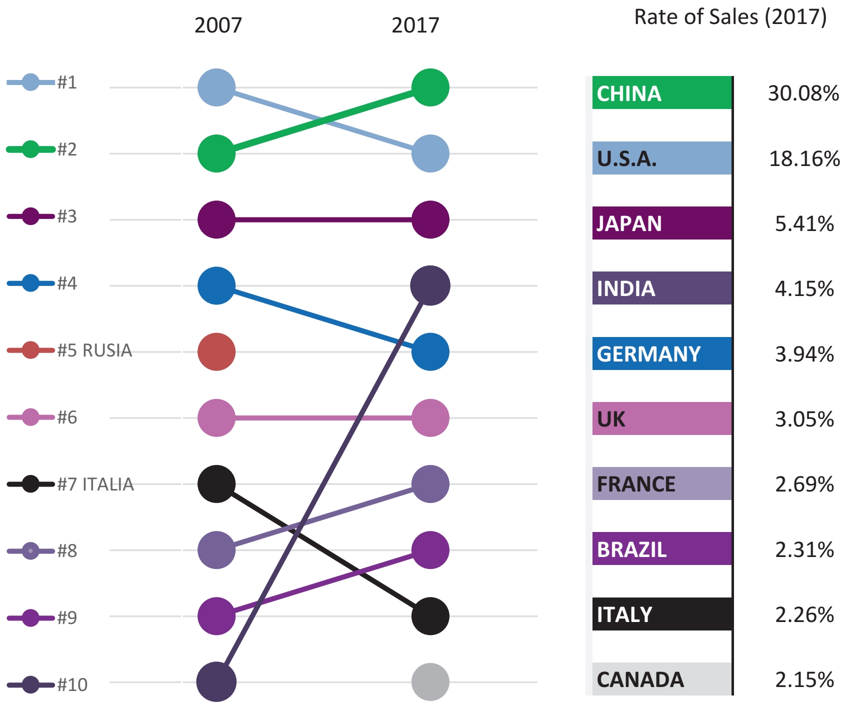


Fig. 18.4 The evolution of the top ten country auto markets. Source: Own elaboration based on the OICA database

There are currently over 1.3 billion cars in use worldwide with the global motorization rate reaching a threshold of 182/1000 inhabitants in 2015. However, this contains considerable disparities. On the upper extreme, the United States has the highest motorization rate of 821 while, at the lower end, African countries have a motorization rate of 42 and continental size countries such as India, a rate of 22. Thus, while the United States has almost one vehicle per inhabitant—the best indicator of the saturation of its market—India has only .22—a clear indicator of the depth of market it offers. Between these two extremes lies the evolution that has already been identified. European countries, followed by Japan, are amongst those with the highest levels of motorization after the United States, that is, the old drivers of the TRIAD. Figure 18.5 shows

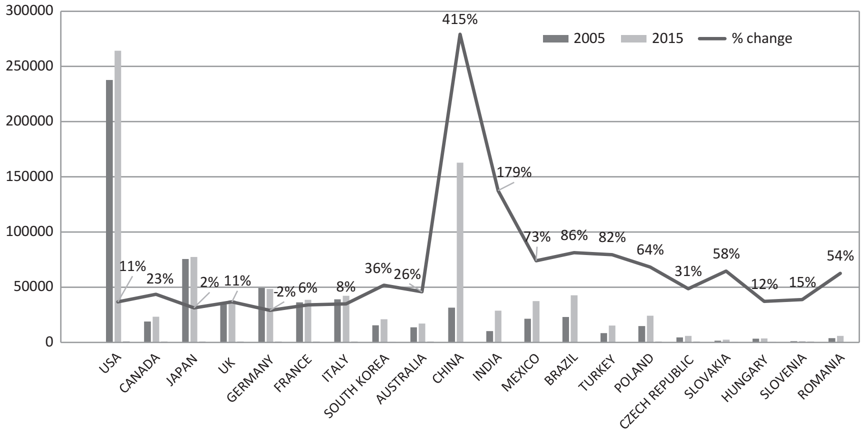


Fig. 18.5 Motorization rates. Change. Source: Author's elaboration based on OICA database

how motorization rates have experienced the least growth in these countries since 2005, with an average of .7 across the three regions. In contrast, countries in Asia, Oceania and the Middle East have grown at a rate of 141%, Central and South America at 60% and a similar rate in Eurasia.

The geography of private motorization confirms that we are at a point of no return: the markets of ECs have more potential to grow simply because they have the largest margin to do so, while the old TRIADs will stagnate and decline given that their growth margin is almost zero, at least regarding traditional internal combustion engines (ICEs) vehicles where the margin for action is limited by public demand for stricter regulations to control polluting emissions. In European countries and Japan, urban environmental issues further complicate the problem: there is simply not enough space to accommodate additional cars and parking lots.

These evolutions represent a structural change. ECs' rising demand, led by that of Asia, is progressively shaping the course of industry. Their size and growth potential allow them to rely upon their domestic markets and affect existing global value chains while advancing their own industry and firms networks. The actions of governments, such as the Chinese one, to purposefully influence the automotive industry transformation give them an additional leverage.

The vehicle market may also be affected by changes in consumer preferences as it has been noted that in some countries, the millennial generation are beginning to postpone buying decisions. Of these, the most notable impact is expected to be the development of new forms of mobility, including car-sharing and small vehicles for last-mile connections. Public policies for achieving sustainable cities, free of the polluting emissions of ICEs, are and will be an additional factor in changing geographies. Ongoing institutional agreements in Paris, London, Brussels, Madrid and Hamburg, as well as Dongtan, amongst others, to convert these into car-free cities, or at least, to be ICE-free in the coming years, are an example of this.[1] As a range of alternative mobility projects accompanies these initiatives—in order to evolve from transit cities to electric mobility cities, and so on—changing geographies will converge with changing techno-organizational frontiers of industrial paradigms.

The Geometry of Power: The Strategies of Firms

The Fight for the Top

Strategies of individual firms in the battle for the top position in the industry are crucial to the changes we have been seeing. In 1930, GM became the leading automotive corporation in the industry on a global level.[2] Flanked by Ford and Chrysler, it headed up the iconic Big Three, maintaining its leading position in the industry—in terms of production and market control—throughout the century. In 2006, Toyota surpassed GM's productive capacity. It was a significant event that signalled the end of one era—the hegemony of the Fordist industrial model, coined in the United States—and the beginning of another. As has been written (Boyer and Freyssenet 2002, amongst others), the decline of the American industry had manifested in the last quarter of the twentieth century. In 1978, Volkswagen (VW) installed its first "transplant" in the United States. At the beginning of the 1990s, another ten German and Asian corporations followed suit. The growing protectionist sentiment in the United States in the face of foreign imports provided these companies with the perfect ticket on which to transfer their investments and systems with the aim of penetrating the still largest world market, from within. The opportunity was bolstered by the weakness of the Big Three that manifested with the changing scenario that emerged from the energy crisis of the early 1970s, combined with the superiority and increasing prestige acquired by the Japanese production model and its small and efficient vehicles.[3] By 1992, Japanese transplants alone totalled nine assembly plants in the United States and three in Canada, 350 suppliers and 20 tyre manufacturers (Florida and Kenney 1996). In 2017, Asian and European transplants operated 27 assembly plants, producing 25% of the vehicles sold in the country and soon accounted for 29% of imported vehicles in the country.[4] That is, following four decades of penetration of the American market with the double strategy of importing and producing at home, European and Asian manufacturers were able to dominate the market. As such, the United States' auto producers became the only component of the TRIADs to lose control of their home market to auto manufacturers from other continents.

This brief history serves to show how behind the global change of industrial geographies and the dispute between countries to define who manufactures and sells more cars lie the most basic of stories: market competition between corporations, expressed in geometries of power. It is a struggle that puts into play the expansion and internationalization strategies that have existed since the last century. The so-called legacy firms (Klier and Rubenstein, Chap. 2)—the Detroit Three, VW and Nissan—have been installing assembly plants in developing countries and Europe since last century. Local government policies of import substitution industrialization provided a powerful incentive to transfer productive capacity to ECs as they provided a direct way of penetrating protected national markets. Internationalization accelerated with globalization, and the strategies used by firms changed, resulting in different power geometries.

Two moments in this process are particularly notable: in the first, which spans the last two decades of the twentieth century, almost all the leading OEMs accelerated their internationalization efforts, following in the footsteps of the legacy firms. The only exceptions were the German premium firms and Hyundai, who both continued to be based in their

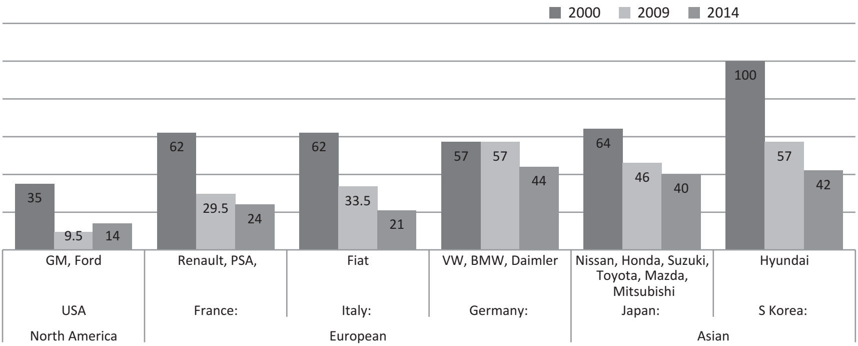


Fig. 18.6 Home country car production as a percentage of OEM's global production. Source: Author's elaboration based on Traub-Merz (2017)

home countries and exported from there (Fig. 18.6). It is notable that at the turn of the century, the 15 major firms had relocated capacity or created new capacity in other countries, to the extent that 39% of their total production was manufactured outside of their home countries. In the case of the Detroit Three, the movement was both a precursor to other moves and brutal. By 2000, almost two-thirds of their production was done in other countries. Only VW came close to a transnational strategy of such depth (61% of its production was outside of its home country).

The second moment occurred in this century. Currently, the relocation of capacities undertaken by all leading OEMs has reached such a massive level, that the "abandonment" of their home countries resembles an emptying of industrial capacity in some jurisdictions. It is a phenomenon that reflects the deterritorialization of the industry. In 2009, only 9.5% of the total production of GM and Ford was produced in the United States.[5] In recent years, these firms have slowed this outflow and the balance of their US-based production has risen slightly (4%). These were clearly the effects of the "going home" policy, initiated by ex-President Obama and furthered by President Trump. The policy has its roots in the bailout coordinated by the governments of Bush Jr. and Obama in 2008–2009. This granted them a voice in the destiny of the ex-Big Three and began the largest government intervention in a global industry and made power geometries more apparent.[6] By then, in the midst of the financial crisis, what took centre stage were the government actions in country after country to stimulate demand and overcome the recession (Jetin 2015a, b).

By 2014, fifteen leading OEMs maintained, on average, only a third of their total global production in their home countries. Renault, Nissan, Honda, Fiat, and to a slightly lesser degree VW, followed the GM and Ford example with the radical relocation of their manufacturing capacity. By then, GM and Ford had more plants in other regions of the world than they did in North America, 24 versus 18 and 20 versus 12, respectively. Similarly, Fiat Chrysler Automobiles (FCA), with a declining Italian market and without having created an export base (Calabrese, Chap. 7), has 12 plants in Europe versus 37 in other regions, while in contrast, Toyota has 31 plants in Asia and 22 in other regions (data regarding plant locations in CAR 2018).

The above data illustrates that firms' internationalization and global expansion strategies follow a certain pattern in which national trajectories and those of specific firms overlap with various accents and balances. In American and Korean OEMs, the weight of national forces is notable, as is the influence between firms. German OEMs tend to follow a strategy of increased imports and on-site production, making Germany the top exporter in the world (GTAI 2018). Honda has most of its facilities in North America and receives most of its revenue from this region with a philosophy of "build(ing) products close to the customer." Toyota, on the other hand, continues to be based mostly in Japan and has a much more conservative strategic approach to international deployment.

In the current stage, the relocation of capacities is totally focused on the ECs, with the aim of using these as skilled and cheap export platforms for vehicles in the OEMs' home countries, in the case of North American, European and-to a lesser degree-Asian companies, as well from which to penetrate the fast-growing Chinese and Indian markets.

Mexico and Central Eastern European countries with Turkey are the most rapidly developing hubs in North America and Europe, respectively, sharing similar characteristics and functions in terms of the global strategies of OEMs (see the contributions of Guzik et al., Šćepanović and Sancack in Chaps. 15, 16 and 17, respectively). Salaries are considerably lower in these countries than in the DCs of their regions and their internal markets are either not growing or are growing very slowly. Integrated regional production chains have been created around these countries at lower costs, taking advantage of the free trade agreements in regional trading blocs in order to facilitate the transportation of merchandise. In this sense, the incorporation of the CEE countries into the EU between 2004 and 2007 had the same effect that Mexican incorporation into the North American Freed Trade Agreement (NAFTA) did a decade previously.

In the Asian region, Thailand, known as the Detroit of Asia-Pacific, has fulfilled this purpose. While the Australian automobile industry was dying, various OEMs moved to Thailand, stimulating its explosion as an export platform in the last decade. With an increase in production from 1.3 to 2 million units between 2007 and 2017, the OEMs' objectives have been the same: to take advantage of its lower production costs and export from there to Australia, the Middle East and Europe.

The competitive advantage of countries and their firms has changed. In the past, exporting countries (Germany, South Korea, Japan and France) and their national champions sought international markets as an extension of local markets. Now the above-mentioned ECs provide a launching platform for exports to other markets. Their economic and business equations complement one another given the absence of home-based firms and the fact that their internal markets are small or have low consumption levels. Nevertheless, it is in this sense that their position of dependency in the industry's global value chain is at its most vulnerable. In a future sector of new mobilities, exporting ECs will have to operate on the borders of the first industrial division: between one subsector of manufactured goods and commoditized services and another centred on the control of software design and high-value technologies.

One event that could potentially change the rules of the game is the emergence of Chinese and Indian firms who are not only growing in their home countries, bolstered by the size of their markets and government policies that protect them, but who are also beginning an internationalization process. The potential of the import substitution policies followed by China in order to develop its own industry, as well as that of extensive joint ventures followed by Indian corporations, headed by Tata, will become evident during this process. Domestic companies have taken advantage of these policies along with the fact that their countries of

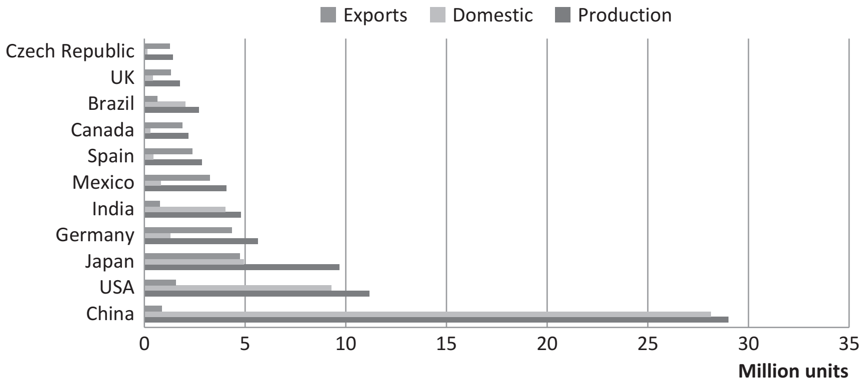


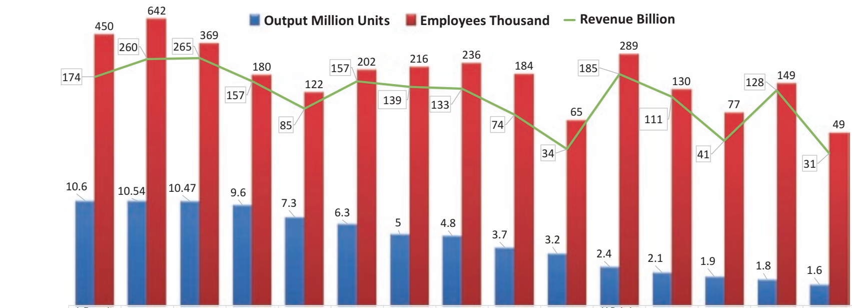
Fig. 18.7 Production and export market of vehicles. Source: Own elaboration with data from Workman (2018)

origin have rapidly evolved to become centres of mass vehicle production and consumption. The implications of this are considerable, as while they continue to exert influence over how their markets are structured, companies such as Tata, Geely, SAIC and BAIC are beginning to internationalize and affect the restructuring process of other jurisdictions and firms. For example, Tata is now well known for its acquisition of Rover and its presence in the UK market, while Geely gained attention for its purchase of Volvo (Wenten, Chap. 11). Figure 18.7 shows the relationship between domestic markets and exportation.

Due to this last factor of global internationalization, now in Asia, the old DCs and their historic OEMs must dispute dominion of the regional markets with emerging actors. This dispute for the top is even more evident in the Chinese, Indian and Korean cases, where the government weighs in heavily to promote and support its industries.

Old and New Leaders

Currently ten corporations and their allies control 72% of the market—that is, in 2017, they produced more than 70 million of the 100 million vehicles that were manufactured (Fig. 18.8). If the next ten companies are also considered, 88% of the market was controlled by 20 firms and



	1. Renault-Nissan-Mitsubishi Alliance	2.VW	3.Toyota	4.GM	5.Hyundai Kia	6.Ford	7.Honda	8.FCA	9.PSA	10.Suzuki	11.Daimler AG Mercedes Benz	12.BMW	13. Geely	14. SAIC	15. Mazda
Output Million Units	10.6	10.54	10.47	9.6	7.3	6.3	5	4.8	3.7	3.2	2.4	2.1	1.9	1.8	1.6
Employees Thousand	450	642	369	180	122	202	216	236	184	65	289	130	77	149	49
Revenue Billion	174	260	265	157	85	157	139	133	74	34	185	111	41	128	31

Fig. 18.8 Top 15 auto makers 2017. Source: Own elaboration with data from Fortune Global 500 (2018)

their allies in 2017. Thus, the industry remains highly concentrated—even more so in G7 jurisdictions, such as Japan—as illustrated by Heim (Chap. 8). The Renault–Nissan–Mitsubishi Alliance (formed in 2016), with 10.6 million units, is the leading corporation, only just exceeding VW and Toyota. The search for allies, buyouts and fusions—a main feature in the consolidation of the industry in the twentieth century—continues as a business strategy in the fight for industry leadership. Examples abound: in 2014, Fiat and Chrysler merged to create Fiat Chrysler Automobiles (FCA), while the Chinese Dongfeng acquired 13% of the French PSA.

As previously noted, currently only GM and Ford remain from the Big Three as the Italian Fiat heads up FCA (see Calabrese, Chap. 7). The combined total of Ford and GM production reveals that the previously dominant industry leaders currently account for just 16% of the market. Meanwhile, a close battle for market control is fought between the Asians—lead by the Japanese (27% of the total), followed by South Korea and China—and the Europeans—lead by the Germans (15%) and followed by the French and Italians. Thus, Renault, VW, FCA, PSA and luxury Daimler and BMW produce the remaining 30%,[7] whereas the Asian corporations are responsible for the largest share of global production (46%).

Five Chinese firms appear among the top 20 corporations worldwide, headed by Geely and SAIC, representing 7.3%, and another five Chinese firms appear in positions 21–25 (with the Indian firm Tata between them), contributing a further 3.6%. As such, ten Chinese firms produce a total of 11% of cars in the world (Fig. 18.9).

These data affirm one of the most significant facts of the changing geography of the industry: that the most rapidly growing corporations of the past few years have come from emerging countries. Added to these ten Chinese firms is the Indian company Tata as well as Hyundai-Kia that took off in the late 1980s and began to penetrate the North American market when Korea was still considered an emerging economy. Together, these firms account for 19% of world production, more than the number of vehicles produced by both American and European firms if they are considered separately. In China, as shown by Wenten in Chap. 11, it is private independent firms that have progressed the most, rather than those that form part of joint ventures with the State. Even so, the Chinese government's involvement in the course of the industry has had an impact, and continues to do so significantly, as will be seen in the following sections.

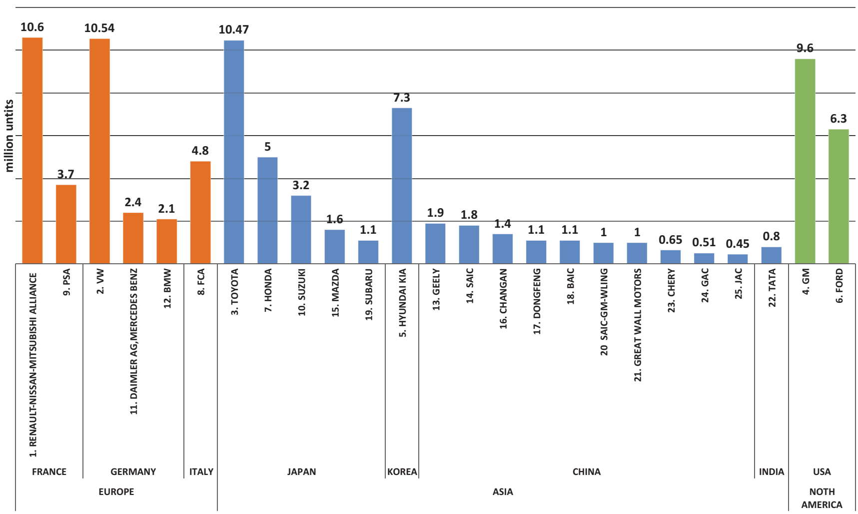


Fig. 18.9 Top 26 auto makers. Ordered by country (2017 output). Source: Own elaboration with data from Fortune Global 500 (2018)

Chinese firms still do not have the capacity to compete in the open market of the global arena, and it is very possible that some of them will either fail, or will need to ally or merge with others in order to survive in the medium and long term. Despite this, their evolution is of considerable importance. It took a century before the first emerging country was able to take up a leading position in the industry (South Korea with Hyundai-Kia), while the Chinese have positioned themselves on the horizon of these leading firms in less than two decades. Chinese firms increased their share of global production in the last decade by an average of 1% point annually, while Hyundai advanced 0.3% annually in the last two decades. Assuming the Chinese maintain the same growth rate for the next 12 years, they will account for a third of global production by 2030. Based on this, it is tempting to forecast that they will become absolute leaders in the industry. Yet, for this to happen, they first must develop a sustainable productive model (Boyer and Freyssenet 2016) and break with its path dependency on the ICE technology while succeeding in their current approach for architecture innovation based on platform and modularity strategies (Wang 2015).

Systems of Labour and Industrial Relations

Salaries and Labour Relations: Broadening Diversity

The basic logic of economic and business cycles would suggest that less industry and investment in the DCs, combined with more industry and investment in the ECs, would result in a correlation between jobs, labour relations and falling income in the first group versus jobs, labour relations and rising incomes in the second. However, this is not always the case. On one hand, the deterritorialization and internationalization strategies of firms have motivated the search for reduced costs and access to lower wages and export platforms in the exploration of new markets. On the other hand, and as has been noted in this book, in the midst of global tendencies towards labour precariousness, a whole gamut of variations exist that depend on institutions and labour markets, as well as on the labour relations of each country.

United Auto Workers (UAW) workers were the most well-paid blue-collar workers in the world in the 1970s. After half a century of pattern bargaining and job-control unionism that meant constant salary protection and detailed job classifications, at the beginning of the 1980s, their income (USD $18/hour) was a third higher than that of their German counterparts, who were the second highest earners. In turn, these German workers earned 30% more than French workers did, third in terms of income worldwide. The French made 12% more than Italian, British and Japanese who made up the rest of the workforce in the industry's leading mature economies. Workers from this sector in the ECs—for example, from Brazil and Mexico—earned, on average, a tenth of what the American autoworkers did.

More than 34 years later, in a study by The Boston Consulting Group (2014) of the largest exporting economies, the United States appeared together with Mexico as the "Rising Global Stars" for having had the smallest growth (strictly negative) in salaries with sustained production since the beginning of the new century.[8] Mexico is the most cost-competitive (i.e., low cost) manufacturing country amongst the leading ten export economies, while the United States occupies the fourth place, after China and South Korea.

In recent years, a popular explanation for wage-setting has argued that maintaining industry competitiveness in each region is conditioned upon low wages. In an attempt to normalize low wages, it is further argued that they have served to promote vehicle consumption, based on the idea that higher salaries would have meant higher prices, and thus, demand would have plummeted (CAR 2018). Thus, calculations for "optimal regional locations" are elaborated by precise combinations of high and low wages in each region: NAFTA and low wages for Mexican workers would make the North American industry competitive, as would low wages in Eastern Europe and Turkey for the European community and in Thailand, India, and more recently, Vietnam, for the Asian region.

Evidence presented in this book indicates that "the race to the bottom":—that is, dragging down wages and eroding job security—is a strategy that has been pursued in North America and subsequently in Japan and India, and one that labour institutions and trade unions have been incapable of counteracting. In other regions, the race to the bottom has been mitigated by labour market conditions as well as a greater capacity of unions and worker organizations to respond. The results of these dynamics have been varied. There is a tendency for conflict and rising salaries in the new geographies where industry is booming, but this is not universal. There has also been a sustained attempt by corporations to reduce, or at least freeze, the income and labour gains that workers had won in the DCs, as well as to decentralize collective bargaining, which has also not been universally successful. Finally, we have seen a general trend of increased government intervention in industrial labour relations.

In the ex-NAFTA region, from 1994 to 2017, the wages of Mexican autoworkers increased, on average, from $1.90 to $2.30. This means that during the 23 years of NAFTA, wages were essentially frozen, despite the industry boom, increased investments, jobs (which doubled) and productivity (which has grown annually during the boom). In the same period, US auto industry jobs decreased by 17%, while those of Canada stagnated, accompanied by a decrease in wages from $36 to $27 and $34 to $26, respectively (Covarrubias, Chap. 13).

The loss of jobs in the United States since the end of the 1970s (from 1.5 million to 953,000 in 2017) has particularly affected membership of the UAW. From a membership of 1 million autoworkers, the UAW had only 355,000 by 2016. As a prototype of an economy coordinated by market mechanisms and in which the government claims to not "pick winners or losers," they have, in reality, contributed to a radically anti-union dynamic. As such, over the years, the number of "right to work states" has grown, including the home of the Detroit Three (Michigan), and they have encouraged policies that have led to the reduction of salaries. The financial bailout of the Detroit Three, undertaken by the then president Obama in 2009, forced an agreement with the UAW that prolonged a pay freeze that had already been in existence for ten years. The results of this have been disastrous for labour organizations. In 2006, a member of the UAW typically earned 74% more that the average American manufacturing worker. Currently, new hires make 20% less than the national average creating a dual labour market within each automobile company.

American OEMs took an early lead in the deterritorialization of the industry, as has already been identified. Part of this went to Mexico with NAFTA creating a framework aimed at encouraging regional integration of the industry while keeping out Asian and European competitors with greater entrance barriers. Although NAFTA was successful in the former, it failed in the latter, to the extent that Asian and European firms have taken the lead in production and market share of North America. This counters the argument that low salaries in Mexico have made the North American AI more competitive. More recently, in the last quarter of 2018, Ford and GM announced that they would be closing new facilities in the United States and laying off workers because of low sales and market contraction for their sedan and subcompact models. GM said it would close five of seven factories and reduce their workforce by 15%, equivalent to 14,000 jobs in the United States. Because of such evident trends towards deindustrialization, the new North American trade agreement, promoted by Trump, has included a new conditionality: new rules of origin for the AI to ensure that 75% of the final product will be produced by suppliers paying an adequate wage level. This is, ironically, a potential source of improvement of the wages of the Mexican automobile workers.

In Mexico, the accession to power of the centre-left Lopez Obrador at the end of 2018 and his steps to increase the minimum wage by 16% show how today, labour markets are highly influenced by political elements. In the first decade of the century, Brazil had a similar experience with the presidency of Luiz Inácio Lula da Silva and his Workers Party (Partido dos Trabalhadores). Lula, a metallurgical worker, rolled out policies that strengthened the enforcement of pro-worker laws, increased salaries and encouraged consumption. The result? The auto industry grew steadily, vehicle production doubled between 2003 and 2013, the real wages of Brazilian autoworkers increased by 17.3% and the Brazilian car market became the eighth largest market in the world (Marx et al., Chap. 14).

With the industry boom, salaries in China began to increase, albeit slowly. Notably, however, these increases have been won in local battles by labour organizations that were able to break through political lines imposed by governments on the labour relations system, rather than through planned public policies. Nevertheless, sub-contracting chains, informal employment and wage inequality, as well as long working days, still persist (Wenten, Chap. 11). Similar stories emerged out of Korea in the 80s and 90s and, recently, in Thailand too. These are stories that show another dimension of the industrial equation that the neoliberal lens prefers to ignore when analysing the globalization of the industry. We refer to the persistence of worker organizations and their resources as entities capable of counterbalancing the competitive strategies of governments and corporations. By contrast, in Japan, salaries have frozen in the midst of an acute OEM restructuring process that has accentuated their approach of high quality at low cost. In addition, we see the labour abuses that have arisen with the extension of training programmes for foreign workers, which have resulted in labour markets without the traditional battle for better wages represented by the "shunto" and lifetime employment systems. That is, two of the pillars of high organizational commitment, characteristic of the lean production methods that explained the apparent superiority of the Japanese organizational model in the 80s and 90s, have been put aside (Heim, Chap. 8).

In Europe, the story is different. In the Central and Eastern European ECs, to where the industry has relocated, wages have risen, largely due to the scarcity of skilled workers in the context of increased production, jobs and productivity. A similar phenomenon has occurred in Turkey, though in this case, worker struggles for better salaries have also been determining factors. In 2015, wildcat strikes swept through the main auto producers, precisely in the moment that Turkey became the primary exporter to the EU and auto industry jobs had grown 350% since 2009. The strikes forced the government to emit a new minimum wage law that notably increased the income for autoworkers. Consequently, wage increases have been notable in Turkey, Romania and Slovakia and a little more tenuous, but still positive in Poland and Hungary.

In Germany, jobs in the automotive industry increased from 749,000 in 2005 to 821,000 in 2017. In the same period, autoworkers' salaries rose from USD $32 to USD $38 per hour. Nevertheless, the German automotive industry has not been immune to difficulties. The "Diesel-gate" scandal revealed technical and accountability issues within the industry even though, as analysed by Pries in Chap. 4 and Pardi in Chap. 5, manipulation regarding polluting emissions is not exclusive to VW or to the German AI. Rather, it revealed a generalized problem of the transition towards a greening of current cars and an incapacity to comply with stricter emissions regulations. It also showed the weakness of government institutions in enforcing environmental protection laws. Even so, the automotive industry is still the backbone of industry in Germany, and codetermination institutions continue to be the most stable and democratic structures of labour–management relations worldwide. However, in both Germany and Italy, unions have accepted new decentralized mechanisms of collective bargaining.

In France, Italy, Belgium and Spain, wages have continued to rise despite the dramatic collapse of employment rates in all cases, except Germany. In Italy, some of the trade unions of the metal sector, in particular the Federazione Impiegati Operai Metallurgici-Confederazione Generale Italiana del Lavoro (FIOM–CGIL), have disputed the more radical changes in collective bargaining and limited FCA's plans for flexibility and cost reduction (Calabrese, Chap. 7).

Figure 18.10 shows that India is the only EC to join Mexico in maintaining a deliberate government policy of low wages. Furthermore, the Indian industry rests on the long chains of sub-contracting and informality that may include up to half of the labour force. In both countries, keeping salaries low and separating them from business cycles in the industry has been a public policy decision for two decades aimed at

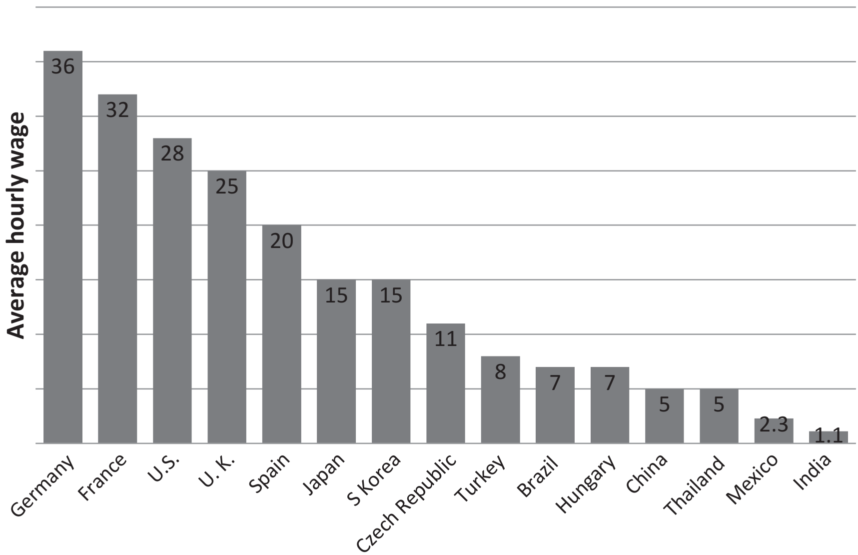


Fig. 18.10 Auto-assembly workers: average hourly wage. Source: Own elaboration based on Statista and Rutherford-AutoExpress (2017)

attracting investment and generating employment. The difference between the two countries lies in the intensity of worker struggles to defend their rights, along with the response of governments and corporations. In India, strikes and movements in defence of union rights and better wages and working conditions have been constant, as has been the violent and repressive government response and layoffs of worker leaders supported by increasingly strong trade unions. Tata, Maruti Suzuki, Hyundai and Honda, amongst others, have confronted labour movements in this way. Comparatively, in Mexico, struggles and protests have been minimal while state-controlled unionism has continued to maintain a stronghold in the industry. Nonetheless, we know that some worker activists have been fired, as was reported regarding the Japanese firms Honda and Mazda.

In light of this data, it is notable that the race to the bottom approach taken in North America and by the Big Three has not been enough to make them competitive. On the contrary, maintaining or increasing employment and higher salaries has not taken European jurisdictions and their automakers out of the competition. The CEE countries may be concerned that these developments could outprice them (Guzik et al. and Šćepanović, Chaps. 15 and 16, respectively). The major challenges of the CEE countries require a two-pronged approach. The first is to establish vocational and professional training programmes that are able to create opportunities and the skilled workers required by the industry (Šćepanović and Sancak, Chaps. 16 and 17). The second is to create programmes and mechanisms for design competencies that can move local producers from manufacturing upgrading to functional upgrading (Guzik et al., Chap. 15).

In Asia, the rise in jobs and salaries in South Korea, China and Thailand have created a new labour market geography that defines productive and market profiles for the industry and contributes to their competitiveness. China is now experiencing what South Korea learned three decades ago and Henry Ford launched as an industry creed a century before that: it is impossible to broaden the domestic vehicle market and use it as a platform from which to consolidate, if workers do not earn enough to consume what they produce.

The thesis of *optimal regional location* equations between jurisdictions based on the variables of high and low salaries is thus evidently insufficient as an explanation for developments in the industry. What is now apparent is a great diversity of salaries and labour relations across borders. The position of the automotive industry in a particular country with its particular industrial relations system, and a set of rules and institutions regulating the labour–management relationship, is what continues to be the decisive factor in explaining labour markets and salaries. In turn, these systems continue to be the most immediate factor that influences the political positions of governments. As such, OEMs continue to decentralize human resource policies at a national level, while protecting the centralization of technological design policies and business models. The pattern of ethnocentric corporate strategies concentrating control over technical design and business with a geocentric, decentralized perspective of labour relations on a country level has only been broken in three jurisdictions: by South Korea in the last century and by China and India in the present century. The implications of this are still to be seen.

Battles between labour and management over the terms of the work relationship have moved to the ECs, accompanying the geographical displacement of the industry and often becoming tense and difficult. This does not mean, however, that the DCs are free of conflict. In some cases, labour organizations have been pushed into concessionary bargaining, where they compromise on income and benefits in exchange for jobs (Sweeney, Chap. 3). Currently, these labour organizations are working towards the goal of having collaborative international networks with labour organizations from the ECs. This is based on an understanding that they cannot compete with neighbouring workers who earn a fraction of what they do and, thus, the best way of securing their jobs is by supporting EC organizations who are striving to improve incomes. Germany's IG Metall, America's UAW, Canada's UNIFOR and Japan's JAW (Confederation of Japan Automobile Workers' unions), organized within the IndustriAll Global Union, have headed up these efforts. This has also led to the signing of Global Framework Agreements, which establish minimum labour standards on a corporate level for each OEM. BMW, Bosh, Ford, PSA, Renault, Saab, MAN, ThyssenKrupp and VW have all signed such agreements. However, while the agreements include trade union rights, health, safety and environmental practices and quality of work principles, they do not impact salaries. Simultaneously, labour organizations have converted collective bargaining into discussion spaces regarding the future of the industry as they examine industry and firm policies. These practices, a part of the European codetermination tradition, are new to North America, which has long been rooted in a tradition of economic, job control unionism. In Italy, the FCA has broadened mechanisms for consultation, which excluded the largest trade union of the sector (the FIOM–CGIL); while in the United Kingdom, the Automotive Council for Britain has been established to discuss the future of the industry, and it includes the representatives of the main trade union, Unite. These are changes that reflect the depth of this transition.

Transition of the Industry and Industrial Policies

In the industry's changing geometry of power, government policies have gained prominence. This is increasingly so due to the current transition of the industry towards a new industrial paradigm of alternative engine and energy systems, as well as car-sharing initiatives and increased digital connected technologies. These transformations require substantial investments in infrastructures and definition of rules and standards at local, regional, national and even international levels. The prominence of government policy also grows with the advancement of protectionist policies and a conservative approach to energy and the environment, as represented by the Trump administration and Brexit (see Coffey and Thornley, Chap. 6). The question remains as to what is happening in the main auto industry countries and what governments and firms are doing in the face of the transition. We will begin by looking at Korea and Mexico, two jurisdictions that, given their position and actions, reflect polar opposites in the evolution of the auto industry and will conclude with the European Union attempt to develop a full-fledged industrial policy in order to advance its current status at the world level.

The case of South Korea says much about what government policies can achieve for the sector and runs against the premises and logic of global value chains (GVCs), which have gained pre-eminence alongside the globalization processes. According to them, multinational corporations invest (FDI) in ECs that offer skill and cost-competitive advantages. In high-tech, strategic industries such as the automotive one, OEMs set up facilities and engineer productive processes that open local windows of opportunity for learning, technological absorption, knowledge transfer and spillover effects. If locals are able to establish and mobilize these competencies into sectoral and national systems of innovation, the catch-up process begins and is able to take them from basic to complex manufacturing. In the last stage of upgrading, latecomer actors become innovators and design their own productive and technological enterprises. The lesson is that ECs must do whatever it takes to attract multinational FDI flows and be part of GVCs: the more the flows and the higher their value, the better (OECD 2018; Gereffi 2018).

Despite this GVC premise, not a single example in the automotive industry exists where a country has succeeded to upgrade exclusively through increased FDI flows. In the Korean case, rather than struggling to attract the flows of FDI, Korea measured out multinationals and used them to get production technology under licensing arrangements and reverse engineering (young-suk Hyun, Chap. 9). According to Lee and Malerba (2017), the windows of opportunity within a catch-up cycle are composed of three dimensions: changes in institutions and public policy, changes in knowledge and technology and changes in demand. The Korean success story, like that of Japan, is a clear example of government initiatives aimed at seizing opportunities and provoking changes in knowledge, technology and demand. Pioneering industrial policy measures supported these initiatives (Lechevalier et al. 2017). For example, in 1960, the government created the Korea Advanced Institute of Science and Technology to foster industry R&D. It then encouraged and supported Korean entrepreneurs from catch-up to leading by reacting to demand and technological windows of opportunity. At the beginning of 2000, the success of the Korean strategy was evident, and a decade later, Hyundai-Kia became the fifth largest global automotive corporation.

On the other end of the spectrum, and in contrast to the Korean "going alone" approach, is the Mexican case. After half a century of reliance on FDI flows to develop its industry and being flooded with these over the course of the last decade (e.g., in 2013, Mexico received the largest FDI flows worldwide), Mexico has made no progress in catching up. It remains rooted in the assembly stage, with no advancement towards internalization and the generation of technology, much less towards achieving a leading market position like Korea. This case shows that being flooded with FDI can generate the unintended effect of precluding latecomers from finding their way to catch up. We refer to this effect as the Mexico syndrome, the false notion that flooding the country with FDI from OEMs and downgrading labour standards are needed to remain competitive and catch up, and will produce a trickle-down effect that will benefit society in the long term. In reality, this choice of not having an active industrial policy will bring the country into a dependency trap that is very difficult to escape.

Conversely, Korea is a good example of the effectiveness of policies in promoting the transition of industry. In 2004, the Korean government planned the development of "Future car technology for emission free (EV) and intelligent vehicles (AV)" with private and public investment totalling \$700 million. Similarly, Hyundai-Kia has undertaken pioneering work in new propulsion technologies for their models Tucson FCEV (2015), first Fuel Cell Electric Vehicle (FCEV) in the world, IONIQ EV (2016), KONA EV (2018) and NEXO FCEV (2018), and Samsung and LG are breaking into the sector through alliances with large players. For instance, Samsung merged with Harman to develop connected lifestyles for future mobility. Meanwhile, in Mexico, there is no government plan from the new centre-left administration to promote new clean technologies, but rather a bet in favour of improving the production of gasoline and hydrocarbons by the Mexican Petrol Company (PEMEX).

Other Emerging Countries

Although Brazil had begun to develop alternative fuels to ethanol and had initiated a programme to stimulate technological learning (InnovarAuto), the results were limited and any successes fell apart with the 2013–2015 crisis. Since then, it has closely resembled Mexico in its complete dependence on the designs and technologies of OEMs, without developing its own capacity nor proposing any appropriate programme as an actor in the transition of the industry. Furthermore, given the fact that both countries rest on enormous oil reserves, there has been little incentive for political and economic decision-makers to seek out other sources of mobility and value generation. Covarrubias V. (2017) has referred to this as the "trapped-oil position." In this sense, there is little difference between what Lopez Obrador has proposed for Pemex and what Lula did with Petrobras.

The Central Eastern European countries share some of the potentials as well as the limitations of Mexico and Brazil. They have a growing share of high-volume production of complex components and, in contrast to the two Latin American countries, are rapidly progressing towards developing local suppliers. However, as identified by Guzik et al. in Chap. 15, they still maintain a semi-peripheral position reflected in limited decision-making and technological competences, despite having a broad base of R&D centres.

However, with the industry transition, they can and wish to play a more active role, and some governments identify this as an opportunity to break their dependence on oil. While the introduction of alternative vehicles and EVs is still limited, some countries already have a wide network of electrification in public transit, specifically in Poland and the Czech Republic. Furthermore, governments such as in Poland are beginning to unveil ambitious plans for EVs and alternative fuel vehicles, encouraged by the opportunity to end their dependence on petroleum. The Plan for Electromobility Development announced by the Polish government seeks to make the country *the motor for electrifying transport in Europe* and to decarbonize its economy in accordance with the Paris Agreement. In order to do this, it has set a goal for 1 million electric cars by 2025 and obligates localities to ensure that a minimum of 30% of their car fleet is electric. Poland also has its own companies, such as Solaris, Ursus and Solbus, that are gaining prominence in the bus market, and foreign companies are developing battery and component complexes for EVs in the country (e.g., LG Chem established the largest European lithium-ion battery factory in Poland, Guzik et al., Chap. 15).

Chinese, Indian and Japanese Cases

China and India do not only seek to follow the trajectory of South Korea but to surpass it. They have the market, are developing their own firms to assimilate knowledge and create an organizational branding from within to without—fulfilling the organizational hypothesis of the Aaker model—and are supported by government strategy. As Pries (Chap. 4) states, the future is open, but China is ahead in terms of markets and plans to be so in technology as well, to become the world leader in the radical transformation of the industry. This assumes taking the lead in both EVs and AVs, what they refer to as SmartEVs. In 2018, headed up by firms such as BYD, Beijing Auto and Roewe, the Chinese accounted for 1 million EVs in the market, half of the global market. Didi, its largest ride-hailing service, plans to have a million EVs in the network by 2020 and 10 million by 2028.

These are goals included in the “Made in China 2025” (MIC2025) industrial strategy (Wenten, Chap. 11), a plan to put the country ahead in 10 core technologies and to have EV makers selling 3 million green cars a year. The forecast for 2023 is for 6 million green cars, one-fifth of total vehicle sales, and for all vehicles on the mainland to be EVs by 2030.

In addition, the Chinese government has devised an action plan to dominate the next generation of networks, the 5G networks, which is anticipated to make a massive difference in device connectivity, Internet of Things, data generation, data analytics, latency, energy and cost savings, and intersystem capacities. This includes creating their own value chains and ensuring access to the global resources of lithium and cobalt for battery production as well as dominating the production of chargers. In terms of demand, they are working on consumer subsidies of up to USD $14,000, or half the cost of a basic EV. This will include free licences while the purchasing of licences for traditional vehicles is either prohibited or penalized. In terms of supply, all carmakers have been required to produce a certain number of EVs, thereby stimulating the formation of new ventures and inducing access to technologies. Hence, Tesla, BMW, Volkswagen and Ford have established new ventures in China, with the Tesla plant becoming the largest producer of batteries.

For its part, India has The Automotive Mission Plan 2016–2026, which aims to convert the country into a leader in shared mobility by 2030 and a global manufacturing centre. It aspires to be among the top three engineering, manufacturing and exporting hubs worldwide. In 2015, it created the Faster Adoption and Manufacturing of Hybrid and Electric vehicles in India (FAME India-I) scheme for EVs, which works on technological developments, demand creation, pilot projects and charging infrastructure (Nag and De, Chap. 12). To stimulate demand, subsidies are offered to consumers, and 11 cities have been targeted for the introduction of electric vehicles in their public transportation systems. Regarding technology development, funds for R&D and incubation centres have been established for start-ups and to finance the acquisition of cutting-edge technology for light weighting, engines, powertrains and auto electronics. The funds back tech transfers, joint ventures, acquisitions and buyouts.

In the shared mobility sector, Ola has created the Ola Mobility Institute that focusses on mobility as a service, the climate footprint of mobility innovations, skill development, job creation, transport-oriented urban planning and the digitization of mobility. Meanwhile, Tata, the largest producer in the country, has made inroads into alternative vehicles through joint ventures and the establishment of R&D centres in scientific parks in the DCs. It was responsible for the creation of the Mini CAT, the first vehicle to run on compressed air, using technology from the French MDI, and set up the Tata Motors European Technical Centre at the University of Warwick, in partnership with both the university and Jaguar Land Rover. It also bought a 50.3% holding in electric technology from Miljøbil Grenland/Innovasjon of Norway to launch the IndicaVE in Europe (Nag and De, Chap. 12).

The Japanese Automobile Manufacturers Association has developed a *Vision of Mobility for 2030*, outlining a new era of multifaceted mobility solutions based on AVs, EVs and connectivity (The Motor Industry of Japan 2018, online, http://www.jama-english.jp/publications/MIJ2018.pdf). Heim (Chap. 8) notes that due to the energy dependence of the country, the development of alternative propulsion systems is closely intertwined with energy policies, with the government playing a prominent role in regulating emissions and safety, as well as offering incentives to buy new energy vehicles. The question arises as to whether regulations should favour the use of public transport or provide incentives to further consolidate the EV market. The author identifies a disruption in the traditional business model as Japan's OEMs increasingly move towards outsourcing, including for the assembly of cars. For instance, while retaining technology design, Toyota has Daihatsu assembling their mini-cars. Furthermore, Japanese OEMs are faced with the challenge of managing the reduction of their internal market and reinforcing their strategy for external market penetration. In order to do this, achieving and maintaining their leadership in Asia, and particularly in China, is critical, particularly given the ever-increasing strength of competition from both the Germans and the Chinese.

Transition in the United States and Canada

As has been noted by Sweeney (Chap. 3), Canada is caught between government efforts to retain OEMs within the country and not become the next Australia, and their efforts to define the role the country will play in the industry of the future. Initiatives regarding new mobilities and EVs have, until now, been left to the efforts of local governments who see these as complementary to greener city and quality of life programmes. Such is the case of Vancouver and its *Greenest Action City Plan*.

The United States is perhaps the country with the most contradictions, conflicts and possibilities regarding the transition of the industry, now magnified by the Trump administration's conservative protectionism. Thus, the pioneering stance of the country in incentivizing the demand for EVs (with tax credits of up to $7500) and regulations regarding emissions and fuel economy regulations is now shrouded with uncertainty due to Trump's initiatives. The conflict over fuel efficiency standards is illustrative: on one hand, Trump is trying to freeze The Corporate Average Fuel Economy (CAFE) at the 2021 level of 37 mpg, while on the other, a group of local governments, headed up by the state of California, fight to maintain the 2011 agreement to reach 54.5 mpg by 2025 (Kleir and Rubenstein, Chap. 2).

Furthermore, scientific capacity and innovative forces continue to be important assets of the country. Tesla, to all practical purposes, is the leading company for EVs in the world, as are Uber and Lyft for ride-hailing services. Moreover, leading high-tech corporations, such as Google, Microsoft and Apple, appear committed to be actors in the transition and are operating large AV and connectivity projects, such as Waymo in Arizona and Bill Gates' project of articulation between new mobilities and intelligent cities. Meanwhile, GM and Ford are testing new business models and establishing alliances with newcomers to ensure their role as actors in a transformed industry of new mobilities with growing offers of EVs, AVs and ride-sharing (Covarrubias V. 2018). Ford is working on 13 new EVs, has allied with Lyft and has established Ford Mobility Solutions, while GM is working towards having 23 EVs by 2023 and maintains an alliance with Maven–GIG.

At the same time, however, GM and Ford have affirmed their decision to prolong their cost containment and deterritorialization strategies in the traditional industry and, stimulated by President Trump's energy policies, are returning to their strategy of strengthening the Sport Utility Vehicles (SUVs) and pickup segment, while leaving aside the compact autos segment.

Transition in Western Europe

Having lost its indigenous OEMs and the progressive withdrawal of the US multinationals historically playing a similar role (Ford and Vauxhall [GM]), the United Kingdom has become increasingly dependent on flows of FDI, particularly from Asian companies. The country is now suffering the consequences of the abandonment of industrial policy, and Brexit is putting into danger its role in the future of the industry, considering that it might give way to a massive exit of FDI, which came to have access to the EU market from Britain (Coffey and Thornley, Chap. 6). Even so, a set of government initiatives has defined the automobile industry as strategic with the aim to contribute to the greening of the industry and to finding areas of opportunity for the country in EVs and AVs. Particularly notable is the creation by the Labour government of the British Automotive Council as a deliberative body and subsequent automobile policy plans defining "the future of mobility" as the "grand challenge." Hence, these authors note that alternatives for the United

Kingdom may lie in mobility services in areas such as digital services, media services, liabilities, data ownership, privacy, cyber security and cross-border connectivity.

This return of industrial policy forums was simultaneous to the launching in France of the French Automobile Platform in 2009. Its immediate aim was, like in the British case, to tackle the impact of the crisis with the larger ambition of developing a long-term strategy to restore the competitiveness of the sector. Subsequently, a plan for developing and introducing clean vehicles was set up. Pardi (Chap. 5) shows that these initiatives have failed "because of a fundamental lack of coordination" and of "a shared industrial strategy" between the French government and OEMs. In May 2018, the government presented a plan for the development of AVs, which couples with initiatives of leading French firms such as Renault, PSA and Valeo to make inroads in this emerging field. Yet, as this author notes, it is unclear what its outcomes could be this time.

In Italy, likewise, Calabrese (Chap. 7) underscores the absence of an industrial policy as typical of the Italian lack of coordination between actors, and a government disinterested in promoting the transformation of the industry. There is no national programme for mobility policies and, given the traditional lack of collaboration between universities and industry, initiatives are largely individualized. FCA is significantly behind the development of EVs and AVs, and their initiatives have revolved around alternative drive systems for the global Jeep Renegade project (Calabrese, Chap. 7). The most recent sale by FCA of its first-tier supplier Magneti Marelli to the Japanese group Calsonic Cansei has created great deception among trade unions favourable to an active industrial policy at the national and European levels like the FIOM–CGIL.

However, in Italy, like in Spain, suppliers are major actors in the national automotive sector. Still, the Spanish case is paramount of systematic policies of regional clusters pushed forward by local governments. The most famous of all is the automotive cluster from the Basque Country, which is the home of three of the four largest 100% Spanish automobile suppliers: GESTAMP, CIE Automotive and Mondragón Corporation. The fourth is the Antolin Group from Castilla y Leon. These policies bring together OEMs, suppliers, trade unions, universities and service industries to focus on R&D and profit from the presence of these companies.

Despite the shortcomings of the above cases, led by Germany, the EU is investing more in automotive R&D than anywhere else in the world, and German OEMs are registering more patents and hiring the most R&D engineers. VW is at the forefront, focussing on their EV portfolio, engines, lightweight materials, digitalization and toolkits. It has also partnered with *QuantumScape* to develop batteries. The challenge now facing VW is its great dependence on the Chinese market, where it currently sells more products (42%) than in Europe.

Pries (Chap. 4) elaborates on the main proposals of EU countries and the European Automobile Manufacturers Association. As detailed in CARS21 strategy, they are sustainable propulsion; safe, smart and integrated mobility; and affordability and competitiveness. Then, by 2017, the European Commission announced the GEAR 2030 strategy to foster the competitiveness and sustainable growth of the industry in Europe. It seeks to tackle the problem of "deep incompleteness" that specialists have pointed out in previous strategies (Jullien et al. 2014). In this sense, it is based on working groups including the main stakeholders of the industry to enable a systematic follow-up of goals, actions and outcomes. Such a new approach relates to the Diesel-gate scandal as it casted doubts on the capacity of the industry to self-regulate and confront the epochal challenges, and showed the necessity to associate other sectors affected by the goals zero-emissions vehicles (ZEVs) and connected-automated driving (European Commission, GEAR 2030: Final Report 2017). Since the report was published, there have been concrete steps in the constitution of the European Skills Programme (DRIVE-Development and Research on Innovative Vocational Education Skills) and the European Battery Alliance and a Strategy for Connected and Automated Transports. Targets for CO_2 regulations and ZEVs are also to be agreed upon.

Last Remarks

We identify the current transformation of the AI as an epochal one, meaning a socio-technical transition. It implies that changes not only affect the technological trajectory, but all the structures of value propositions, policies and regulations, profit models, technical capabilities and industry mindsets that integrate an industrial regime. The transition responds also to the deep changes in the underlying economic geographies and power geometries, including government positions, where private and public stakeholders interact. Various forces come into play that can radically reorient the industry. Socially, there is an accentuated demand for more efficient systems for accessing and connecting people and goods and increasing regulations for the protection of the environment. Technologically, a new avenue has opened up with the advances in new propulsion systems, particularly regarding EVs, which suggest a future free of the carbon footprint that is the ICE fuel oil legacy. However, another, as yet unmeasured, avenue stems from the multiple possibilities that have opened with the total autonomy and connectivity that feed the digital revolution. Automobiles have evolved into increasingly more complex machines and receptors of new and better high-tech content that improves safety, performance and efficiency. At the same time, a gamut of new players is appearing and making inroads into the industry, with more value passed to the supplier side and towards non-auto industry sectors, including Information and communications technology (ICT), chemicals, service supplier integrators and data analysis, among others. Geographically, the axes of the industry have moved to ECs. From a product life cycle viewpoint, these tendencies are predictable as, after a century of automobilities, demand for cars is declining in DCs, while the cycle is restarting in the ECs—where markets are virgin—or being reinvigorated. Chinese, Indian and Korean firms already account for nearly a fifth of the traditional vehicle production and more than half of alternative vehicles, EVs and others. Furthermore, half of the market for these emerging technology vehicles is already in China. These factors interact to create a new geometry of power in the industry.

As a result, the industry and its actors are in a hectic period of experimentation which, according to dialectic issue life cycle model, is the phase that precedes a radical transformation. It is understandable as the issues at stake are paramount. The automotive industry generates more wealth than dozens of countries put together and offers extraordinary leadership possibilities for those who dominate. Moreover, given that the automotive industry has been charged with structuring the contours of digital economies and intelligent cities of this century, much like it did with the industrial society of the last century, it should be no surprise that the battle to control and dictate its future course is a sordid and turbulent one.

Traditional OEMs are adjusting their mainframes and narratives of the industry, and no firm today would claim to produce only automobiles, but rather to provide mobility solutions. While each may have a different emphasis, all are offering alternative systems of traction, increasing levels of autonomous technology, connectivity, and business and labour models of ride- or car-sharing. Labour organizations struggle to remain afloat as jobs follow the geographical footprints of the industry and firms extend cost-containment strategies in both old and greenfield settings. Labour unions also adjust their mainframes and work on building international networks and pattern bargaining to counterbalance multinational global resources.

In the midst of these tendencies, government policies take on greater prominence. On the one hand, from a public value and public purpose perspective, the role of the entrepreneurial state grows under critical junctures like the one the AI is experiencing as its resources to act as the investor of first resort become critical. In all the main jurisdictions of the AI, all the contributors of this book show, the state is taking an active role to retain the traditional industry and/or define the coming one. Indeed, the plans, programmes and strategies of governments related to the sector increase continually in depth and breadth. And while oil rich countries and legacy firms look for actions that extend the life of the old ICE fuel oil paradigm, dependent oil countries and newcomers ask for government actions that can expedite the transition to a new one and assure them a better position in both domestic and international markets.

Even in the ongoing battles and negotiations surrounding the US–China trade war, the Brexit, the NAFTA 2.0, among others, the AI and its transition play a role.

On the other hand, in ECs, the state has a legacy of intervention in structuring the productive and social life in its jurisdictions so that its weight in the transition of the industry is greater vis-à-vis that of firms and labour. This fact and the fact that ECs' rising demand, led by the

Asia, is progressively re-shaping the course of the industry are amounting to an additional structural change. The size and resources of these players are progressively enabling them to rely upon their domestic markets and affect the existing global value chains while advancing their own industry and firm networks.

Thus, while nothing is yet certain, it can be anticipated that at least a part of the new institutional arrangements, technologies and labour and business models will have an Asian tint. Still, the final determination of the new paradigm of the industry will be a product not only of technical decisions but also of government actions and policies, as well as the mediation of worker organizations. As Piore and Sabel noted more than three decades ago (1984), each new industrial division has been a product not only of battles and new technological arrangements but also of political and labour ones. And this time will be no different.

Notes

1. See Business Insider (Garfiel, Leanna) (February 2, 2017). "12 major cities that are starting to go car-free", online, https://www.businessinsider.com/cities-going-car-free-2017-2.
2. Measured by the units produced, that in the language of the industry, translates as productive leading edge.
3. In 1977, Japanese car imports reached two million units. Demand for these vehicles grew with the rising oil prices. Arnholt, Mike et al. (Arnholt et al. 1996) captured the feeling in the United States at the time in "Foreign invasion: Imports, transplants change industry forever", WardsAUTO, online, https://www.wardsauto.com/news-analysis/foreign-invasion-imports-transplants-change-auto-industry-forever.
4. A CAR (2018) study provides extra data: in 2017 Ford, GM y FCA provided 46% of vehicles sold in the United States, using a formula of producing 31% of the cars and importing the remaining 15%.
5. In 1980, the Detroit Three had 56 plants in the United States. In 2010, this had reduced to 19 (Covarrubias V. 2014).
6. As it is well known, the bailout of GM and Chrysler was an unprecedented financial operation in the history of the industry, reaching around $80 billion of public funds. Having unleashed a mammoth restructuring

process between 2005 and 2006, Ford could avoid bankruptcy. Yet, Ford itself strongly advocated for the rescue of other firms as their bankruptcy would seriously threaten its own survival and received a $5.9 billion loan from the Energy Department. It was an extraordinary event showing just how interconnected the American industry was.

7. For purposes of estimation, the Renault–Nissan–Mitsubishi alliance is divided in two.
8. The study considers two additional variables that are beyond the scope of this study, namely exchange rates and energy costs.

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[1] Note: Page numbers followed by 'n' refer to notes.

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