

OM Forum -- Benchmarking Global Production Sourcing Decisions: Where and Why Firms Offshore and Reshore

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Abstract

Problem definition: Manufacturing firms are undergoing re-structuring defined by a collection of adjustments and decisions, which affect the source and destination of manufactured products throughout the firm's global supply chain network. We report on a comprehensive picture of manufacturing sourcing on a global basis.

Academic / Practical Relevance: With dynamic changes in global economic, political and technological conditions, the design of global supply chain strategies has become critically important for executives, and has great potential for Operations Management (OM) research.

Methodology: Our work is based on a global field study conducted in 2014 and 2015 among leading manufacturers from a wide range of industries. The data set has the distinguishing feature of reflecting actual decisions that the firms made recently (during the last 3 years).

Results: Companies are currently restructuring their global production footprints. The majority of firms engage in offshoring. Reshoring does occur but seldom for corrective reasons. China remains the most attractive site for production sourcing, followed by Eastern Europe and Southern Asia. Manufacturing continues to decline in the developed economies of Japan and Western Europe. We observe that while North America may be at the cusp of a manufacturing renaissance, such a change is not just because of reshoring by domestic firms. Labor cost no longer dominates manufacturing location decisions, rather, firms decide based on complex trade-offs among a variety of factors. Finally, firms localize production in developed economies and use developing economies as production hubs.

Managerial Implications: Our goal in this paper is to inform both managerial policy decisions and the academic research agenda by developing insights on managerial practices that concern production sourcing and on the factors that drive such decisions. We develop hypotheses concerning how firms make these strategy decisions and we discuss implications for analytical and empirical research.

Keywords: manufacturing location decisions, offshoring, reshoring

1 Introduction

The globalization of manufacturing is well established in many industries and has led to a high level of interaction throughout global supply chains. Recently, however, there has been a negative reaction to globalization based on the uneven distribution of its benefits. While many in developed economies now have access to lower cost products, many others have lost their jobs and have seen their prospects for economic advancement diminished. The discussion on how to deal with the globalization of manufacturing has become highly politicized, with some politicians and political candidates in the US and other developed economies promising to restore lost employment and industrial activity. Although many commentators have expressed doubt that such promises will be fulfilled, the debate on what governments should do has intensified. For example, following the 2016 US presidential election, the new administration has focused on providing incentives to firms to remain in the US and to reshore,¹ while the UK's decision to leave the EU has led politicians to pressure firms not to offshore from the UK. This discussion has expanded to include the growing role of automation in manufacturing and its potential to reduce future job growth and modify capacity decisions.

There is much confusion and disagreement about whether and how firms should respond to such political pressure as well as to changes in the global business environment (i.e., potential modification of trade treaties such as NAFTA, changes to corporate and border taxes, or shifts in labor costs in certain countries). A recent survey by the Boston Consulting Group found that more than 30% of US manufacturing executives said their company was embarking on expansion of manufacturing capacity in the US, while only 20% said that their company was expanding in China (Sirkin et al. 2014). On the other hand, AT Kearney used aggregate economic data to conclude that offshoring is occurring at a higher rate than reshoring (van den Bosche et al. 2014).

Globalization is a concern central to operations, and thus the OM research community has an opportunity to contribute to one of the core issues of our time. In recent years, the operations literature has looked at these issues from multiple perspectives. Similar to other empirical studies we analyze an empirically grounded data set concerning the status of global supply chain sourcing for manufacturing, based on a recent survey of a diverse sample of global manufacturing firms.² However, our data set has the distinguishing feature of reflecting actual decisions that the firms made recently (during the last 3 years). This decision-based approach contrasts with typical surveys conducted in recent years, that are based either on the responses of specific individuals who are asked to speak to their firm's plans and intentions, or on aggregate volumes of imports and exports of manufactured goods. Other related but incomplete sources are company announcements and press

¹ We define *reshoring* as an increase in production volume in the region where the business unit's headquarters is located.

² The benchmark survey is available upon request from the authors, and its descriptive results are presented in a companion report (Cohen et al. 2016).

releases that typically present a limited amount of information and may have a public relations motive. Our results confirmed that a significant wave of restructuring of global supply chains is indeed in progress. Our response data allows us to address the following questions.

1. To what extent have global production sourcing networks changed over the last three years?
2. Has the offshoring or reshoring activity of firms increased or decreased over this time frame? What are the major drivers of the observed change?
3. What role do the three main manufacturing regions (North America, Western Europe, and China) play in the re-structuring of global production sourcing? Which regions have attracted manufacturing investments, and which have seen divestment? What are the drivers of these changes? How do these results vary by industry?
4. What is the role of developing economies, i.e., Southern Asia and Eastern Europe, in the global sourcing of production? What changes have arisen over the last three years? What factors can explain these observations?

Our observations revealed a pattern of changes that reflects the widespread re-structuring of manufacturing supply chains that is underway, on a global basis, derived from complex trade-offs among factors that may include but are hardly limited to labor cost. This re-structuring is defined by a collection of adjustments and decisions, which affect the source and destination of manufactured products throughout the firm's global supply chain network as well as the use of technology. These changes are occurring in every industry we surveyed. While we are able to validate expectations, some of the results of our survey are surprising, i.e., China is still the most attractive region for production sourcing, followed by the countries in Eastern Europe and Southern Asia. Whereas Japan and Western Europe suffer from a net outflow of production volume, manufacturing in North America is actually growing – but not because of reshoring by American companies.

Our goal in this paper is to develop insights that inform both managerial policy decisions and the academic research agenda. We believe that the detailed and comprehensive picture of global manufacturing sourcing that emerges from our survey is especially relevant to OM research, which has a long history of analyzing global supply chain strategy as well as developing optimization models to support manufacturing planning and control.

At the managerial policy level, our analysis of the data, in particular, illustrates how industry and product factors are especially relevant for understanding the observed pattern of global sourcing adjustments. These results, enabled by our decision-focused survey methodology, identify specific tradeoffs, risks and constraints derived from both resource and policy considerations, which firms report to be important in explaining the drivers of their actual global sourcing decisions. These insights suggest new model formulations for optimizing a firm's global supply chain strategy and for analyzing manufacturing sourcing policy questions. Our observations also provide evidence concerning adoption of automation and investment in R&D in different industries and geographies.

Analysis of the results leads us to several hypotheses about the drivers of these decisions and the potential impact of environmental factors. These hypotheses could be tested in further empirical and analytical studies. While we do not claim to have developed a causal model of global sourcing that generalizes across multiple industries and geographies, we believe our results provide direction to ongoing research in both the OM and policy domains.

At the academic research level, our research addresses the gap between current theory and the empirical issues of offshoring and reshoring relevant for practice in global manufacturing sourcing strategy. Moreover, this research has led to methodological insights concerning empirical research in strategic domains such as global sourcing. Finally, our research is informative with respect to corporate decision making for global supply chain sourcing. Specifically, we observed firms are making such decisions based on analysis of tradeoffs and risks and not on individual criteria such as labor cost differences (e.g., US vs. China).

Additionally, our study is distinguished by the nature of our sample, which yields an unprecedented depth of information that enables wide-ranging observations of how individual firms are modifying their global supply chains. More specifically, we gathered data from a global sample of leading firms in multiple manufacturing sectors, and respondents shared comprehensive details concerning their individual production sourcing decisions.

Decision-specific responses provided information at the product (group) and location level. This data allows us to take an exploratory perspective similar to "grounded theory" research so that we can better understand, unbiased by preconceived notions or hypotheses, how executives think about location decisions and technology investments. Our approach is thus closer to the theoretical sampling typical of case study research than to statistical sampling (Eisenhardt 1989). Although the size and selection of this sample preclude generalization of our results, the rich information content leads to conclusions that are consistent with the current global manufacturing landscape and informative for the ongoing policy debate. Hence, we view this research as a field study into recent production sourcing decisions that is relevant to all companies who are engaged in global manufacturing.³ Finally, a key purpose of this paper is to guide the OM community on the challenges and opportunities associated with conducting research on global supply chain sourcing strategy. Accordingly, we develop recommendations to inform the OM research agenda.

The rest of our paper is structured as follows. Section 2 reviews the literature including prior empirical and analytical work. We then explain our methodology in Section 3. Section 4 overviews the production sourcing and re-structuring decisions made by our respondents. We contrast *offshoring*, which consists of locating manufacturing operations in regions other than where the business unit is headquartered, with *reshoring*, which is the relocation of manufacturing operations

³ Our sample includes four of the ten largest automotive OEMs, two of the ten largest electronics companies, and two of the ten largest engineering firms.

to the region of a business unit's headquarters. We describe these two sourcing strategies in detail and explore them further by identifying the drivers of decisions to invest or divest in the particular manufacturing regions. We also discuss several other sourcing strategies observed in our sample. Section 5 introduces hypotheses suggested by the observed pattern of decisions and the implications for OM research and global supply chain model formulations.

2 Literature Review

The study of manufacturing sourcing has generated a vast literature with contributions from multiple disciplines. See Mihalache and Mihalache (2016) for a recent review of the past 25 years of academic research in this area.

Both anecdotal evidence from business press articles and empirical evidence presented by scholars in the field suggest that companies are indeed reconfiguring their supply chains and global manufacturing footprints. We reviewed publications from academics as well as professional associations and management consulting firms researching recent decisions on the configuration of global supply chains. We find results that are consistent across these publications, yet also findings that seem to be idiosyncratic to the underlying sample. Across the publications, we observe a tendency to base analyses on the total pool of decisions taken by a firm and not individual decisions, which constitutes the key differentiator between these studies and ours.

This section briefly discusses three of the principal streams, i.e., strategy frameworks, analytical modeling, and empirical studies, devoting the most space to the third since this paper falls primarily into that category.

2.1 Strategy Frameworks

The theory of industry competitiveness (Porter 1990, 1998) highlights the benefits to a firm of being located close to its peers that perform similar activities and the consequent lively ecosystem of enabling resources ("industry clusters"). The eclectic paradigm is a comprehensive framework for explaining the entry mode choices of multinational enterprises (MNEs), (Dunning 1980, 1998, 2000). Internalization theory (Buckley and Casson 2009) explains the behaviors of MNEs from the perspective of setting the boundaries of a firm and utilizing location-specific advantages. Rugman and Verbeke (2009) review the literature on the interactions between the location advantages and the competitiveness of MNEs. Faeth (2009) reviewed the international business (IB) literature, and concluded that determinants of foreign direct investment (FDI) by MNEs cannot be well explained by any individual one of the existing theories.

Finally, we point out that the Theory of the Firm literature's analysis of the timeless question of make-vs.-buy (i.e., outsourcing), which specifies the organizational boundaries of the firm, can also speak to the choice of geographical boundaries that is intrinsic to offshoring decisions (McIvor 2013). Branches of this literature include transaction cost economics (Williamson 1975), the resource-based view (Wernerfelt 1984), and the knowledge-based view (Kogut and Zander 1992,

Grant 1997).

The work noted above tends to use exogenous variables of either a firm-specific, industry-specific, or a country-specific nature. The resulting insights have been very important for the framers of government policy, but have had less impact on actual strategy formulation or implementation of sourcing policies by firms.

2.2 Analytical Modeling in OM/OR

The operations management and operational research literatures provide conceptual and mathematical models to account for manufacturing location decisions in international manufacturing networks (for reviews, see Melo et al. 2009, Cheng et al. 2015). Mathematical models (e.g., Cohen and Lee 1989, Dong et al. 2009, Lu and van Mieghem 2009, Wu and Zhang 2014, Chen and Hu 2017) tend to focus on optimal production network configurations under specific circumstances, whereas conceptual models (e.g., Kouvelis and Niederhoff 2007) organize the factors relevant to decisions about global production sourcing.

We note that the OM/OR analytical literature contains models that are framed at various levels of detail and are positioned over a range of planning horizons. These models also incorporate various decisions taken from the hierarchy of decisions associated with global sourcing. It has been our experience that these models are rarely implemented or are not used directly to support analysis of company-specific decisions. Rather, it seems that companies have adopted more basic approaches to developing the business case for a contemplated structural or policy change associated with global sourcing. The data collected for our study suggests that this may no longer be the case.

2.3 Empirical Studies

Most of the studies find evidence that companies are indeed reconfiguring their supply chains (O'Marah and Lee 2013, Accenture 2014, Chen et al. 2015). Yet, while Kinkel and Maloca (2009) observe offshoring decisions to Eastern Europe and China, O'Marah and Lee (2013) argue that China has lost its appeal as an offshoring destination and that countries in Southeast Asia are becoming an attractive alternative. The same study further observes decisions to nearshore manufacturing to the US and Mexico, which is supported by the findings of Ellram et al. (2013) and Accenture (2014). In contrast, van den Bossche et al. (2014, 2015) conclude that reshoring to North America is not happening to a large extent, something that Kinkel and Maloca (2009) confirm for Europe as well. A recent study by Goldman Sachs (Delaney et al, 2017) reports that, for the first time, foreign direct investment (FDI), by Chinese companies into the US has exceeded the investment of US companies into China.

Just as the literature reports a wide range of trends, multiple studies document a move beyond mere labor cost comparisons to decision drivers such as proximity and access to markets, risk resilience, and supply chain flexibility (Kinkel and Maloca 2009, Simchi-Levi et al. 2012, Ellram et al. 2013, Chen et al. 2015, Delaney et al. 2017). Yet, there is still evidence for cost-driven offshoring, especially to Eastern European and Asian countries (Kinkel and Maloca 2009, O'Marah and Lee

2013). The factors driving decisions vary by region (Kinkel and Maloca 2009, Ellram et al. 2013, O'Marah and Lee 2013, Chen et al. 2015), over time (Ellram et al. 2013, Gylling et al. 2015) and by industry (Delaney et al. 2017).

The decision to reshore has received special attention in recent empirical research (Tate 2014). Some interpret reshoring as a corrective action, i.e., an attempt to remediate an earlier location decision that turned out badly (Kinkel and Maloca 2009, Gray et al. 2013, Fratocchi et al. 2014). However, others argue that such a shift in production might actually be an appropriate response to a changing business environment (Martínez-Mora and Merino 2014, Tate et al. 2014b). Comparing total manufacturing costs across the globe, the Boston Consulting Group concludes that the formerly substantial cost gap between developed and developing countries – in particular, between the United States and China – has diminished to the extent that some products may actually be cheaper for American firms to produce domestically (Sirkin et al. 2014). The same trend is emerging in other regions (Treville and Trigeorgis 2010).

Sirkin et al. (2014) explain this development by changes in productivity-adjusted labor cost, currency appreciation and rising energy costs in many developing economies, and by increases in oil prices and hence in transportation costs. As a result, the factor that for the past 25 years has pushed production offshore – namely, labor cost – may now be responsible for the reshoring of production volume.

The empirical studies reviewed here have identified different aspects of global production sourcing decisions and observed a diversity of motivations. Nevertheless, we believe that the particular perspective on these decisions taken in this paper, i.e., analyzing individual production sourcing decisions of a global sample, is new to the literature. Further, most empirical studies have a rather narrow geographic focus and are limited in their ability to track shifts of production volume. As far as we know, ours is the first study that maps current production sourcing decisions of a global sample and also ties them to the drivers of decisions at the individual level. While our sample size does not warrant generalizability of our results, we believe that the sample and the way the information was captured nevertheless allow for unique insights into how these decisions were made. These insights have led us to formulate hypotheses about trends in global production sourcing and their decision drivers, which subsequently could be tested through empirical or model-based research.

3 Data Description

3.1 Data Gathering

We collected data during 2014 and 2015 using a questionnaire administered on-line and by mail. This instrument enhanced the questionnaire developed for a predecessor study in China (Chen et al. 2015). Respondents provided information about specific production sourcing decisions and the resulting volume changes within the company's manufacturing network. We also asked about the business unit, the product, the importance of different decision drivers, and the current sales and

production footprint. Given the scope and depth of our questions, respondents were required not only to gather data from multiple sources but also to obtain the clearance needed for sharing highly confidential data. The data set is described in detail by the on-line companion report (Cohen et al. 2016), which illustrates the nature and depth of the information obtained. The questionnaire is available upon request from the authors.

Each firm responded for a single product category, indicating how the production sourcing changed across regions over the preceding three years and also identifying the main drivers from a list of 24 possibilities. Thus, the unit of analysis in this study is the firm's product-level decision. If instead the survey had asked for data at the level of the firm, responses would reveal only volume changes aggregated across multiple product categories. That approach would have obscured the reasons why, for example, a firm simultaneously increases the production of one item in a given region while decreasing the volume of another.

The questionnaire was distributed to the professional networks of this paper's authors, to selected customers of our industrial partner Avnet, and to a list of the largest manufacturing firms in Europe and Japan. We promised strict confidentiality. Invitees were incentivized by offering both early access to our analysis and an invitation to participate in a round-table conference with the research team and representatives of fellow responding companies.

3.2 Sample Profile

We received 85 completed questionnaires but omitted the 11 that did not report any changes in production sourcing. Even though the omitted data did reveal something about the extent of supply chain restructuring, we could not use them to enhance our understanding of the decision drivers. Thus, our final sample consists of 74 respondents. These respondents of record were supply chain executives (68% at the Vice-President level or higher) but in all cases the inputs were collected from multiple sources within each company. Table 1 shows the wide range of industries represented. Most of the companies were based in North America (37%), Europe (31%), and Asia (28%). The respondents span different stages of the value chain, including the raw material and basic component stage (7%), the lower tier assembly or processing stage (5%), the first-tier assembly or processing stage (24%), and the final product stage (64%).

Table 1: Respondents by industry (n=74)

Industry	Absolute	Relative
Automotive	11	15%
Capital Goods	10	14%
Consumer Goods	13	17%
Information Technology	12	16%
Machinery	14	19%
Other	14	19%

As noted, we have defined *reshoring* as an increase in production volume in the region where the business unit's headquarters is located, following the definition of domestic manufacturing given by

Brush et al. (1999). Although a focus on the location of headquarters can be misleading – because of practices such as tax inversion (see Tsay 2014) – in our sample it is an appropriate choice with respect to most respondents: the location of headquarters usually corresponds to the firm's historic origin or the region of operational focus (or both). We define reshoring in a wide sense to include all investments in one's home region; the reason for this approach is that an investment at home, even without a reduction in offshore production volume, still alters the firm's balance between onshore and offshore manufacturing. We must point out that this definition of reshoring does not include second-order effects, i.e., when a component supplier follows a customer into an offshore region. Our results should thus be interpreted accordingly.

4. Results and Observations

4.1 Changes in Global Manufacturing Footprints

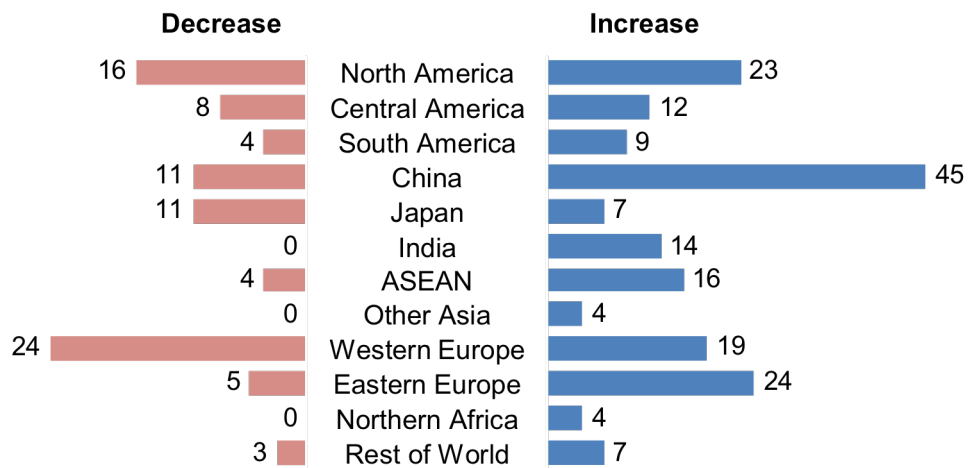
In this section, we present observed changes in global manufacturing footprints derived from the survey data. In particular, our sample (of 74 companies) confirms anecdotal evidence that across all industries and firm sizes, companies indeed are restructuring their supply chains by investing and divesting in production capacity. We divide the results into four categories. First, "Supply Chain Restructuring" captures the resulting changes in production per region. Second, "Offshoring and Reshoring" explains the imbalance observed across the sample regarding the two ways of evaluating the restructuring observed. Third, "Reloading versus Rebalancing" is a way to explain the nature of the changes in manufacturing capacity decision. Finally, "Natural Hedging" reflects the degree of co-location of sales and production in a region. Consistent with all other prior studies, we report our results based on the percentage of the respondents in the sample.⁴

Supply Chain Restructuring. To answer our research question about current manufacturing location decisions, we compiled descriptive statistics related to whether or not a firm has increased and/or decreased production volume in a region (Figure 1). As expected, China remains the most attractive region for production sourcing. Almost half of the 74 sample respondents (45%) reports investments in manufacturing in China, while only 11% of the sample decreased their operations in that country.

Across the sample, we distinguish between developed and emerging (a.k.a. "developing") economies. Emerging economies, which include China and India as well as ASEAN and Eastern European countries, clearly exhibit a surplus of investments over divestments. For example, nearly five times as many respondents reported increasing their production volume in Eastern Europe (24%) as reducing it (5%). The situation is different for developed economies (North America, Japan, and

⁴ We note that this approach treats all companies with equal weight. Alternative weights could be based on factors such as the size of the factory workforce or the dollar amount of production or sales in order to report the inflow and outflow between different regions. Since our responses are based on specific decisions for a particular product group, instead of the firm as a whole, such detailed workforce or dollar amount information on production and sales flows was not available.

Figure 1: Percentage of firms changing production volume per region



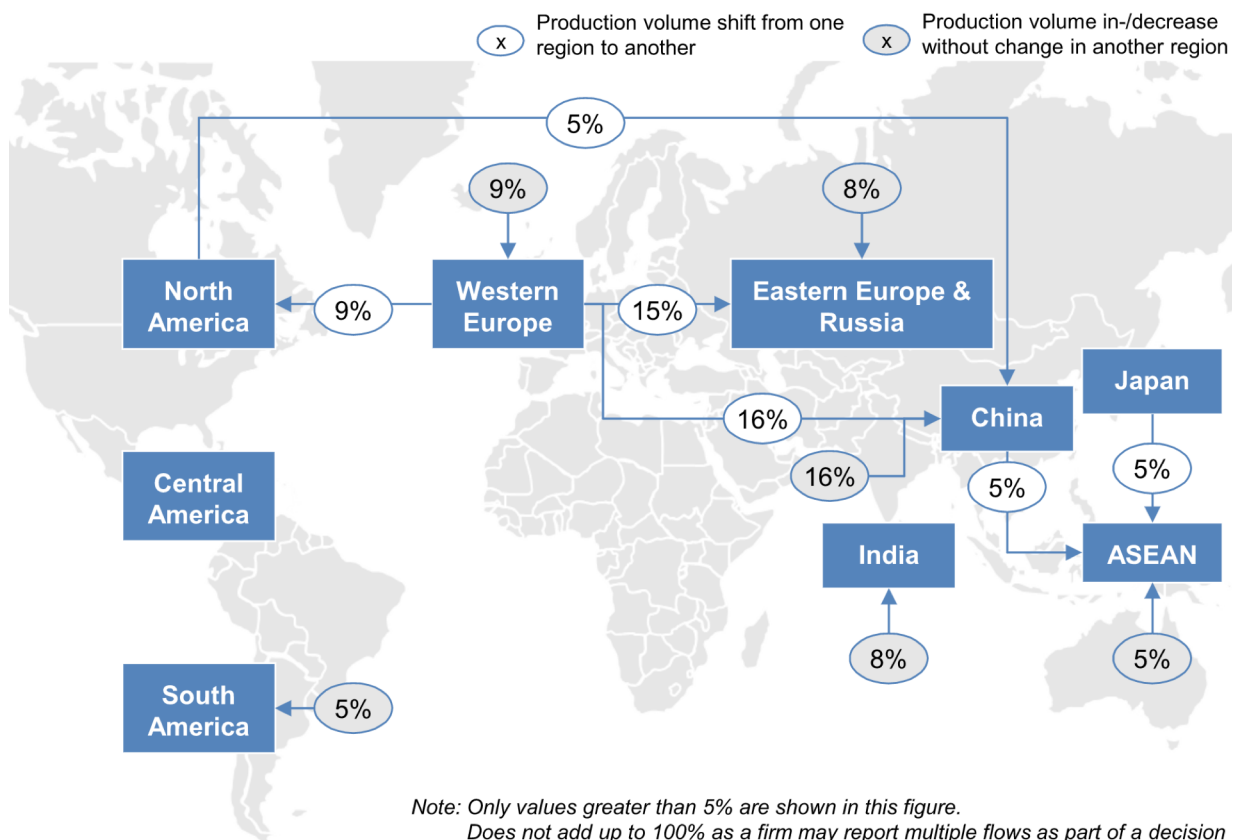
Western Europe), where the number of firms increasing their volume is roughly comparable to the number reducing. Only in North America is there a surplus of investments over divestments – a modest indication of Sirkin et al.'s (2012) postulated resurgence in US manufacturing.

Figure 2 captures the flows of production volume among the regions of the world. The numbers indicate the percentage of respondents in the sample that decrease production volume while at the same time increasing production volume in another region. For example, 9% of the 74 sample respondents report a decrease in production volume in Western Europe and at the same time an increase in production volume in North America. Hence we consider this to be a “flow” of manufacturing sourcing from Western Europe to North America. An interesting observation is that there is no dominant strategy for production sourcing decisions. While there are stronger and weaker flows of production volume between regions, currently there is a complex and diverse pattern of production volume flows that is occurring on a global scale.

While evaluating the flows of production between regions, we note that the largest flows into any region are those into China, and the largest outflows are those from Western Europe. Notably, the flow from Western Europe to China is the largest flow observed between any two regions, and 16% of the sample respondents include a shift of production volume from Western Europe to China. An equally sized reloading flow was observed into China with no simultaneous volume decrease in another region. These firms grew their global manufacturing capacity by investing in China. While 5% of the sample respondents shifted production volume from North America to China, an equal number of respondents shifted production volume outside of China to ASEAN countries.

Eastern Europe & Russia is the region after China for which the most respondents reported an increase in production volume. Of the 24% of the sample that reported investments in this region, the majority, 15% of the entire sample, are associated with a shift of production volume from Western Europe. Another 8% of the sample reload and invest without reallocation.

Figure 2: Flows of production volume between regions (Percent of sample)



Offshoring vs Reshoring. Results indicate a significant difference between offshoring and reshoring. Of our sample firms, 76% engaged in the offshoring of production, i.e., investing in nondomestic production, and 32% of them have reshored production. Reshoring is thus conspicuous in our sample and is reported by almost a third of the respondents, although the incidence rate differs by region. We find that the share of reshoring firms is highest among Western European companies: 36% as compared with 28% and 26% respectively for Japanese and North American firms. This difference is not statistically significant but it does show that reshoring is not solely an American phenomenon – despite receiving the most media attention.

Reloading vs. Rebalancing. As noted earlier, some regions are gaining ground by expanding their manufacturing activity while others are losing ground. We identified two types of manufacturing capacity decisions: *reloading* and *rebalancing*. Both can include reshoring or offshoring, but under reloading, firms have either added or removed production capacity across the global regions in order to achieve a more profitable footprint (i.e., the gain of production in one region is not associated with a loss of production in another). Under rebalancing, firms have shifted production from one region to another. We can think of this activity as a zero-sum game, i.e., one region's gain is another region's loss. Figures 3 and 4 indicate how these two strategies are adopted across the different regions and industries respectively.

Figure 3: Changes in production volume per region (Percent of sample)

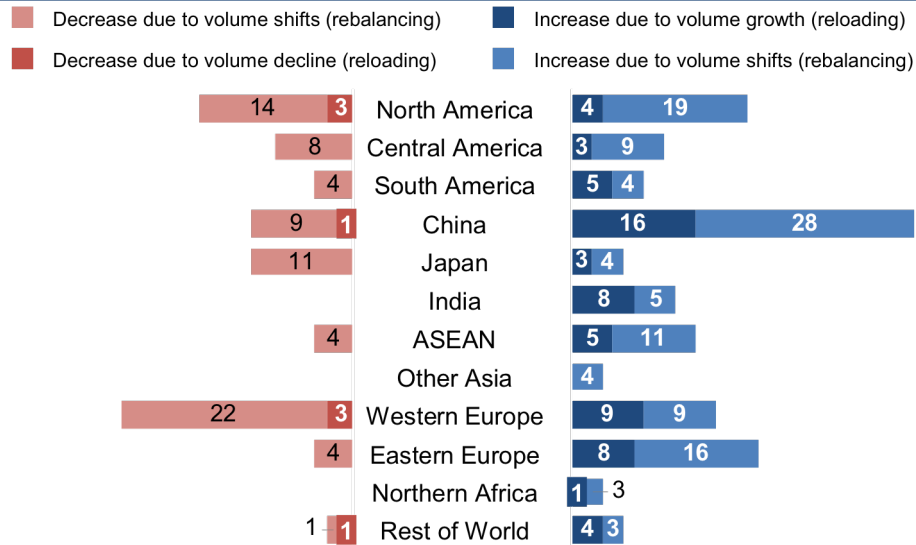
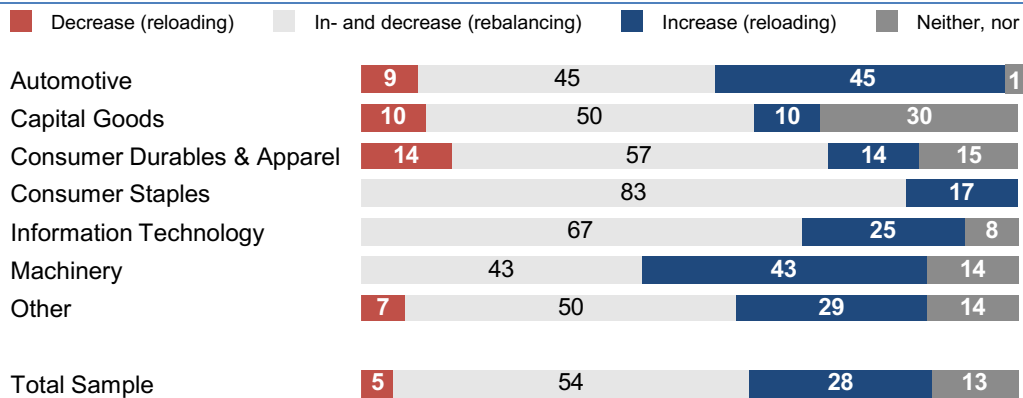


Figure 4: Changes in production volume by industry (Percent of sample)

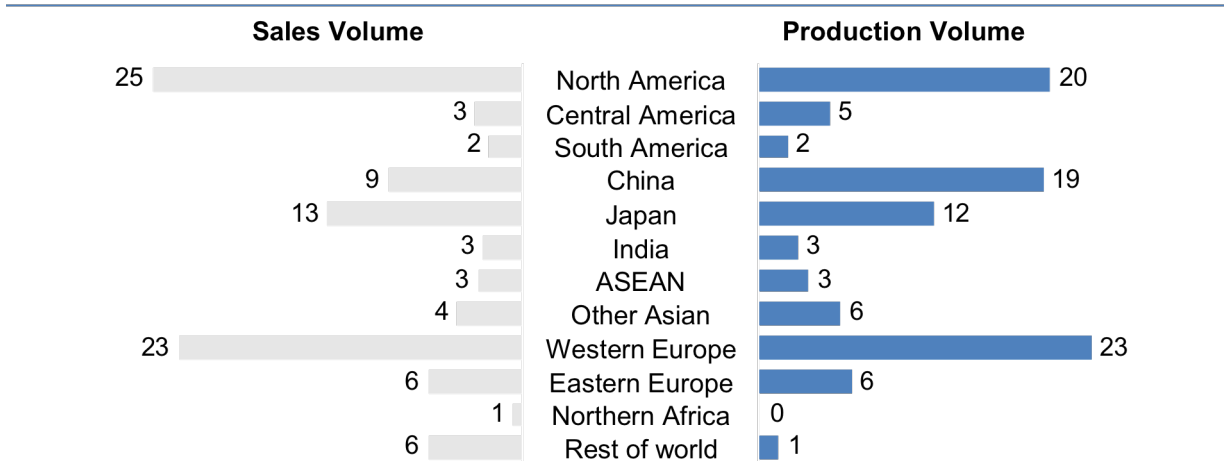


Across the sample, we observe that rebalancing dominates as shown in the figures. This is especially true in China, North America and Europe, where a large share of investments can be classified as rebalancing. China, Europe and India also show a relatively high share of reloading investments associated with volume growth. For divestments across all regions, the vast majority is due to rebalancing. Only a few firms in our sample decreased their global production volume.

The pattern of changes to the global allocation of production volume shows a distinct variation across industries. While as many of the automotive and machinery firms in our sample reloaded (production volume increase) as rebalanced, rebalancing prevails for firms in other industries in the total sample. In three industry groups – consumer staples, IT, machinery – no reloading due to a volume decline is observed. Overall, capital goods firms appear to be the least active in changing the allocation of production volume: 30% of the sample did not engage in changing their production footprint at all but rather invested in automation or R&D.

Natural Hedging. We define natural hedging as the condition under which the share of production and sales volume is balanced, i.e., to which degree production and sales activities of a firm are co-located in a region. A perfect natural hedge occurs when for a firm in each region local

Figure 5: Share of global sales and production volume per region in 2014



production equals local sales. As we can see in Figure 5 for most regions, e.g., Western Europe or Japan, the share of production and sales volume is balanced on the level of our total sample, i.e., when averaging across all sample respondents. For example, on average, 20% of production occurs in North America while 25% of product is sold in the North America market: a mismatch of just -5%. However, for China local production volume is more than twice that of local sales volume. Much of what our sample produces in China is thus exported. This finding is in line with the offshoring activities of the past decades. Similarly, given the fact that many North American companies engaged early in large-scale manufacturing offshoring to China, it is not surprising to see that in North America more is sold than produced.

At a more granular (i.e., firm) level, we observed that despite the fact that all of the companies in our sample, whether small or large, engage in international business, many companies rely heavily on their home regions – defined as the region where the business unit’s headquarters is located – for sales and production. Across the sample, we observe that a company's home region is in most cases not only the largest market but also is the largest manufacturing source. The regions where the business unit’s headquarters are located account on average for 44-64% of sales and 31-77% of production volume. North American firms seem to depend the least on their local market. From the total of sales volume of 25% for North America, we see in Figure 5, 44% occurs in North America while only 31% of the global production volume is manufactured at home (from the total production volume of 20%). In contrast, Europe accounts for 52% of the sales volume of European firms and for 62% of the global production volume. This is a high number for production given the relatively high factor costs in Europe, but it is in line with the recent history of global manufacturing. American firms had quickly shifted production to China over the past decades, which accounts for 30% of North American production, while European firms were more hesitant to do so.

The concept of natural hedging is important and requires further research. Several advantages derive from natural hedging. These include reduction in exposure to foreign exchange risk, reduction in lead time to the country market, which leads to increased flexibility and responsiveness, the

potential marketing value of local presence, and the potential to reduce exposure to government intervention in the form of corporate taxes and other incentives or pressures. A possible disadvantage is that this is a less sophisticated global sourcing strategy that may be suboptimal for a company in light of the full range of tradeoffs that we observed firms are considering. These adjustments are made in response to changes in costs, conditions, incentives and technology. Clearly some caveats to the conclusions apply in light of the sample size.

4.2 Regional Perspectives

In section 4.1, we focused on the changes made to production sourcing reported by the entire sample. We now present individual perspectives by region and highlight not only the decisions but also their drivers and impact, i.e., in accordance with the flows observed in Figure 2. We divide the results into three main areas: China, Eastern Europe & Russia, and North America.

4.2.1 Market-seeking companies enter China.

Not surprisingly, China continues to be the most attractive region for production sourcing. And it is predominantly North American (33%) and European firms (36%) from all industries that invest in production volume in China. These companies invest in the production of not only labor-intensive but also to a large degree in capital-intensive products in China. This finding is consistent with ongoing news coverage about manufacturers in China investing in automated high-tech manufacturing. In terms of value chain position, a significantly larger share of the respondents, when compared to other flow decisions, indicated that the products shifted to China are intermediaries that are used as inputs for other products.

The interesting result is that cost is no longer the major driving force. Instead, market access, quality and supply chain related factors have emerged as dominant drivers for increasing production volume in China. However, the primary driver for decreasing production volume in China is primarily labor cost, as it is in most cases involving ASEAN countries.

We consider the primary drivers that companies cited in connection with two groups of decisions to increase production volume in China, i.e., a shift from Western Europe to China and growth within China without any reallocation. In both cases, market changes, product quality and supply chain performance (supply availability, delivery lead-time, flexibility, logistic cost) rank as the most important drivers.

The importance of labor (cost) distinguishes decisions to shift production from Western Europe to China. Companies following this production volume flow rank labor cost highly but labor quality and availability to a lesser degree. In contrast, companies increasing production volume in China without any reallocation put labor cost among the least important drivers (#17 out of 24) while it is in the top five for decisions to shift from Western Europe to China. A plausible explanation might be that for the latter decisions the cost differential between China and their current location is still too substantial to be ignored. This again is an interesting result for further research.

Both groups that increased production in China, however, agree on the importance of market

changes. Companies that shift production from Western Europe to China rank market changes as significantly more important as do companies that follow any other strategy. Analyzing the sales activities of the companies investing in China indicates that already in 2014 China accounts for a significantly higher share of global sales than for other firms in our sample. Over the next three years, these companies expect to see a further increase in Chinese sales. Moving production to China can therefore be seen as an enabler or accelerator for serving this vast and rapidly growing market.

4.2.2 Low-cost-seeking companies leave China

While China is the country with the single most reported decisions for increasing production volume, it is also the country with the third most responses (11% of 74 sample respondents) quoting a decrease in production volume. About half of them report a shift of production volume to ASEAN countries.

Contrary to decisions to invest in China, no European but many North American companies (75%) report decreasing production volume in China. These companies relocate mostly the production of labor-intensive final products, contrary to decisions to invest in China. For the decisions in this group, proximity of production to R&D or to the market is of low importance for innovation or for after-sales service, suggesting that the new manufacturing locations are used primarily as offshore manufacturing sources.

When asked about the primary decision drivers, companies rank labor cost as the most important, along with supply availability and market changes. In many industries, cost pressure first hits the suppliers. Accordingly, the high ranking of supply availability and raw material cost next to labor cost suggests that these companies now follow some of their suppliers to lower cost locations outside China.

Also, market change is ranked as most important and significantly more important by firms who followed decisions other than leaving China. So, the very reason that led some companies, many of which were Western European, to invest in China, causes others, mainly in North American, to divest. Analyzing where these markets are, our results indicate that companies that decrease production volume in China do not primarily serve the Chinese market. Instead, North America accounts for around 50% of their global sales. One can thus conclude that the production that used to be located in China was for offshore supply, but now in response to the changing global cost competitiveness has relocated to cheaper places or in places closer to demand. Even though the largest outflow for China-based production was into ASEAN countries, the US could turn out to be the low-cost production location close to demand for companies selling to the North American market.

4.2.3 Eastern Europe & Russia serve as low-cost nearshore location for Western Europe

Eastern Europe & Russia ranked second after China in terms of attracting investments to increase production volume (24% of the responses). Moreover, only 5% of the respondents indicated a production volume decrease in Eastern Europe & Russia. More than half of the investments are associated with shifts of production volume from Western European countries. Not surprisingly,

Western European companies from a wide range of industries account for the majority of decisions to invest in Eastern Europe & Russia. Accordingly, we will take the perspective of production volume shifts from Western to Eastern Europe to illustrate the driving forces of decisions to increase production volume in Eastern Europe & Russia.

Eastern European countries have a lower manufacturing cost than do Western European countries. It is therefore not surprising that primarily products that are price sensitive are typically moved to Eastern European and Russian facilities. However, this does not mean only production of labor-intensive products is shifted. In fact, production for the products shifted to this region are no more or less labor-intensive than in the rest of our sample. Yet, results indicate that the production of the moved products is relatively knowledge and capital-intensive. Unlike production moved out of China to low-cost locations primarily in ASEAN countries, production moved to Eastern Europe & Russia can thus be assumed to be for rather complex products with high need for quality despite their price sensitivity.

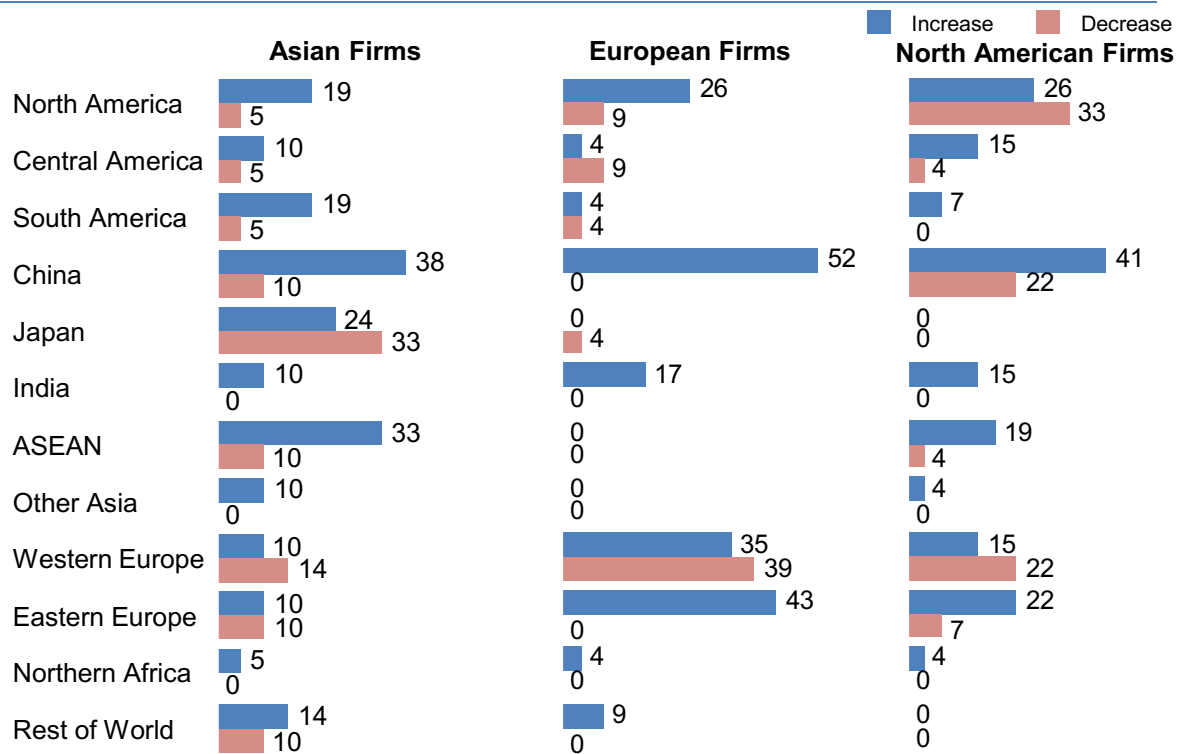
In a fashion similar to the case of China, respondents ranked cost (labor, fixed, logistics) as the most important drivers for decisions to shift production volume from Western to Eastern Europe. While global cost competitiveness is shifting, the notion of low-cost manufacturing in Eastern Europe & Russia still holds true.

Also for the decisions to shift to this region, market changes are reported to be the top driver while they are not significantly more important for the case of other decisions. Upon understanding where these markets are, it becomes clear that companies that shift production volume from Western to Eastern Europe serve to a large degree the Western European markets (relative to North America, China and Eastern Europe). Production in Eastern Europe and Russia is thus used as a low-cost nearshore supply location for Western European markets.

4.2.4 Reshoring to North America is not observed.

While there is a surplus of investments in production volume in North America from various sources, the question is whether this increase is based on American firms bringing capacity back to North America, i.e., reshoring. The answer, according to our responses, is no. Figure 6 contrasts the decisions made by companies from Asia, Europe and North America. We can see that more decisions to decrease production volume are reported in North American firms than decisions to increase (i.e., 33% versus 26% of the sample). Among Asian and European firms on the other hand, far more companies report investing than divesting in North America. So, while we may continue to speak of a return of manufacturing to North America due to a net increase in production volume, we should not say that it is driven by reshoring of North American firms, in particular, as 60% of the increase in North America is due to offshoring of Asian and European firms.

Figure 6: Changes in production volume by origin (in Percent of Sample)



When evaluating the data in more detail, the flows of production to and from North America indicate that the largest inflow of production volume comes from Western Europe and not China. Given the massive offshoring wave of North American firms that occurred in the 1990s, many have predicted that production would return to the US through reshoring by US firms. However, this is not consistent with our observations.

As for the product features of products whose production has shifted to North America, proximity to R&D and its positive impact on innovation are ranked significantly higher than in the case of companies making other decisions. Decisions to increase production volume in North America thus are motivated by a desire to co-locate manufacturing and R&D. The fact that R&D functions had been offshored to a lesser degree than manufacturing in the past could now lead companies to return manufacturing to North America.

Apart from the aforementioned drivers, firms that report an increase in production volume in North America rank quality and delivery (supply chain flexibility, delivery lead-time) as being important. Of course, companies that follow other decisions also rank these drivers highly. Two differentiators here are market changes and after-sales services quality. Both are ranked significantly more important for decisions to invest in North America, with market changes being the most important driver. Considering that to a large degree these companies serve the North American market (relative to South America, China and Western Europe), one can conclude that proximity to the North American market is of great importance and will be even more relevant as the US economy continues to recover from the financial crisis.

5 Hypotheses Derived from Observations

Our sample confirms anecdotal evidence that across all industries, geographies and firm sizes, companies indeed are restructuring their supply chains by investing and divesting in production capacity, automation and R&D, to respond to the multiple challenges they are facing. In particular, we observed that more than 80% of the respondents made changes to their production volume while about 60% invested either in automation or in R&D. Based on the observations of the actual decisions and their associated drivers, product attributes and impacts, we can develop hypotheses that can be analyzed in subsequent empirical research. Some of these hypotheses are consistent with high-level performance by global firms while others capture interesting behavior that challenges conventional wisdom and offer motivation for problems to be analyzed in more detail by OM researchers.

1. Restructuring of global supply chains is taking place in all industries and geographies, with firms considering multiple tradeoffs, incentives, and constraints.

Globalization of supply chains has become an established fact in almost every industry and as a result, most products comprise components and inputs that are sourced from multiple countries. At the same time, companies who have set up extensive global supply chains are asking if their current structures and strategies are appropriate in the current turbulent times. Indeed, many companies have engaged in or are contemplating making significant changes to their global supply chains. While it is clear that companies cannot rely on government policy makers or external actors to solve the challenges of competing in global markets through manufacturing, they also must be responsive to the momentous changes that are occurring in the countries in which they operate.

2. Although reshoring to the US or Western Europe is occurring, it has been more than offset by the ongoing offshoring by these two regions. At the same time, China and Eastern Europe have emerged as the dominant destinations for offshoring.

Reshoring in the form of increasing manufacturing in the developed economies of North America and Western Europe through the return of capacity that had left previously is not happening at a significant level. Manufacturing activity however is growing, at least in North America, but the source of this growth is from Asian and European and not US companies. Similarly, as reported recently in the *Wall Street Journal* (Magnier 2016), China has been investing heavily in the acquisition of European manufacturing firms, (e.g., KUKA Robotics in Germany), and as noted earlier, Delaney et al. (2017) report that FDI from China in the US now exceed FDI by the US in China. Also, we observed that in our sample China and Eastern Europe were the destinations most favored for relocating manufacturing. Moreover, the reasons reported for these changes were not the ones that have been put forward in the current political discourse. Our analysis of the drivers of the reported decisions indicated some interesting deviations from the base line strategy of balancing

production and sales on a regional basis (i.e., natural hedging). One strategy that was most mentioned was associated with enhancing agility by locating production in countries that provide flexibility or access to innovation. A second often-mentioned strategy leverages proximity by locating manufacturing closer to growing markets and/or sources of input supply (such as labor or energy). More recently, we also see the impact of political and regulatory issues affecting these decisions (Goldman Sachs Report, Delaney et al. 2017).

3. The key driver of these decisions is not just labor cost differences; there are other drivers, with automation becoming a dominant factor.

The much-discussed cross-country labor cost differentials that persist are not the most important driver in many cases. The decisions seemed to be based on a more comprehensive evaluation of the costs and benefits associated with the sourcing decision. This includes assessing cost and revenue tradeoffs, as well as risks and incentives associated with alternative location choices. The bottom line is that the emerging picture is more complex and nuanced than the one put forward by political commentators and politicians of all persuasions, who mostly claimed that labor cost differences were the most important factor that drove manufacturing sourcing. Our results show that companies are behaving in a rational and responsible manner, making tradeoffs among many other factors. The strategies that companies are adopting can inform the search for effective company strategies and for government policy solutions that will address the challenges facing firms worldwide due to global supply chain re-structuring and the shifting of manufacturing activity. These changes, coupled with ongoing changes to technology (i.e., automation has become a dominant factor in many cases) and to the fundamental economics and risks associated with global sourcing, are driving companies to consider restructuring and new strategy options. However, these adjustments must be responsive to the often-conflicting objectives of the stakeholders.

4. Natural hedging occurs in many industries.

Most companies are actually acting as good corporate citizens in the sense that they are balancing their production and sales on a regional basis. This means that companies are adding value through manufacturing at a level roughly comparable to the revenue that they are generating in each region of the world. We called this strategy one of “natural hedging” since balancing production with sales provides some protection against currency exchange fluctuations (if you buy and sell in the same country you are not affected by a change in the exchange rate). The two outliers were the United States and China, with the former selling more than it produces domestically and the reverse being true of China. These two flows, of course, are related. In fact, reshoring by domestic companies seems to be less attractive than offshoring into North America from foreign companies.

For OM researchers, there are a number of implications for how to formulate normative models to support global supply chain sourcing or restructuring decisions in light of government policy changes:

- *The scope of the supply chain to be modeled.* In supply chain design decisions, the question is often how much should be included in the model formulation, and whether we can decompose a global problem into a series of regional sub-problems. As evidenced in this study, there are significant in-flows and out-flows across regions, and it would therefore be suboptimal if the decomposition resulted in missing some key flows. It is possible that such cross-continent flows are less significant in some industries, such that a regional approach to modeling may be adequate. This shows the importance of the type of industry.

- *Explicit treatment of government policies and constraints.* In the past, the impact of government policies and constraints have been captured in some simplistic ways, e.g., a simple linear custom rate is applied to goods going from one country to another, or a fixed tax subsidy is given if a facility is opened in a particular country. Government policies and incentives have become more complex, e.g., custom rates may depend on the bill of materials and where the components and sub-components came from, and what kind of trade agreements existed among all the countries involved in subassembly, final assembly and the consuming market. Government incentives may not be based purely on opening or closing a plant, but on various investment schemes used by the firm. For industries plagued by complex trade regimes and tax treatments, more complex modeling of how these incentives interact and impact supply chain decisions is necessary. Different industries may vary in their vulnerability to policy and environment changes, and thus the relative weights of the decision drivers could change when political and regulatory regimes and economic conditions change.

- *Technological advances in supply chain.* While OM has developed models to help decision makers determine the best capacity designs across the global supply chain, we should recognize that executives are also making technology decisions like investments in automation, new manufacturing technologies like 3D printing, and information technologies for monitoring and communication. We should note that capacity and technology decisions interact, and for some industries where technological investment opportunities are abundant, the supply chain capacity and technology decisions should be modeled jointly and optimized together.

- *Modeling uncertainties and evolutions.* Most supply chain models capture demand uncertainties, and some include supply uncertainties related to lead time, quality or disruptions. However, as we have seen in this study compared to previous ones, there are other key parameters and environmental changes that supply chain executives also must grapple with. These include labor cost changes, trade agreements, exchange rates, market shifts, technological advancements, and comparative economic developments. Some of these changes are based on known trajectories, and others are uncertain over time. Supply chain models that span multiple periods need to capture such evolutions and uncertainties.

Company sourcing decisions are often not a result of myopic behavior, and may not always respond immediately to the latest political and economic changes. Hence, supply chain design research should capture the long-term view of companies. Policy and economic trends are also subject to changes in the future. This argues for analytical models that treat such changes as uncertain variables, just as other OM researchers have captured factors like demand and exchange rates in the past.

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