Industrial Organization

Team Mountain Jungle

Elson Browne-Low

Aashish Karki

Akhanda Shrestha

The Impact of CAFE regulations on the United States Pickup Truck Industry.

Three firms have historically dominated the United States pickup truck industry: Ford, General Motors and Chrysler, supplying virtually the entire market prior to 2000. In fact, the "Detroit Big Three" depend heavily on pickup sales, more than half of Ford's sales, for example, being pickups. Since 2000, however, Toyota and Nissan have also competed, even though the original three continue to outperform them. The imposition of new CAFE regulations by the Federal Government is likely to create an opportunity for these relatively new entrants (as well as other foreign-based firms) to erode this dominance, however, so it is plausible they will increase their market share, at last challenging "Detroit's Big Three." This is because not only are these regulations growing stricter and stricter, they have been altered so that each individual vehicle has to comply with specific mileage criteria, so automakers cannot compensate for certain lines' poor mileage by selling other, more fuel efficient ones. This limitation (which will be explained in greater detail later) will force automakers to produce smaller vehicles which are more perfect substitutes for sedan-based unibody pickups, and thus result in Asian sedan manufacturers benefiting both from cost advantages and, interestingly,

advertising advantages.

CAFE regulations are government specifications manufacturers are required to comply with whose "purpose…is to reduce energy consumption by increasing the fuel economy of cars and light trucks" (1). They are especially relevant when analyzing the pickup truck industry because they continue to grow stricter over time, forcing manufacturers to change their production processes or make new investments in order to improve their mileage ratings. Both the Bush and Obama administrations have continued this trend, culminating in "regulations that will nearly double fuel economy by 2025 to 54.5 miles per gallon."(2) It should be noted, however, that as of 2012 regulations will, as stated above, regulate vehicles' mileage individually, but also regulate the average mileage required by manufacturers' entire fleets. This means that those with fewer fuel efficient lines will be required to fulfill less stringent strategies whereas those with more fuel efficient vehicles the opposite. As a consequence, while pickups will be required to increase mileage every year, this effect is not quite as drastic as if there were no accommodation, and they were required to meet the higher standards of firms producing more fuel efficient cars. Thus, CAFE regulations will still have a very great impact on pickup production, but not quite as great an impact.

At this stage it is useful to define the particular market and product examined because it is especially relevant to the impact CAFE regulations are likely to have on each firm. This is the market for "full-size" pickup trucks sold within the United States, those trucks specifically being light motor vehicles with an open top and rear cargo area which, unlike smaller trucks, usually feature V8 or V6 engines. Engine size and that of the trucks

themselves are relevant because, as of 2011, CAFE regulations are based on fuel economy target levels for vehicles of different sizes, and engine capacity is related to fuel use. Thus, trucks which are both physically large and feature powerful engines must constantly be improved in order to keep within the bounds of CAFE regulations.

This market also satisfies many of the characteristics of an oligopoly- there are high barriers to entry (sunk advertising costs by the Detroit Big Three as well as the cost of building or retooling current factories to manufacture pickups) only a few firms (five main firms), and a relatively homogenous good in pickup trucks. It could be argued that the homogeneity of pickups is a questionable characteristic, however, because each firm has greatly emphasized product differentiation. This means that the market is an oligopoly, but has limited traits of monopolistic competition.

Finally, one other relevant feature of this industry is that it is subject to a "Chicken tax," which "levies a 25 percent tariff on any imported light truck." Further, "The law was established in 1964 by President Lyndon B. Johnson in retaliation for duties France and West Germany levied on U.S. chickens". While France and Germany might not currently be Detroit's biggest competitors in the pickup industry, this tax keeps firms in Asia (such as South Korean manufacturer, Hyundai) from exporting pickup trucks to the United States. As a result, they have to build manufacturing plants in the United States (or Mexico and Canada which are not subject to the tax) in order to compete. Although this barrier has been overcome by firms like Toyota, it does forces any foreign firm considering entry into the US market to take a huge risk in sinking the capital. This discourages foreign firms, providing domestic firms an advantage, but becomes a less

relevant factor after factories have been built. Because of this entry barrier, firms willing to enter the US market will need a clear evidence that their pickups can attract enough market share before they sink costs in building factories. While this has not been the case in the market so far, if Toyota and Nissan do increase their market share due to new CAFE regulations, this could likely serve as the evidence Hyundai and other manufacturers require to invest in new plants which are not subject to the chicken tax..

In order to understand how CAFE regulations are likely to favor foreign automobile makers the first important factor to consider is why the Detroit Big Three have performed so well in the first place. This is due to many varied reasons, but four of the most prominent are: 1. Customer loyalty, 2. Product differentiation, 3. The quality of their products, and 4. The "macho" effect.

Customer Loyalty

Customer loyalty is important because it acts as an effective type of product differentiation. This makes each firm's pickup trucks an imperfect substitute for another's, so consumers are less willing to purchase it. As a result, not only can firms which have supplied the market for some time preserve market share relative to historical rivals, they can make it exceedingly difficult for new entrants to persuade any of their customers to switch.

Such loyalty is very strong in this market, as this quote from an article entitled "Big Three bank on loyalty to pickup trucks as competition heats up" illustrates:

When it came time to replace his 9-year-old Ford pickup, Lucchese, 49, a software engineer from Los Angeles, drove Chrysler's new Ram truck and even gave Toyota's Tundra a try. He ultimately ended up right where he started: at Ford, with a $48,000 F-150 with leather seats and a 360-horsepower V-8.

"I've been a Ford guy all along," he says.

Further, this New York Times article entitled “Toyota drops subtlety for macho truck ads” states:

Most of the people who do buy pickup trucks are very loyal to whatever brand it is," said Art Spinella, president of CNW Marketing Research, an automotive consulting firm in Bandon, Oregon. "You're not going to find many Ford truck owners who switch over to a Chevy.”

Given such strong ties, Toyota and Nissan faced, and continue to face, a difficult task cutting into the Detroit Three’s market share.

Product Differentiation

While it may be argued that product differentiation can add value to products by increasing consumer choice, many of the changes wrought on pickup trucks by competing firms, and Toyota itself, since its entry have been cosmetic, unrelated to the function of the vehicle itself (such as driving, towing or carrying loads in its bed etc.). In fact, one writer goes so far as to call them “cosmetic”, saying of the third model of the Tundra:

The changes that Toyota has made to the fullsize pickup are mostly cosmetic, with the underpinnings of the vehicle staying unchanged.

There's a new grille, along with a revised, three-part front bumper design. Fenders and wheel wells are more square than in the out-going truck, too. Perhaps most significant is the revised bed design, which Toyota calls "all-new," with new sheet metal on the sides, a revised tailgate and a very subtle integrated spoiler.

Ford's 2013 F-150 model also features, for example, a new grille, chrome wheels option, and several additional color options, such as "jeans blue". Since many of these changes are cosmetic, it would appear Ford is trying to differentiate its product from its competitors without fundamentally altering the nature of it. This, as stated earlier, renders trucks imperfect substitutes for each other because consumers are unwilling to purchase rival products which don't provide the same features. Thus, a consumer seriously considering the Tundra might not be willing to buy it because Ford's wide array of features offers him a slight preference advantage. This makes it even more difficult for Toyota or Nissan to convince customers to turn to their trucks, even though they may be of comparable quality.

Quality of Products

In determining the relative quality of each firm's trucks it does not appear useful to compare the number of prestigious awards received, because each model seems to receive numerous awards. Alternatively, since pickups are marketed on criteria tailored

to appeal to buyers, a comparison of some of the criteria manufacturers commonly advertise is indicative of the relative quality buyers perceive when comparing trucks. The table below illustrates one such comparison.

Brand	Engine (V8)*	Fuel Economy City,Highway	Horsepower@ RPM	Torque @ RPM
Ford F150	6.2L V8 Ecoboost 3.5L V6	13,18 15,22	411 @ 5500 rpm (6.2L V8) 365 @ 5000 rpm (3.5L EcoBoost®)	434 @ 4500 rpm (6.2L V8) 420 @ 2500 rpm (3.5L EcoBoost®)
Chevrolet Silverado	5.3l V8	20,23	332 HP @ 5100	367 lb-ft @ 4100
GMC Sierra 2500	6.6L V8 Turbo	20,23	332 @ 5100	360 @ 4100
Ram 2500	5.7L V8	14,20	383	400 lb-ft
Toyota Tundra	5.7L V8	15,20	381	401
Nissan Titan	5.6L V8	13,18	317	385 lb-ft

*all vehicles considered use standard gasoline.

Ford F-150 offers industry-leading specifications in both Horsepower and torque ratings, but is not quite as fuel efficient as GMC or Chevrolet's models. On the other hand, these three companies' models have mileage ratings well above their competitors, even though both the Ram 2500 and Toyota Tundra feature greater horsepower and torque. This variation in specifications indicates that, for the most part, it is difficult to distinguish trucks in terms of their quality. Ford's F-150 seems to be the best by a small margin, however, since it dominates both the horsepower and torque categories while offering the second highest mileage. It is therefore seen that F-150 is the best-selling pickup, but

much more ambiguous as to why Toyota and Nissan are afforded such a small market share. Quality is thus one important aspect of this question, but an insufficient answer in of itself.

Macho Effect

Last, the Macho effect plays a major role in this market. Within this context, this effect, loosely, can be described as purchasing pickups not just because of their prices, one's personal loyalty to a particular firm or even function-oriented characteristics, but because pickup trucks are perceived as big, powerful, manly vehicles. As a consequence, those companies whose trucks appear more "Macho" gain and preserve a larger market share.

While this effect may seem dubious, it is nonetheless a reality in the pickup truck industry because, as the article *Toyota drops subtlety for macho truck ads* states, Toyota is spending millions of dollars to tailor its advertising campaign to these customers. The article says:

If you want to be a player in the full- size truck market, you can't be subtle," said James Farley, Toyota's vice president for North American marketing. "We couldn't out-emotionalize our competitors. What we could do is outperform them, and we think that's emotional."

The Tundra ads are certainly not subtle. For one ad, the company built a five-story steel seesaw in a desert. A Tundra pulling a five-ton trailer speeds up the incline, then the

seesaw swings down and the truck quickly brakes to a halt before it reaches the ground. The other spot shows a Tundra speeding toward the edge of a cliff before screeching to a halt inches from disaster.

The stunt driver Toyota hired described it as "the scariest commercial he'd ever done," Farley said.

In a third national ad, workers toss bags of manure into a Tundra, described by a voice-over as having "the biggest honkin' bed."

Thus, it would appear that one criteria buyers gain utility from is how “macho” their trucks are, or at least are perceived. The reason Toyota had not been able to appeal to audiences in this way was because its advertising campaign had historically focused on “refined ads like a 1989 spot depicting 10 champagne flutes stacked on the hood of a Lexus LS400 sedan, unaffected by the smooth revving of the engine,”. And, it traditionally manufactured cars, so it had no previous “macho” reputation upon which to rely.

This effect was compounded by the fact that the Detroit Big Three had already sunk costs over their long history into making their trucks not just appear “macho,” but be perceived as being “macho.” The subtle distinction between being “macho” and being perceived as such is important because it illustrates that while Toyota may have produced trucks which satisfied the criteria of being big, powerful and “manly,” they had not yet advertised to the extent that buyers were familiar with this. Thus, the Detroit Big Three had already sunk advertising costs to ensure buyers knew how “macho” their vehicles were, (that is to say, perceived this) whereas Toyota had not, giving them an

advantage even if Toyota produced a similarly "macho' vehicle. This served as an entry barrier because it prevented Toyota from benefitting from the "macho" effect, at least in the short run (until they had sunk enough costs to ensure buyers knew about their pickups), in some senses lowering the quality of Toyota's trucks, so they were priced higher relative to their competitors, thereby selling fewer units.

The Effects of New CAFE Regulations

CAFÉ regulations continue to increase, with the Obama administration's stated goal being 54.5 mpg for cars and trucks by the year 2025. Considering the fact that leading MPG rating of any truck on the market is only 21 mpg, however, pickup manufacturers will have to invest in some form of change which lowers fuel consumption. There are three potential ways to do this: 1. Further investments in existing technology, 2. Investment in entirely new or greatly redesigned technology or 3. Reducing the load engines carry altogether.

Currently Ford and General Motors, in particular, greatly emphasize the first option, with their EcoBoost and Ecotec engines. According to Ford, the Ecoboost engine "incorporates established heavy-duty truck diesel engine technologies" and "deliver(s) fuel economy gains of up to 20 percent." GM's Ecotec engine, on the other hand provides "estimated highway fuel economy of more than 30 mpg." These investments have allowed Ford and GM to continue to meet CAFE standards at a time when their rivals have struggled to produce similarly efficient engines. What is interesting to note, however, is that (given

current regulatory trends) these gains are still insufficient to meet requirements even five years in the future.

Year	CAFÉ regulations
2011	25.0 mpg
2012	26.4 mpg
2013	27.8 mpg
2014	28.2 mpg
2015	28.6 mpg

As the table above indicates, pickup trucks' required mileage is steadily increasing, and will approach in the year 2016 or 2017, 30 mpg. Thus, GM and, eventually, Ford (as firms whose engines provide even less mpg), will need to invest in technology which goes beyond current capabilities. This opens up the possibility of one of two things occurring: 1. A technological breakthrough markedly improves the performance, or revolutionizes the nature of, engines themselves or 2. Pickup trucks are built to weigh considerably less.

While it is difficult to speculate what technological advances may or may not occur, building pickups which weigh less is quite possible, since, unlike improving mileage, it does not rely on any major technological development. Chris Knittel, in his article "Automobiles on Steroids: Product Attribute Tradeoffs and technological Progress in the Automobile Sector", writes that pickups have actually increased engine capacity and weight markedly over the last thirty years, and a slowdown or reversal of this trend could result in large mileage gains. He says: "if weight, horsepower, and torque were

held at their 1980 levels, fuel economy could have increased by nearly 60 percent from 1980 to 2006" and "Once technological progress is considered, meeting the CAFE standards adopted in 2007 will require halting the trend in weight and engine power characteristics, but little more. In contrast, the standards recently announced by the new administration, while attainable, require non-trivial "downsizing"." Thus, a reversal of this trend, resulting in smaller and lighter pickups which carry similarly powerful engines, could easily compensate for the increase in CAFE regulations.

This size reduction will make unibody pickups, which are smaller and lighter than full-size trucks, though not quite as powerful in terms of towing and hauling capacity, a more perfect substitute. According to an article entitled *Ram Dakota: The First Unibody Truck*: "A unibody chassis translates to a smoother ride, decreased weight, and better fuel economy", so as full-size pickups grow smaller in an effort to become more fuel efficient, unibodies would increasingly appear a viable alternative. While this will not likely lead to the discontinuation of body on frame (traditional) pickups, given the current popularity of such models, it may lead buyers who are more interested in unibodies' comparatively better fuel economy, or even indifferent to whether or not they buy body-on-frame trucks, to purchase unibodies.

Further, the article *Sources Say: Ford Planning Innovative Changes Aimed at Fuel Efficiency in Next F-150* states: "Frame stiffness is important in a pickup truck for towing and hauling; to ensure the alloyed frame can perform its job, the F-150 is expected to use limited elements of unibody construction." Additional frame stiffness is required because this article also states Ford is looking into "an innovative magnesium-aluminum

alloy" which is "36 percent lighter than aluminum," but not as inflexible as traditional materials, such as steel. Thus, through combining the best features of a unibody truck to ensure both better mileage and sturdy construction, pickup trucks can achieve levels of performance comparable to current standards, while significantly reducing weight (therefore increasing mileage). This hybridization would thus make such trucks even closer substitutes for unibodies.

If this is indeed the way pickups are manufactured in the future, there is potential for Asian car manufacturers to increase their market share or (for firms currently out of the market) even enter. This is because of two key reasons: 1. Quality advantages in the manufacture of sedans and 2. The diminishing "macho" marketability of pickups. The first reason is tied to the fact that Asian manufacturers have experience producing very successful sedans, Toyota's Camry, for instance, being the best-selling sedan in the US for the past eleven years. If pickups are increasingly built on sedan bases and sedan-based unibodies more perfect substitutes for them, it follows that Toyota's advantage in the sedan market could carry over to the pickup market, allowing it to increase its market share.

Further, since Toyota has openly declared the "macho" effect important in marketing pickups, spending millions of dollars on advertising (as cited in the article above), these changes could significantly impact manufacturers' sales. This is due to the fact that, while their performance may be comparable, under CAFE regulations pickups will be forced to assume the smaller and more sedan-based image of unibodies. This directly diminishes their large, dominant appearance, thereby reducing the extent to which manufacturers

can appeal to customers on a "macho" basis. Considering Toyota has had to alter its marketing strategy to appeal to such "macho" affinities, this reduction in "macho" advertising will diminish the entry barrier it faced (as described in the section entitled the "Macho" Effect above), because it does not have to advertise to the same extent on criteria in which its rivals have already sunk costs. Therefore, as a result of CAFE regulations, Ford, GM and Chrysler would now have to sink costs appealing to customers in alternative ways, whereas Toyota already has experience with such alternatives (having used such advertising, for instance, prior to its emphasis on "macho" characteristics) so it can advertise at a lower cost, and has also sunk costs to some degree on such alternative criteria (due to said previous advertising). Toyota would therefore be at an advantage, whereas The Detroit Big Three much the opposite.

Market Structure Changes and the Big Three's Response

Because of the two key reasons stated above, any market structure changes will be tied to firms' experience selling sedans. The table below illustrates sedan sales for the best-selling models of each of the six major producers of pickups, as well as Hyundai and Honda. Hyundai and Honda are included because not only do they sell large numbers of sedans, they have both investigated producing a small pickup (citation needed) or unibody (the Ridgeline) which could serve as a substitute (provided they increase engine capacity) for the expected, smaller full-size pickups.

Sedan	2012 Sales
Toyota Camry	404,886

Honda Accord	331,872
Nissan Altima	302,934
Ford Fusion	241,263
Hyundai Sonata	230,605
Chevrolet Malibu	210,951
Chrysler 200	125,476
GMC	-

The top three manufacturers in terms of sales are Toyota, Nissan and Honda, whereas the Detroit Big Three fall significantly behind. In addition, Hyundai, while behind the other Asian manufacturers, nonetheless sells a comparable number of sedans to Ford. What this indicates is that Nissan and Toyota are likely to increase their market share in the pickup market whereas the Detroit Big Three's will decline. Further, if this occurs it is reasonable to think that Hyundai will decide to build factories in The United States, Canada or Mexico (in order to overcome the Chicken Tax) and enter the US market for pickups. Honda, which already has factories in the US, has even less of an entry barrier to face, and so will very likely enter the market, perhaps by reintroducing its Ridgeline unibody.

These changes will prompt an increased level of competition in the market, lowering prices, and therefore incentivizing firms to find a means of restraining this. This is because such competition could lead to a Bertrand's paradox scenario, in which each producer receives little or no surplus- due to undercutting in order to gain market share, firms eventually force the price so low that it is the same as the marginal cost of

producing pickups, so no surplus is received by any firm (assuming production costs are the same for each firm). If production costs are lower for any particular firm, however, that firm will continue to make some surplus profit, because the market price will nonetheless be above its marginal cost of production.

If each firm's production costs are similar, and undercutting does ensue, firms can try to avoid Bertrand's paradox by utilizing one of the four escapes available: 1. Capacity constraints, 2. Product differentiation, 3. Collusion and 4. Timing. If its rivals do not have ample capacity to supply the entire market, the first escape would yield surplus profits for one automaker because then it could charge monopoly prices on its vehicles. This is because it is the only supplier that has the ability to supply those customers who demand pickups, but are not being catered to by the other automakers; such a position provides the automaker monopoly market power, so it can charge monopoly prices. This does not appear to be the case currently, however, because the pickup market is supplied by several firms, all of whom operate large factories.

Product differentiation is another means of escaping Bertrand's paradox because it, as stated earlier, makes each firm's products imperfect substitutes, so consumers are unwilling to buy rival goods instead. This escape is already being utilized both in the form of sinking costs in advertising to induce brand loyalty and expanding the range of customizations available (e.g. exterior colors, dashboard configurations, interior leather options etc). But it does not seem plausible it would have a much greater impact if firms decide to emphasize it even further. Interestingly, however, another form of product differentiation may ensue, that of nationalist branding. Since none of the firms who could

challenge the Detroit Big Three are of American origin, these three firms could invoke nationalist sentiment, branding their trucks "American," and their rivals "foreign." This would make the challenging firms' pickups imperfect substitutes for theirs because consumers would be unwilling to support companies viewed as "foreign." Evidence of such branding is already present, one example being the Chrysler 200 commercial which states that it is "imported from Detroit," a subtle attack on its rivals' imported cars. Thus, in an effort to further product differentiate, the Detroit Big Three may produce commercials similar to this in much greater numbers.

Collusion is another possible means of ensuring an escape from Bertrand's paradox- in this scenario firms agree to set the prices and quantities each firm will sell in an effort to extract as much total surplus as possible from consumers (this occurs because consumers must pay a price that is higher than the marginal cost of production, thereby transferring surplus, in the form of profits, to producers). It is difficult to determine whether or not this will likely occur, first, because it requires firms to be willing to carry out clandestine, illegal activities, but also because their conduct in this particular industry is even more difficult to predict. This is due to the historical rivalry between the Detroit Big Three, which would make them less likely to collude, and their willingness, on the other hand, to consider cooperating in times of need- the article…….states that the CEO of GM actually visited that of Ford in an effort to merge during the 2008 financial crisis, when sales for both companies were low.

Further, Collusion most often occurs where the major companies in an industry are mature, that is, familiar with each other having been in business for an extended period

of time, and when firms both provide homogenous products (so it is difficult to product differentiate) and are experiencing difficulties of some sort (such as low levels of profitability due to low prices). While the Detroit Big Three do fulfill the criteria of being "mature firms," their rivals, some of whom have only recently entered the market for pickups, are not. Further, pickups are far from homogenous- though they may share similar characteristics and become increasingly perfect substitutes for unibodies, there have been numerous efforts to differentiate them in some way. On the other hand, one might argue that undercutting may lead to low levels of profitability, so all firms will be willing to collude, but considering the new entrants will be trying to increase their market share, their incentive to collude (which would restrict their market share to that determined by the group) is weak. This evidence favors an outcome in which there is no collusion, but as there remain some incentives to collude, it is difficult to predict what might occur.

Timing is perhaps the most important escape as CAFE regulations continue to affect this industry, because several firms have already investigated or experimented with the unibody concept, providing them an early advantage in developing these pickups. Ford, GM, Chrysler, Toyota and Hyundai have all done this, but none have actually mass produced a unibody pickup. Most notable, however, is that this is where Honda has a clear advantage over the others, having developed and mass produced the Ridgeline since 2005. While the other firms engage in research and development, preparing for their first releases, Honda will have already developed and over time honed its design. This means that not only will Honda likely have a cost advantage (due to learning by

doing), it has already sunk its research and development costs. Whereas its rivals need to price their vehicles higher in order to recoup these costs, Honda no longer needs to take them into account, so it can undercut them. This means that as unibodies become ever closer substitutes for full-size pickups it is very likely that Honda will increase the number of Ridgelines it sells, cutting substantially into the market share of the Detroit Big Three.

Conclusion

Because of the increasing stringency of CAFE mileage regulations, pickups will grow smaller and lighter each year. This makes them closer substitutes for unibodies and, while full-size trucks are unlikely to disappear altogether, they will face greater competition from such trucks. As a result, Asian manufacturers, with advantages in producing sedans (upon which unibodies are built), will gain market share, posing a threat to the Detroit Big Three's dominance. Further, Honda in particular, with a first mover advantage in the production of unibodies, will also gain market share. Thus, stricter CAFE regulations have changed the full-size pickup market's basic conditions, presenting Asian manufacturers such as Honda and Toyota an opportunity to challenge the Detroit Big Three.