

The Growing Role of Mexico in the North American Automotive Industry

Trends, Drivers and Forecasts

Prepared by



Prepared for



July 2016

The Growing Role of Mexico in the North American Automotive Industry

Trends, Drivers and Forecasts

Bernard Swiecki
Debbie Maranger Menk



Center for Automotive Research
3005 Boardwalk, Ste. 200
Ann Arbor, MI 48108
www.cargroup.org

July 2016

Table of Contents

Table of Contents i

List of Figures and Tables ii

Acknowledgements..... iii

Executive Summary..... 1

Introduction 4

Overview of the Mexican Automotive Industry..... 7

Light Vehicle Production Trends 7

Capacity Utilization 12

Engine and Transmission Production Trends..... 13

Development of Domestic Market for Vehicle Sales 16

Mexico and Its Favorable Trade Environment..... 17

Currency Trends 29

Employment Trends..... 31

Investment Trends 33

Decision Factors: Locate In Mexico? 37

Labor Availability and Trends..... 37

Mexico’s Economic Development and Incentive Practices 41

Cost of Doing Business 43

Crime and Security 54

Environment 55

Conclusion..... 56

Appendix I – Research Centers 57

Appendix II- Environmental Laws 59

Appendix III - Compliance 66

References 68

List of Figures and Tables

Figure 1: Mexican Production vs. Production Capacity: 2007 – 2015 Actual, 2016 – 2022 Forecast.....	2
Figure 2: Mexican Automaker Assembly Plants and Automaker-owned Parts Plants as of February 2016	7
Figure 3: Mexico Vehicle Production: Automobiles, Trucks, and Buses: 1988-2015 Actual and 2016-2020 Forecast.....	8
Figure 4: German, Japanese, and Korean Production Capacity and Investment in Mexico between 2010 and 2015	9
Figure 5: U.S. Vehicle Production and its Share of North American Production: 2007-2014 Actual; 2015-2020 Forecast.....	10
Figure 6: Total Ford, GM, and Fiat-Chrysler Production in North America, by Country: 2012-2015 Actual, 2016-2022 Forecast	11
Figure 7: Mexican Production vs. Production Capacity: 2007 – 2015 Actual, 2016 – 2022 Forecast.....	13
Figure 8: Mexico Powertrain Production: 2012-2014 Actual and 2015-2018 Forecast	14
Figure 9: Engine Production in Mexico and the United States: 2012-2014 Actual and 2015-2018 Forecast	14
Figure 10: Small and Large Engine Shares of North American Production: 2012-2015 Actual; 2016-2022 Forecast.....	15
Figure 11: North American 3- and 4-Cylinder Engine Production by Country: 2012-2015 Actual; 2016-2022 Forecast.....	15
Figure 12: Mexico New Vehicle Sales: 1988-2014	16
Figure 13: Mexican Used Vehicle Imports vs. New Vehicle Sales: 2005-2014.....	17
Figure 14: Mexican Automotive Imports from and Exports to the United States: Motor Vehicles: 2005-2014	21
Figure 15: Mexican Automotive Imports from and Exports to the United States: Motor Vehicle Parts: 2005-2014	22
Figure 16: Mexican Automotive Imports from and Exports to the United States: Bodies & Trailers: 2005-2014	22
Figure 17: Mexico’s Port System: 2015.....	27
Figure 18: Exchange Rate between the Peso, Euro, Won, Yen, and Dollar	29
Figure 19: Mexican Trade Surplus with United States: 2001-2015	29
Figure 20: Mexican National Trade Deficit as Percentage of GDP: 2000-2014	30
Figure 21: Mexican Automaker and Auto Parts Employment: 2007-2014	31
Figure 22: United States and Mexican Hourly Automotive Wages in Nominal U.S. Dollars/Hour: 2007-2014	32
Figure 23: Motor Vehicles, Trailers, and Semi-trailers Manufacturing Hourly Compensation: 2008-2013	33
Figure 24: Total Announced Automaker Investment by Country (\$US): CAR Book of Deals: 2000-2015 ..	34
Figure 25: Mexican Automotive Assembly Investment: 2009-2015.....	35
Figure 26: Institutions Granting Automotive-Related Degrees by State: 2014	39

Figure 27: Student Enrollment by State: 2014.....	40
Figure 28: Mexican Quality and Ease of Access of Electricity	50
Figure 29: Average Price of Electricity to Industrial and Commercial Consumers (U.S. Cents per kilowatt/hour).....	51
Figure 30: Medley Global Advisors Security Index Map: 2015	54
Table 1: Mexico and North America Production vs. Capacity: 2007-2014 Actual, 2015-2018 Forecast	12
Table 2: Mexico’s Exports and Avoided Tariff Payments in 2014	17
Table 3: Mexico’s Free Trade Agreements as of 2015.....	20
Table 4: Top Five Auto Parts Exported from the United States to Mexico, 2010-2015	24
Table 5: Top Five Auto Parts Imported to the United States to Mexico, 2010-2015	25
Table 6: New Assembly Plants Announced from 2011 to May 2016.....	34
Table 7: Total Announced Automaker Investment by Country (\$US): CAR Book of Deals: 2000-2015	34
Table 8: Example Comparison of Incentives and Investments: 2010-2015.....	42
Table 9: Total per Vehicle Cost Advantages of Producing a Vehicle in Mexico for U.S. or European Markets (compared to cost of producing that vehicle in the United States)	46
Table 10: Total per Vehicle Cost Advantages of Producing in Mexico for U.S. and European Markets.....	49
Table 11: Cost Factors that Would Encourage Automotive Manufacturers to Produce in the United States	53
Table 12: Maximum emission levels for existing equipment (prior to 2012).....	61
Table 13: Maximum emission levels for new equipment (from 2012 onwards).....	62
Table 14: Limits on VOCs.....	63
Table 15: Shadow U.S. and Canada Rules.....	63
Table 16: Values and parameters used to calculate net emissions applicable to passenger vehicles.....	63
Table 17: Air and GHG emissions, Carbon dioxide (CO ₂), Million tons.....	67

Acknowledgements

The authors would like to thank the representatives from the companies and agencies who shared their knowledge of doing business in Mexico. In particular, the authors would like to thank representatives of American Axle & Manufacturing, American Honda Motor Company, Audi, Delphi Automotive, Design

Systems Inc., Entrada Group, Fiat Chrysler Automobiles (FCA), Ford Motor Company, General Motors Company, Grupo Prodensa, Magna International Inc., the Michigan Economic Development Corporation Export Office, the Mexican Consulate, Mitsubishi Electric Automotive America, Penske Logistics, Renault-Nissan Alliance, Robert Bosch LLC, Toyota Motor North America, the U.S. Commercial Service, Volkswagen of America and ZF North America.

This study is the result of a group effort. The authors would also like to thank our colleagues at the Center for Automotive Research for their assistance with this study. In particular, the authors listed below each contributed significantly to various sections of this publication. Additional assistance was provided by Diana Douglass, who contributed greatly to the coordination of the project and the production of this document.

Contributing authors:

- David J. Andrea, Executive Vice President of Research
- Sean McAlinden, Vice President for Strategic Studies and Chief Economist
- Kristin Dziczek, Director, Industry, Labor, and Economics Group

Additional research assistance provided by:

- Valerie Sathe Brugeman, Senior Project Manager
- Yen Chen, Senior Industry Economist
- Joshua Cregger, Project Manager
- Lisa Hart, Senior Vice President
- Estefania Jurado, Research Assistant
- Juliana Patterson, Research Assistant
- Troy Schott, Research Assistant
- Michael Schultz, Industry Economist

Report Prepared by:

Bernard Swiecki, Director, Automotive Communities Partnership
Debbie Maranger Menk, Senior Industry Economist

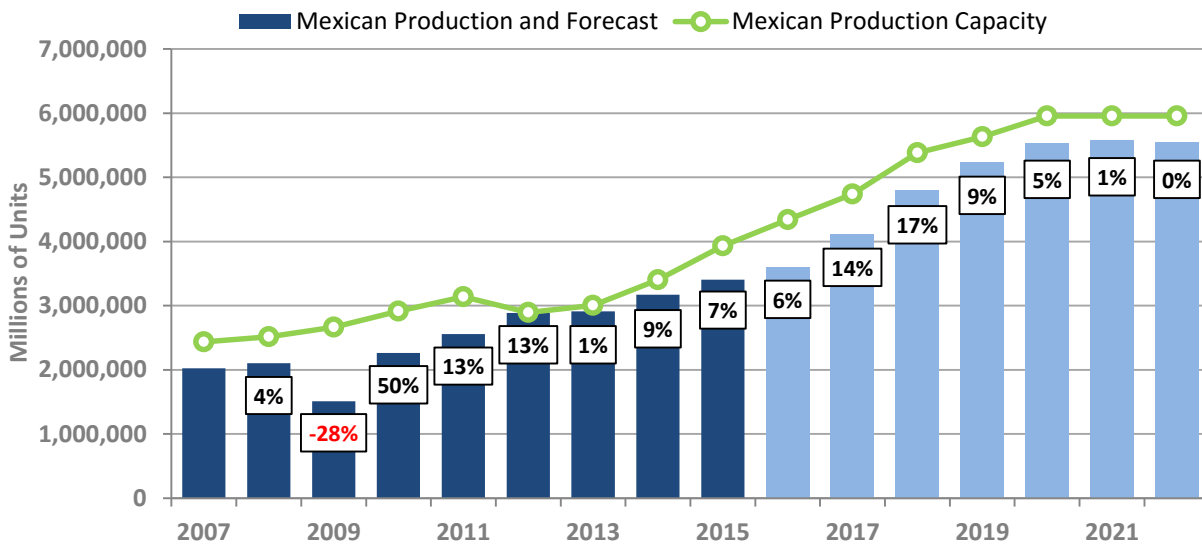
Executive Summary

This paper provides U.S. and Canadian economic development officials with an assessment of Mexico's success in attracting growing automotive investment and the drivers behind that success. In addition, the authors characterize which types of automotive investment are most likely attraction and retention targets for the United States and Canada. This paper will be of interest to automotive suppliers that do not have a presence in Mexico and are trying to gain a better general understanding of the considerations surrounding potential investments.

The growth of the automotive industry in Mexico carries different implications for different stakeholders in the automotive value chain. Economic developers often see Mexico as a competitive threat, fearing the loss of potential new investments and worrying about their community's existing automotive endowment slowly shifting south of the border. While Mexico may indeed pose such a threat, it is also highly likely that the automotive firms in the United States and Canada are part of a supply chain that includes Mexico as either a source of inputs, destination of their output, or both. Given Mexico's success in attracting new automotive investment, an increasing focus on retention of investments is a priority for these economic developers. Automotive suppliers may see Mexico as a nearly inevitable location for their next North American facility based on their customers' location decisions, but not every operation is optimally suited for the country. This analysis of trends, drivers, and patterns behind the growth of the automotive industry in Mexico will inform various stakeholders of what these developments mean for them.

Figure 1 illustrates the rapid growth of vehicle production in Mexico and provides a forecast of production volumes through 2022. The forecast shows Mexican vehicle production may more than double during the decade from 2010 to 2020. Both the drivers and the implications of this growth have tremendous significance for the U.S. and Canadian automotive industries. Economic developers face the prospect of the suppliers in their community contemplating whether this growth is too big to ignore - whether they should either choose Mexico for expansions or outright move their operations there. This study provides context for the factors behind these considerations.

Figure 1: Mexican Production vs. Production Capacity: 2007 – 2015 Actual, 2016 – 2022 Forecast



Sources: LMC Automotive

Note: Percentages represent year-over-year changes in Mexican production and forecast numbers.

In recent years, Mexico has become a key destination for investment from all types of manufacturers, but especially from automakers and their suppliers. While automotive assembly compensation is approximately 80 percent lower in Mexico than in the United States, low wages are not the only factor that makes Mexico an attractive investment destination. Mexico offers workforce development and training programs and other aggressive development incentives. At the Federal level, Mexico is pursuing multiple coordinated strategies to support and grow a strong manufacturing base, and many of these initiatives aim to address current weaknesses in the country’s value proposition for manufacturing industries. The efforts include strengthening the educational system, improving the legal system, investing in public infrastructure, and combating crime and violence.

Perhaps more importantly, the low value of the U.S. dollar vis-à-vis other currencies (e.g. Yen, Euro) has made Mexico the most advantageous auto manufacturing location in the NAFTA region. Low production costs and low tariffs due to the broad reach of Mexico’s free trade agreements (FTAs) made it possible for the country to emerge as a prime export base—not only within NAFTA, but globally as well. Exports from Mexico to 44 countries are exempt from tariffs, including the 10 percent tariff the European Union assigns to imported motor vehicles. Asian and European automakers closed production in their home countries to relocate to Mexico, and while U.S.-based automakers have not relocated production, they have responded by increasing Mexican investment in order to remain globally competitive.

U.S. consumer preferences, low fuel prices, and U.S. regulatory mandates have also contributed to increasing the attractiveness of Mexico as a location for passenger car production. Passenger cars overall have a lower margin than larger vehicles—such as pickup trucks, SUVs, and CUVs—and Mexico offers a way due to lower manufacturing costs, and gain access to non-NAFTA markets where many consumers prefer cars over pickup trucks and SUVs.

This research provides an analysis of the factors that make Mexico attractive to manufacturers. Forecasts show vehicle and engine production, as well as Mexico's overall share of North American production increasing. Mexico is expected to experience continued automotive growth in spite of potential negatives for automakers and suppliers; these negative factors include the country's lack of a well-developed port system, relatively high utility costs, and the dangerously high crime rate.

Twenty percent of all North American light vehicles are produced in Mexico; going forward, the ceiling for Mexican automotive manufacturing capacity has no bounds. If Mexico's federal initiatives succeed, particularly at expanding port capacity and improving the skills of the labor force, the shift of North American automotive manufacturing to Mexico will continue. Automakers will draw their supply base to Mexico, and given the tendency of automakers to locate research and development facilities near assembly plants, Mexico may also capture an increasing share of engineering, provided continuing improvements in Mexican education systems.

The report provides two tools to demonstrate some of the factors and implications of manufacturing in Mexico as opposed to the United States, Canada, Japan, South Korea or Germany. One is a cost model that analyzes the competitiveness of Mexico as a manufacturing base for a typical midsize sedan. The factors included in this analysis are assembly plant labor, parts cost, transportation of the vehicle to its destination, and FTA advantages. The report also includes a matrix designed to illustrate which factors are likely to make an automotive supplier investment favor Mexico as a location. The decision factors include amount of labor content, automation and tooling support, access to and processing of advanced materials, how process-intensive production is, how energy-intensive production is, whether the product is for export outside of the NAFTA region, and whether or not a specially trained workforce is necessary.

Introduction

The Mexican automotive industry has undergone a period of intense growth, and will soon produce nearly half as many vehicles annually as the United States. However, after a strong period of continuous growth in annual vehicle sales in North America, the forecast is for the North American automotive market to level off or even decline over the next five years. Automotive investment brings with it the promise of regional prosperity due to the complex supply chain required to support vehicle production. The competition for automotive investments, already intense between Canada, Mexico, and the United States, will become more intense with a lower frequency of new assembly plant announcements, as well as the supplier investments that are often associated with an automaker site selection.

The battle for automaker investment in Canada and the United States must focus on retaining and expanding existing facilities, while the battle for supplier investment will focus on the suppliers that are growing, and Asian and European companies that are setting up operations in North America. This study analyzes the dynamics behind the growth of the automotive industry in Mexico and provides insight into the future of Mexican automotive expansion. This paper provides U.S. and Canadian economic development officials with an assessment of Mexico's success in attracting growing automotive investment, as well as the drivers of those successes. In addition, the authors characterize which types of automotive investment are most likely attraction and retention targets for the United States and Canada. This paper may likewise be of interest to automotive suppliers that do not have a major presence in Mexico and are trying to gain a better general understanding of the considerations surrounding potential investments.

In recent years, Mexico has become a key destination for investment from all types of manufacturers, but especially from automakers and their suppliers. The country's aggressive incentives, which include newly available educational and on-the-job training funding, infrastructure improvements, and competitive tax abatements, are bringing in billions of dollars in investments and creating thousands of Mexican jobs. Since the beginning of 2010, automakers, including BMW, FCA, Ford, General Motors, Honda, Hyundai, Mazda, Nissan, and Volkswagen, have announced more than \$24 billion in Mexican investments.¹ Many of the announced investments were for expansion or retooling of existing facilities, but a large portion of this investment was announcing plans to build new factories by companies such as BMW, Ford, Honda, Hyundai, Mazda, Nissan, and Volkswagen/Audi.

In addition to traditional manufacturing operations, automakers are choosing Mexico as a place to locate research and development (R&D) centers. Companies such as FCA, General Motors, Nissan, Volkswagen, Continental, and Delphi have automotive research and engineering facilities located in Mexico. Both the Mexican government and other private organizations are also focusing on attracting

¹ CAR Book of Deals, 2016.

and growing automotive R&D centers, though Mexico recently discontinued its most attractive incentive—a 30 percent tax break for R&D investments.

Growth in Mexico’s automotive manufacturing labor costs has been relatively flat in the last decade, while countries such as China and Brazil have seen automotive labor costs nearly double over the same period. However, Mexico’s success in attracting automotive investments is only partially the result of lower costs of production in Mexico. The country is developing a reputation for high quality production. Mexico is improving its educational systems and now graduates more than 90,000 engineers and technicians annually, meaning that automakers and suppliers can rely on a local labor pool of Mexican-trained engineers to a greater extent than ever before.

Finally, Mexico is experiencing unprecedented export growth, largely due to the country’s favorable trade agreements with the rest of the world. Mexico is working to increase trade with other countries, and has entered into 13 different free trade agreements (FTAs) involving 44 countries that account for over 60 percent of global Gross Domestic Product (GDP). These FTAs include the North American Free Trade Agreement (NAFTA), the European Free Trade Association (EFTA), the Northern Triangle, and nine trade agreements with individual countries. Mexico also recently joined the Trans-Pacific Partnership (TPP), which will add an additional 6 countries to the Mexico’s list of preferred trading partners.² By comparison, the United States is involved in FTAs that include just 20 other countries and account for only 14 percent of world economic output. Through its FTAs, Mexico had tariff-free access to 47 percent of the global new vehicle market in 2015, while automakers in the United States had access to only 9 percent.³

Mexico’s expanding list of financial and strategic advantages for automotive manufacturers and parts suppliers is quickly solidifying Mexico’s position as a major player in the global automotive industry. There are negatives to locating in Mexico, of course. The process of establishing a legal business entity in Mexico takes longer than in the United States, and the fees are higher. Purchasing property in Mexico takes longer than in the United States, as do government permits and procedures that are required to begin construction. Once businesses are operating, there are additional costs in Mexico over and above what the same services cost in the United States. For example, Industrial rates for natural gas and electricity are higher in Mexico than in the United States.⁴ Importing to and exporting from Mexico takes roughly twice as long as the same procedures in the United States, and the cost of production distribution in Mexico is 40 percent higher than in the United States. Finally, the business cost of crime is nearly 50 percent higher in Mexico—leading to higher security costs, insurance, and losses.⁵

This report draws on more than two dozen interviews with automakers, auto suppliers and United States and Mexican government trade agencies. Additionally, researchers used a number of proprietary

² There are 12 countries in the TPP (including Mexico), however, Mexico already has FTAs with 5 of these – adding a net of 6 countries with which Mexico will have trade agreements.

³ CAR analysis of global vehicle sales data from the Organisation Internationale des Constructeurs d’Automobiles (OICA), and the free trade agreements of Mexico and the United States.

⁴ <https://www.imf.org/external/pubs/ft/wp/2015/wp1545.pdf>

⁵ <https://www.competitivealternatives.com/industries/indsummary.aspx?id=883>

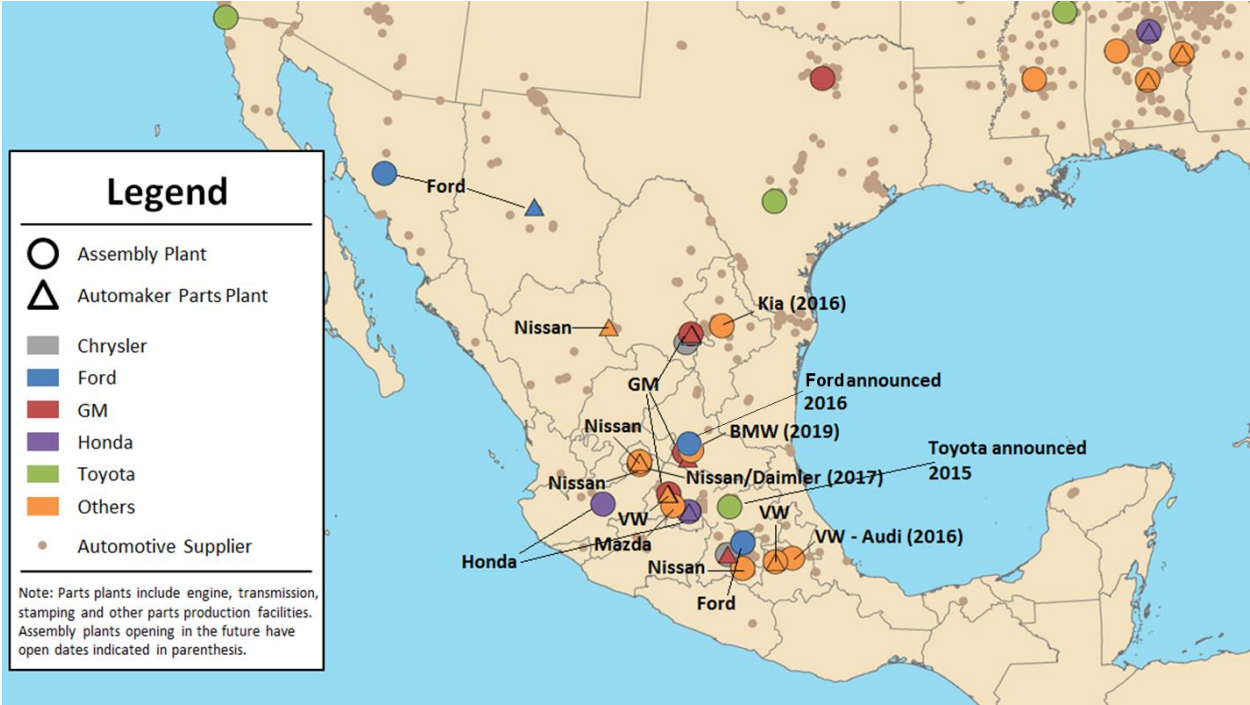
databases on automotive investment, capacity, industry forecasts, incentives and production. This report is targeted primarily for government decision-makers at local and regional levels to understand the factors involved in industrial site options between Mexico, the United States, and Canada, but may also prove useful to automotive suppliers who do not yet have operations in Mexico.

Overview of the Mexican Automotive Industry

Light Vehicle Production Trends

In 1987, Mexico was a small player in the North American automotive industry, producing only 3 percent of the continent’s vehicles. The country’s central location in the Western Hemisphere along with the passage of the North American Free Trade Agreement (NAFTA), offers of aggressive incentive packages from the Mexican government, and reduction in trade barriers with the rest of the world, have resulted in billions of dollars of automaker and supplier investment and re-investment. Figure 2 shows automaker-owned assembly and parts plants that are currently operating in Mexico, as well as plants that have been announced but are not yet in operation. The figure shows the date these new plants are expected to begin operations next to the name of the automaker that owns the facility.

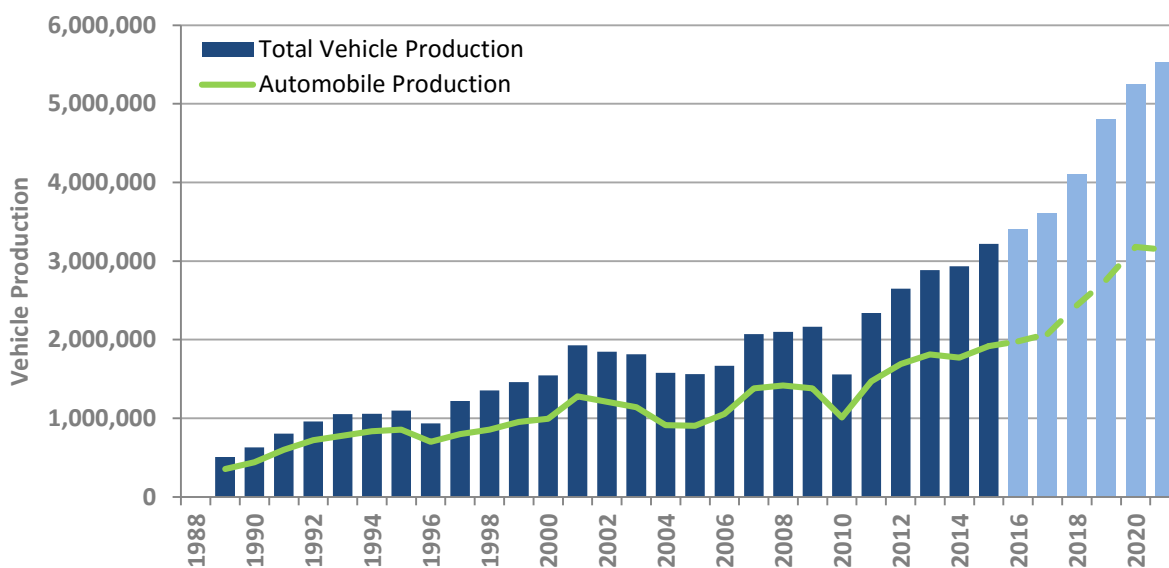
Figure 2: Mexican Automaker Assembly Plants and Automaker-owned Parts Plants as of June 2016



Even though Mexican light vehicle production continues to trend upward over time, volume has fluctuated over the years—reaching low points in 1995, 2004, and dipping to just over 1 million vehicles between 2008 and 2009, when the effects of the global recession affected the auto industry. By 2010, production had recovered, reaching nearly 1.5 million units. Overall, car production represented an average of 65 percent of Mexican total vehicle production between 1996 and 2014, with the production of large trucks, tractors, and buses accounting for 35 percent of vehicle total production.

Mexico joined NAFTA in 1994, and the country transitioned to an open market throughout the remainder of the 1990s. In recent decades, vehicle production in Mexico includes a large share of vehicles manufactured for export. Between 1990 and 2014, the percentage of vehicles manufactured in Mexico for export increased from 34 percent to 82 percent. This trend recently reversed; according to an *Automotive News* report in January 2016, Mexican production climbed 4 percent while exports fell 5.9 percent after shipments to Brazil and China floundered.⁶ Despite the reduction in vehicle exports, automakers are doing well in Mexico as demand for new vehicles in the Mexican market booms. “When companies such as Honda Motor Company could not export some made-in-Mexico cars to struggling economies in 2015 due to low demand, they chose to sell them to [Mexican customers]. Several factories have modified production plans for this year to account for more sales in Mexico.”⁷

Figure 3: Mexico Vehicle Production: Automobiles, Trucks, and Buses: 1988-2015 Actual and 2016-2020 Forecast



Source: Asociación Mexicana de La Industria Automotriz-Mexican Automotive Industry Association (AMIA) and Instituto Nacional de Estadística y Geografía --- National Institute of Statistics and Geography (INEGI), LMC Automotive, Ward's Automotive, U.S. Federal Reserve Board, Statistics Canada, and CAR Estimates
 Note: NAFTA took effect in 1994

In 2013, Mexico produced more than 1.7 million light vehicles and more than 1.1 million heavy-duty vehicles like trucks and buses, totaling roughly three million units. The next year, Mexico became the seventh largest vehicle producer in the world when total vehicle production surpassed 3.2 million units. U.S. demand for heavy trucks is driving the growth in this manufacturing sector in Mexico; 83 percent of Mexican heavy truck production is exported to the United States.⁸ Figure 3 above shows light vehicle production (red line) compared to total vehicle production in Mexico (blue columns).

Mexico now produces approximately 20 percent of the light vehicles made in North America. In 2008, Mexico surpassed Canada to become the second largest North American producer of light vehicles. In

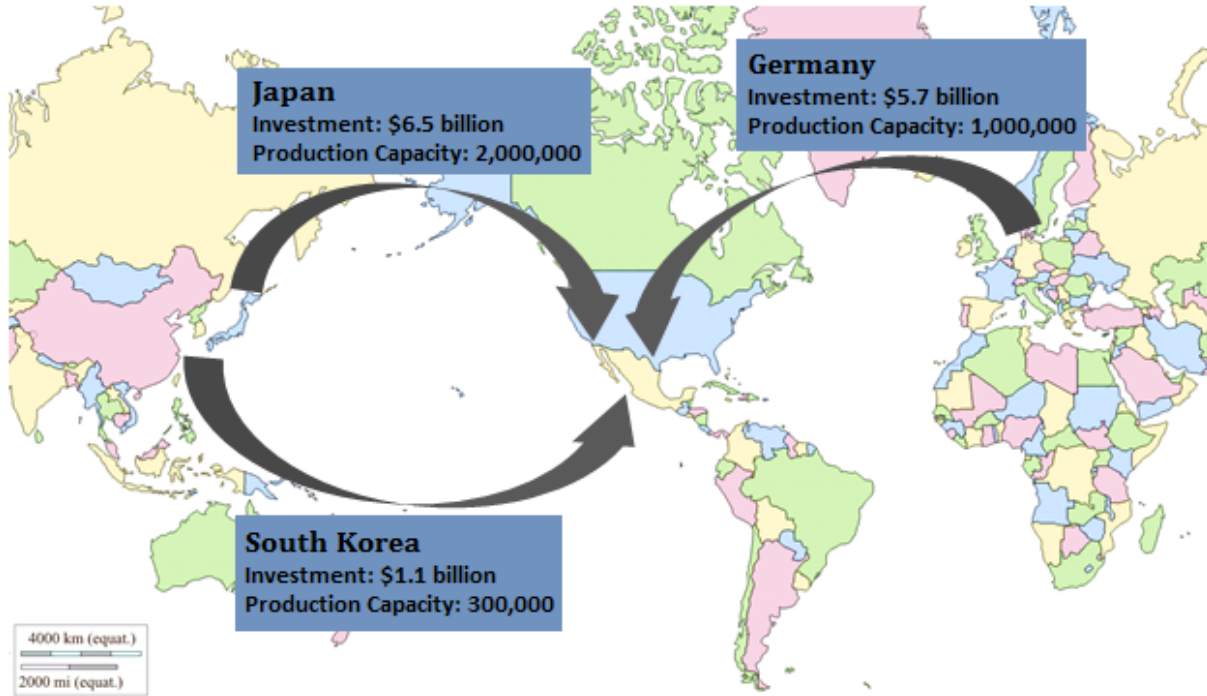
⁶ <http://www.autonews.com/article/20160105/RETAIL01/160109963/in-hot-mexico-market-even-troubled-vw-is-thriving>

⁷ Ibid.

⁸ <http://mexiconewsdaily.com/news/heavy-truck-and-bus-exports-soar-in-2015/#sthash.rH0zoPD.dpuf>

addition, Mexico has captured 9 of the last 11 announced new assembly plants for the continent since 2011, and is expected to significantly increase light vehicle production to more than 5 million units by the end of the decade.

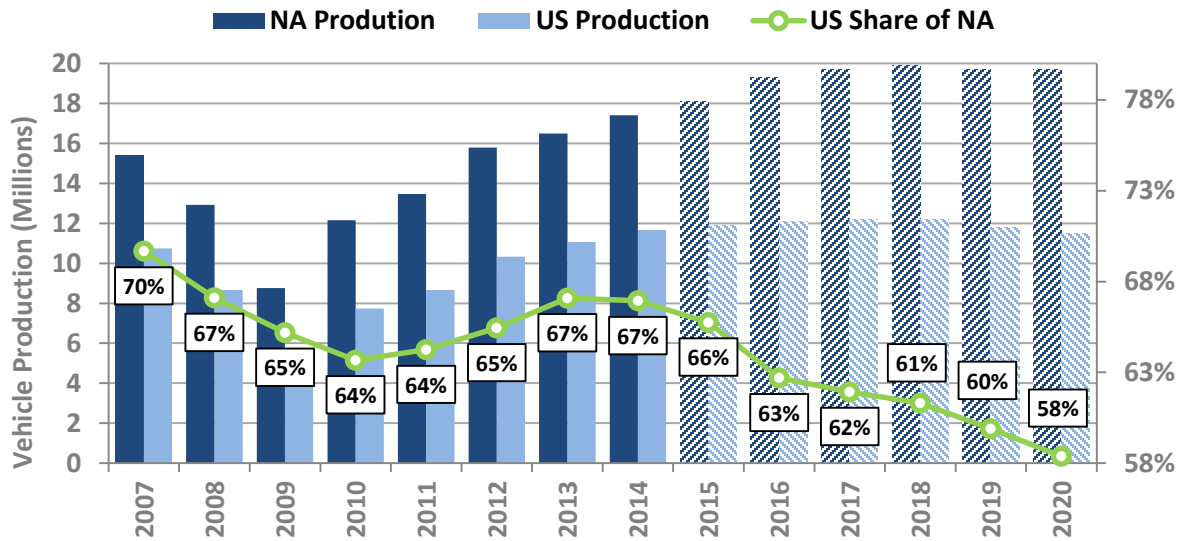
Figure 4: German, Japanese, and Korean Production Capacity and Investment in Mexico between 2010 and 2015



Source: LMC Automotive, CAR Book of Deals, d-maps.com

As costs for OEMs rise to meet higher emission standards and greater fuel efficiency requirements, automakers look to trim costs in other areas. For this reason, new investment is flowing into Mexico. Japanese automakers, for example, have invested over \$6.5 billion in the country since 2010. Figure 4 above shows the amount of investment into Mexico from three major automobile-producing countries. Many international automotive firms have closed manufacturing lines in their home countries to establish a manufacturing base in Mexico. The investments slated for Mexico might otherwise have been made in Canada, the United States, or in the companies' home countries—indicating that Mexico is capturing a majority of new assembly capacity being built for the North American market.

Figure 5: U.S. Vehicle Production and its Share of North American Production: 2007-2014 Actual; 2015-2020 Forecast



Source: Ward's Automotive, CAR 2015

The blue line in Figure 5 shows the U.S. share of vehicle production in North America, which is predicted to drop below 60 percent by the end of the decade. Much of the reduction in U.S. share is due to new production coming online in Mexico rather than shuttering and moving current U.S. production capacity out of the country. The United States is not yet losing substantial existing production to Mexico, but rather it is missing the incremental growth and investment from automakers and suppliers as these companies choose to locate their new investments in Mexico.

Announced Production Shifts, 2015

The 2015 UAW labor contracts revealed several production moves at FCA, Ford, and GM. With U.S. labor costs increasing relative to Mexican labor costs, it is widely believed that small car production will largely move to Mexico, as labor represents a sizeable share of the production cost of these vehicles. Ford announced plans to build a new assembly plant during the spring of 2016.⁹ While not confirmed, the following product movements are expected:¹⁰

- The Chrysler 200 and Dodge Dart will cease production, and the Dodge Journey and its replacement are expected to be sourced within the United States, with production likely at Belvidere Assembly in Illinois.
- Production of the Ford Focus and C-Max at Michigan Assembly Plant will cease, as will production of the Lincoln MKC at Louisville Assembly Plant in Kentucky, with all three vehicles shifting to Mexico. Production of the Ford Fusion will more than double at Hermosillo Assembly in Mexico, utilizing capacity freed by moving production of the Lincoln MKZ to Flat Rock

⁹ Snavely, "Ford to invest \$1.6 billion for new plant in Mexico," *Detroit Free Press*, April 5, 2016, <http://www.freep.com/story/money/cars/ford/2016/04/05/ford-invest-16-billion-new-plant-mexico/82645712/>

¹⁰ LMC North American Powertrain Production. 2015 Q4.

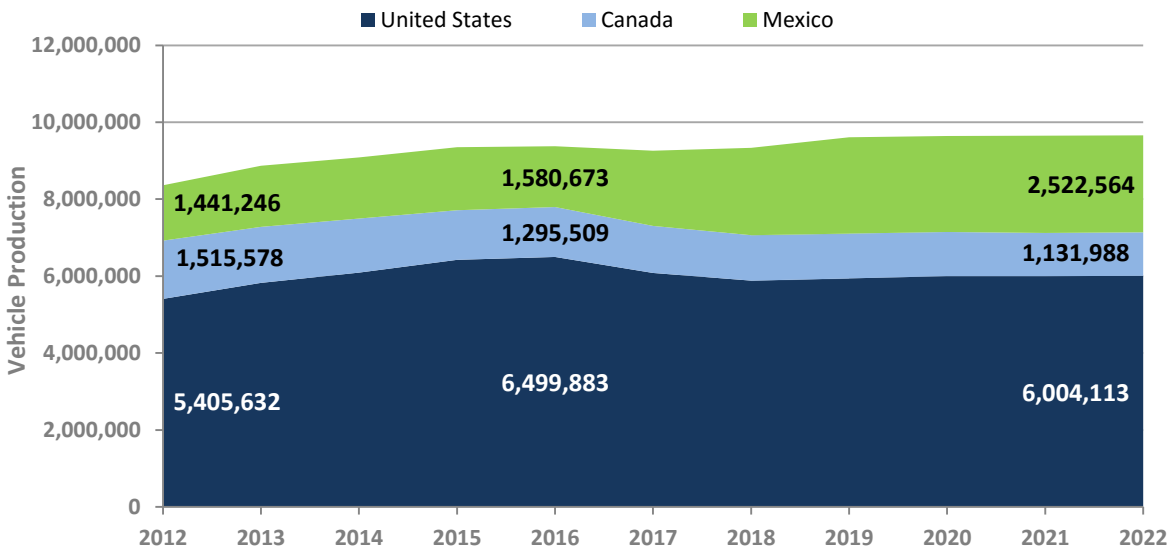
Assembly in Michigan. The new Ford assembly plant in San Luis Potosi is expected to build small cars and CUVs.

- Production of the Cadillac SRX and Chevrolet Captiva Sport will cease at GM’s Ramos Arizpe Assembly Plant. The SRX will be renamed as the XT5 and shifted to Spring Hill Assembly in Tennessee, while the Captiva will be discontinued. The resulting free capacity at Ramos Arizpe will be used for production of the Chevrolet Cruze, the Chevrolet Equinox, and the South American Chevrolet Onix. Canadian production of the Equinox and U.S. production of the Cruze will continue, however Ramos Arizpe will be the only site for North American production of the Onix.

Following these shifts and other capacity adjustments, overall North American production by FCA, Ford, and GM, is expected to increase by more than 285,000 vehicles between 2016 and 2020 (approximately 3 percent of overall North American production). All of this increase will stem from production growth of 850,000 vehicles in Mexico (approximately 9 percent of all North American production).^{11,12} Total production volumes in the United States and Canada are expected to decline by 430,000 and 135,000 (5 percent and 1 percent of total North American production),¹³ respectively over the same period.

Figure 6 below illustrates this shift, as a notable percentage of vehicle production shifts from the United States (blue), to Mexico (green).

Figure 6: Total Ford, GM, and Fiat-Chrysler Production in North America, by Country: 2012-2015 Actual, 2016-2022 Forecast



Source: LMC Automotive

¹¹ LMC North American Powertrain Production. 2015 Q4.

¹² Automotive News Data Center (2016). *North American Car & Truck Production by Plant, Dec. & YTD*. Retrieved from Automotive News Data Center database

¹³ Ibid.

Capacity Utilization

Recently, automotive companies have focused their efforts on increasing both capacity and capacity utilization. In the last five years, automakers have undertaken a number of expansion projects for their Mexico plants, as production levels in these plants begin to reach capacity. As shown in Table 1, capacity utilization levels in Mexico reached almost 100 percent during 2012 and 2013. In 2014, capacity utilization remained high, at 94 percent of total capacity.

Table 1: Mexico and North America Production vs. Capacity: 2007-2014 Actual, 2015-2018 Forecast

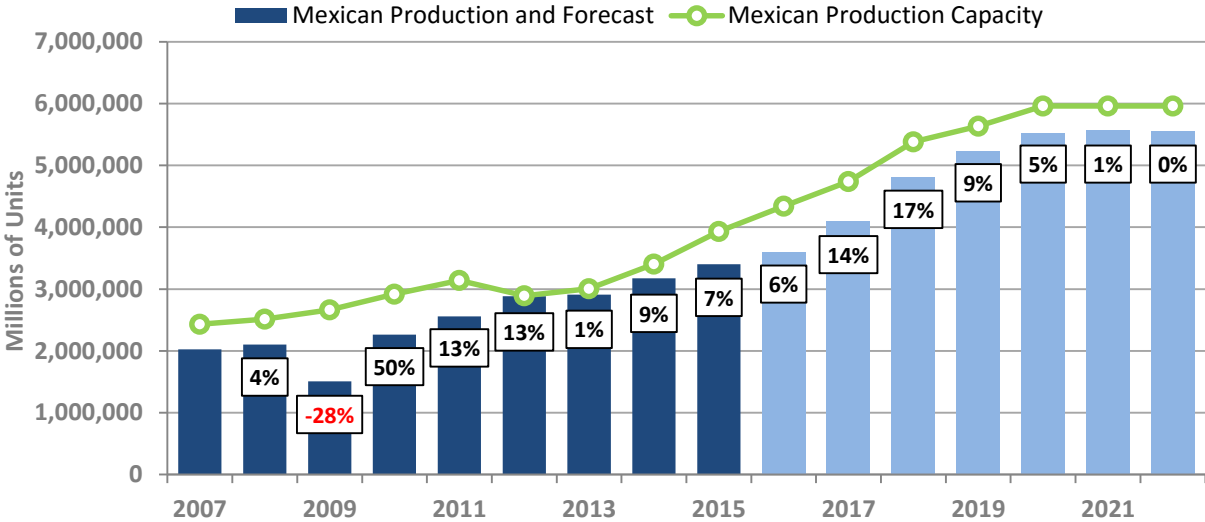
	Mexican Production and Forecast	Mexican Production Capacity	Mexican Capacity Utilization	North American Production Forecast	North American Capacity	North American Capacity Utilization	Mexican Capacity as a Percentage of North American Capacity
2007	2,022,241	2,433,307	83%	15,426,345	20,230,028	76%	12%
2008	2,102,801	2,515,089	84%	12,922,468	20,805,115	62%	12%
2009	1,507,527	2,665,000	57%	8,761,823	17,911,800	49%	15%
2010	2,260,809	2,915,000	78%	12,157,040	17,610,800	69%	17%
2011	2,557,550	3,140,000	82%	13,478,426	17,764,000	76%	18%
2012	2,884,869	2,892,500	100%	15,800,943	17,401,300	91%	17%
2013	2,933,465	3,005,000	98%	16,500,815	17,421,300	95%	17%
2014	3,219,786	3,403,000	94%	17,422,866	18,176,800	96%	19%
2015	3,477,620	3,934,000	88%	17,461,846	19,018,800	92%	21%
2016	3,639,042	4,341,500	84%	17,854,461	19,764,000	90%	22%
2017	4,201,307	4,629,000	91%	18,221,137	20,076,600	91%	23%
2018	4,375,702	5,024,000	87%	18,589,524	20,591,600	90%	24%

Sources: LMC Automotive, AMIA, INEGI, Ward's Automotive, U.S. Federal Reserve Board, Statistics Canada and CAR estimates

Mexican production reached 3.48 million light vehicles in 2015. According to LMC's Q1 2016 forecast, capacity utilization was expected to be over 88 percent in 2015. LMC estimates that by 2018, auto companies will increase light vehicle production capacity by 48 percent and automotive production by 36 percent.

Figure 7 shows that LMC is forecasting Mexican production to reach 5 million vehicles sometime between 2018 and 2019.

Figure 7: Mexican Production vs. Production Capacity: 2007 – 2015 Actual, 2016 – 2022 Forecast



Sources: LMC Automotive

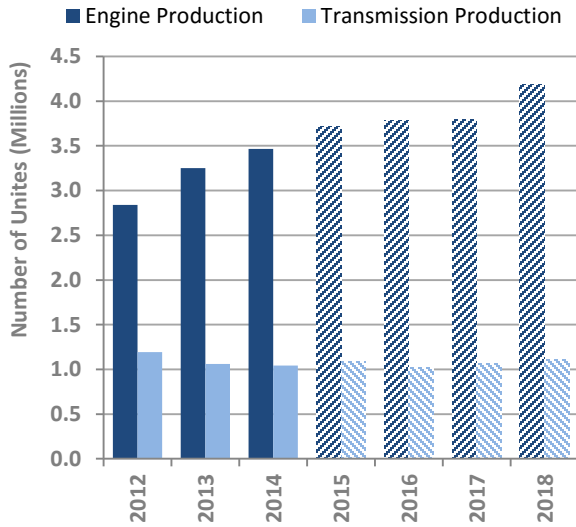
Note: Percentages represent year-over-year changes in Mexican production and forecast numbers.

Engine and Transmission Production Trends

A large number of automakers and suppliers produce engines and transmissions in Mexico, and many of these companies are currently investing to expand their operations. For example, Ford announced in April 2015 that it will make a \$2.5 billion investment to shift production of 1.5-liter engines from China and the U.K. to Mexico.

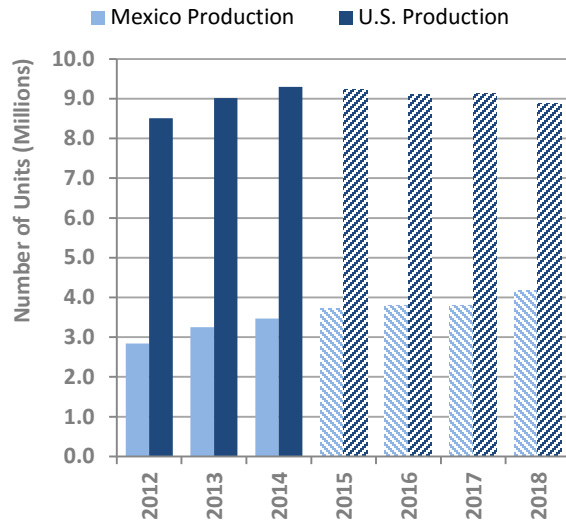
As shown in Figure 8, Mexico has expanded its powertrain production numbers over the past several years. Figure 9 shows that from 2012 through the full year 2015 alone, engine production is projected to increase by over 31 percent—from 2.8 million to 3.7 million engines. Additionally, engine production is projected to grow to 4.2 million units by 2018. This rapid growth is the result of the expanded vehicle assembly presence in the area. Mexican transmission production numbers, on the other hand, are projected to remain relatively stagnant.

Figure 8: Mexico Powertrain Production: 2012-2014 Actual and 2015-2018 Forecast



Source: LMC Automotive, 3Q Production Forecast

Figure 9: Engine Production in Mexico and the United States: 2012-2014 Actual and 2015-2018 Forecast

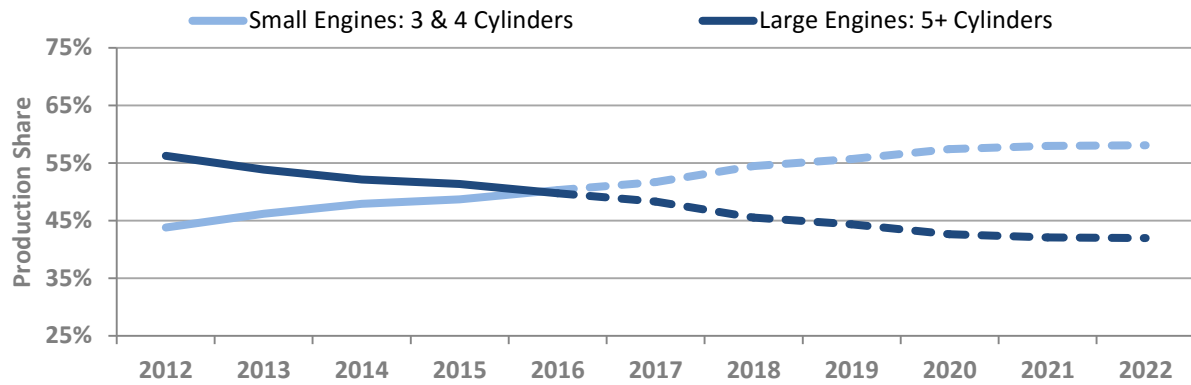


Source: LMC Automotive, 3Q Production Forecast

Compliance with the 2025 fuel economy mandates has already had a dramatic impact on how vehicles are designed and built. There has been a rapid and ongoing shift towards smaller engines: 3- and 4-cylinder engines, which accounted for less than 44 percent of engine production in 2012, are expected to represent 58 percent of all North American engine production by 2022.¹⁴ Figure 10, below, shows this change as small engine share (blue line) steadily captures production share over the next 7 years, and large engines (red line) lose share. In order to maintain vehicle performance, turbochargers are often added to these small engines. Since Mexico builds a large share of small engines and the small passenger vehicles these engines are installed in, Mexican production of turbocharger units may be positioned to increase rapidly.

¹⁴ LMC North American Powertrain Production. 2015 Q4.

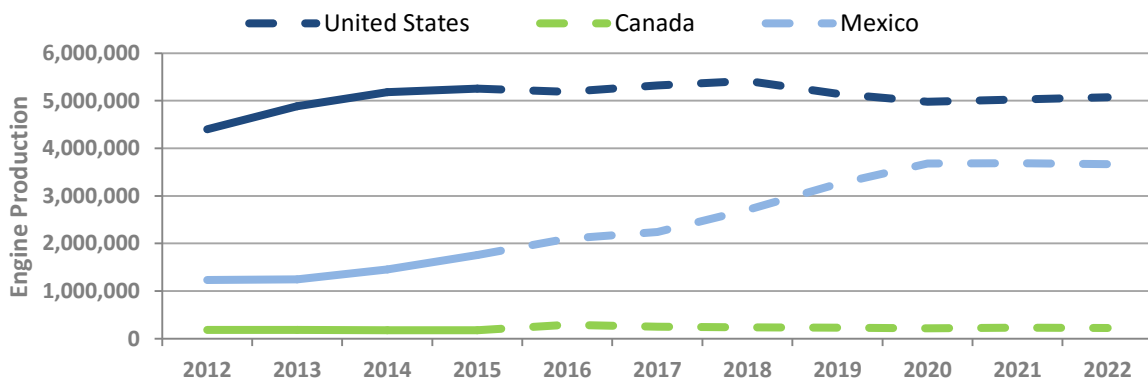
Figure 10: Small and Large Engine Shares of North American Production: 2012-2015 Actual; 2016-2022 Forecast



Source: LMC Automotive

This shift in engine production further reinforces the drive of automotive investment to Mexico. Historically, small engines have been made in Mexico, while 5-cylinder engines and larger have been produced in the United States and Canada. Overall, North American engine production is expected to increase nearly 5 percent from 2015 to 2020, and large engine production is expected to decline more than 13 percent over the same period. These changes (shown in Figure 11) show a drop in United States production, represented by the blue line, and a sharp increase in Mexican production, represented by the green line. Canadian production, represented by the red line, is not expected to change significantly during this period. Between 2015 and 2020, total North American small engine production is expected to grow in excess of 23 percent,¹⁵ and nearly all of this growth is projected to occur in Mexico.

Figure 11: North American 3- and 4-Cylinder Engine Production by Country: 2012-2015 Actual; 2016-2022 Forecast



Source: LMC Automotive

Total engine production in North America is expected to increase from 14.8 million units in 2015 to 15.5 million units in 2020. In the United States, total production will fall by 4.7 percent—a decline of almost

¹⁵ LMC North American Powertrain Production. 2015 Q4.

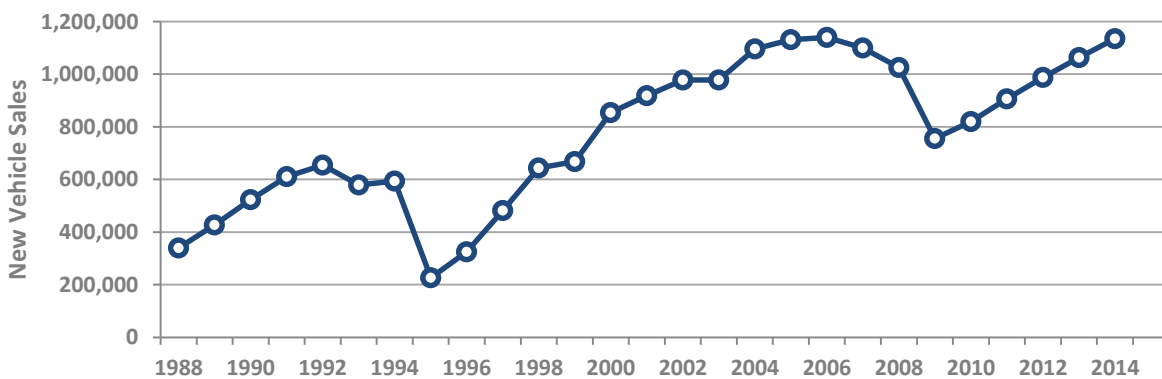
half a million units. Canadian engine production volume will fall by a lesser amount, 185,000 units, but due to Canada’s smaller engine capacity, this drop represents a far larger decline of 18.9 percent. In contrast, Mexican engine production will grow by more than 36.3 percent, gaining 1,350,000 units. With its history of building smaller engines, Mexico is well positioned for future automotive production that is driven by fuel economy and emissions regulations.

Development of Domestic Market for Vehicle Sales

In 1995, new vehicle sales in Mexico declined sharply due to a sudden devaluation of the Mexican peso against the U.S. dollar.¹⁶ The causes of this peso crisis included a public sector deficit and currency issues, among other factors.¹⁷ The crisis meant that light vehicle sales fell by more than half, from 594,000 units in 1994 to 227,000 units in 1995. During this period, Mexico also faced a significant economic crisis, and was forced to borrow money and allow its currency value to fluctuate in order to reverse the crisis.

The second sharpest decline in Mexico’s domestic vehicle sales occurred in 2009 due to the Great Recession. Vehicle sales began to fall in 2007, and by 2009, they had dropped to 755,000, but by 2014, the Asociación Mexicana de la Industria Automotriz (AMIA) reported sales of just over one million units—a return to pre-recession sales numbers. Through November 2015, AMIA reported record sales of 1.2 million units sold—an increase of nearly 20 percent over 2014. These fluctuations in the Mexican domestic market are shown in Figure 12.

Figure 12: Mexico New Vehicle Sales: 1988-2014



Source: Asociación Mexicana de la Industria Automotriz (AMIA)

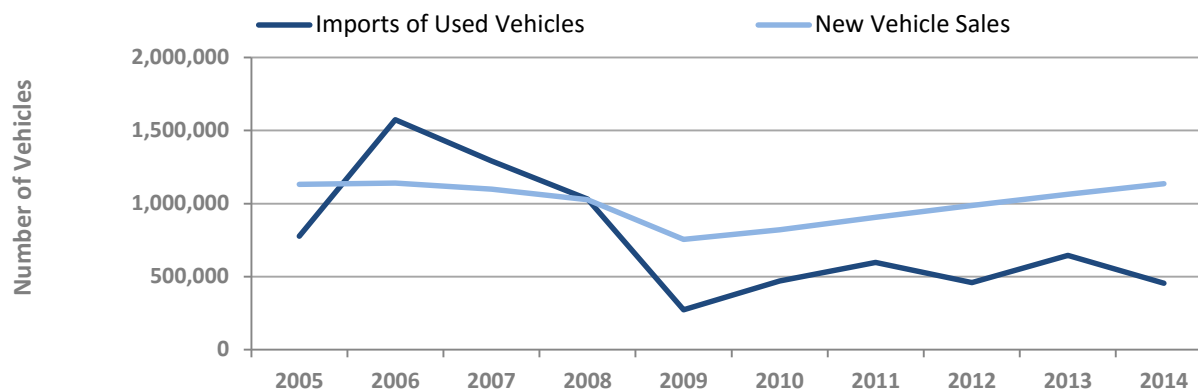
The market for vehicles in Mexico differs from that in the U.S. in that a large portion of vehicles are used vehicles that are imported. Figure 13 shows that Mexico imported 455,000 used vehicles in 2014, which equates to just over 40 percent of new vehicle sales for that year. In 2014, the proportion of imported

¹⁶ <http://www.colorado.edu/economics/courses/econ2020/6550/readings/Mexico-currency.html>
<http://www.cnnexpansion.com/economia/2009/01/30/la-crisis-del-199495-y-la-actual-crisis>

¹⁷ Ibid.

used vehicles in 2014 was about 30 percent lower than it was in 2013. Overall, used vehicle imports as a share of new vehicle sales have decreased considerably in Mexico compared to 2006.

Figure 13: Mexican Used Vehicle Imports vs. New Vehicle Sales: 2005-2014



Source: Asociación Mexicana de la Industria Automotriz (AMIA)

Vehicle sales in Mexico have increased considerably in recent years, partly due to greater credit availability and new policies, which came into effect in mid-2014, that limit the number of used cars imported from the United States.¹⁸ New vehicle sales have increased in Mexico despite the country’s sluggish economic growth and the decline in the relative value of the peso.

Mexico and Its Favorable Trade Environment

Tariffs and Trade Agreements

Mexican automotive exports benefit from the more than 40 different free-trade agreements Mexico has entered into with other nations. According to CAR estimates, these agreements give automotive exporters duty-free access to countries containing more than 60 percent of international economic output, as defined by global GDP.¹⁹ On a unit-sales basis, Mexico’s FTAs provided tariff-free access to 47 percent of the global new vehicle market in 2015.²⁰ For instance, Mexico’s trade agreements provide for duty-free exports to two of the world’s largest automotive markets—the European Union and Brazil (with whom Mexico has a limited Auto Trade Agreement)—whereas exporters from the United States to these regions pay 10 percent and 35 percent tariffs, respectively.²¹ In 2014 alone, light vehicles assembled in and exported from Mexico to its FTA partners avoided \$1.2 billion in tariffs.²²

Table 2: Mexico’s Exports and Avoided Tariff Payments in 2014

¹⁸ <http://eleconomista.com.mx/industrias/2015/06/02/venta-autos-perfila-record-historico>
<http://lta.reuters.com/article/businessNews/idLTAKBN00J04Q20150603>

¹⁹ <http://www.wsj.com/articles/why-auto-makers-are-building-new-factories-in-mexico-not-the-u-s-1426645802>

²⁰ CAR analysis of global vehicle sales data from the Organisation Internationale des Constructeurs d'Automobiles (OICA), and the free trade agreements of Mexico and the United States.

²¹ <http://www.wsj.com/articles/brazil-mexico-to-renew-auto-trade-agreement-1425899470>

²² Estimated based upon analysis of data from the World Trade Organization, the United Nations COMTRADE, and the Swiss Customs Administration.

Free Trade Agreement	Partner	MFN Average Ad Valorem Tariff	Value of Mexico's Exports (\$)	Estimated Tariff Avoided(\$)
Costa Rica - Mexico; Central America - Mexico	Costa Rica	0.9%	40,284,094	351,464
Northern Triangle - Mexico; Central America - Mexico	El Salvador	20.9%	4,611,390	963,268
Northern Triangle - Mexico; Central America - Mexico	Guatemala	0.0%	19,760,946	0
Northern Triangle - Mexico; Central America - Mexico	Honduras	9.2%	2,623,871	241,979
Nicaragua - Mexico; Central America - Mexico	Nicaragua	8.3%	7,564,593	628,281
Chile - Mexico	Chile	6.0%	190,272,164	11,416,330
Colombia - Mexico	Colombia	30.4%	791,799,603	240,472,472
EFTA - Mexico	Liechtenstein	no data	no data	n/a
EFTA - Mexico	Iceland	0.0%	625,067	0
EFTA - Mexico	Norway	0.0%	2,884,094	0
EFTA - Mexico	Switzerland	4.0%	16,786,259	671,450
European Union - Mexico	European Union	9.7%	2,071,391,681	201,385,302
Israel - Mexico	Israel	5.4%	7,812,680	425,478
Japan - Mexico	Japan	0.0%	166,052,444	0
NAFTA	Canada	5.8%	2,113,465,440	121,759,092
NAFTA	United States	2.5%	22,591,940,047	564,798,501
Peru - Mexico	Peru	6.0%	126,535,424	7,592,125
Uruguay - Mexico	Uruguay	23.0%	85,094,597	19,571,757
Total Value of Mexican Exports and Aggregate Tariff Avoided:			\$28,239,504,394	1,170,277,501
HC 8703 (except buses)				

Sources: WTO, UN COMTRADE, Swiss Customs Administration

Note: El Salvador tariff rate data reflects 2013. Iceland's imports of Mexican vehicles reflect import data reported by Iceland. All other records reflect Mexico's reported export data.

Despite these trade advantages, Mexico still needs to diversify its export markets. The U.S. market, Mexico's biggest customer, is estimated to slow in coming years. "Many OEMs, including the Japanese, are keen to use Mexico as an export base for the wider Latin American region, so improving relations with Argentina and Brazil would make sense." However, both of these countries have capped Mexican imports at \$1.55 billion for the last three years, since they also produce vehicles for the South American market, and tend to view Mexican products as competition. Beyond Brazil and Argentina, Latin America's biggest markets are Chile, Colombia, Ecuador, Peru, and Venezuela. "2012 saw these five countries recording combined sales of 1,000,000 units, indicating the underlying opportunity" for Mexico. Since Mexico produced more than three million units in the same year, "It's imperative that

Mexico views trade agreements with South American neighbors as complementary to the trade agreements with the rest of the world.”^{23,24}

Exports and Imports

As noted earlier, Mexico has FTAs with 44 other countries. Combined, these FTAs allow goods exported from Mexico to reach roughly 60 percent of the world’s GDP tariff-free. For new vehicles, specifically, these FTAs provided tariff-free access to 47 percent of the global new vehicle market in 2015.²⁵ No other country in the world boasts an equivalent export environment. With easy access to both the Atlantic and Pacific oceans, Mexico’s access to global markets has been a powerful tool in attracting automotive investment. This is particularly true for automakers such as BMW and Audi, which specifically plan for their Mexico operations to be global export hubs for the vehicles produced there.

Table 3 details the numerous FTAs in which Mexico is involved and denotes the year in which each agreement became effective. The sheer number of agreements is telling of the potential cost savings that automakers might find in Mexico when attempting to export vehicles outside of North America, since Mexico enjoys FTAs with the European Union and many parts of South America that the United States does not have at this time.

²³ Automotive World Megatrends, Dawson (2014).

²⁴ Ibid

²⁵ CAR analysis of global vehicle sales data from the Organisation Internationale des Constructeurs d'Automobiles (OICA), and the free trade agreements of Mexico and the United States.

Table 3: Mexico's Free Trade Agreements as of 2015

13 FTAs, 44 Countries	Year Entered into Force	Year Treaty Signed	2014 Mexican Exports (\$US Millions)	Tariff %	5 Year Trend in Mexican Exports % (2010-2015)
North American Free Trade Agreement (NAFTA)	1994	1992	24,705	2.5-5.8	+49
Colombia - Mexico	2011	1994	791.8	30.4	+187
Costa Rica - Mexico	1995	1994	40.3	0.9	n/a
European Union - Mexico	2000	1997	2,071	9.7	-10
Nicaragua - Mexico	1998	1997	7.6	8.3	n/a
Chile - Mexico	1999	1998	190.3	6.0	+14
EFTA - Mexico	2001	2000	19.7	0-4.0	+639
Israel - Mexico	2000	2000	7.8	5.4	-63
Northern Triangle - Mexico	2001	2000	27.0	0-20.9	n/a
Uruguay - Mexico	2004	2003	85.1	23.0	+50
Japan - Mexico	2005	2004	166.1	0.0	+18
Peru - Mexico	2012	2011	126.5	6.0	+145
Central America – Mexico	2012*	2011	74.8	8.3	+140

Sources: Villarreal, M. Angeles. "Mexico's Free Trade Agreements." Congressional Research Service. July 2012.; Foreign Trade Information System. "Trade Policy Developments: Central America - Mexico." 2014.

*El Salvador - Mexico component not yet in force. Once in force, Mexico will have FTAs with 46 countries.

Manufactured goods constitute 80 percent of Mexico's exports.²⁶ In terms of automotive exports, Mexico hit record levels for both units produced and units exported in 2015. Though the country is currently the world's sixth largest automobile producer, most of the vehicles it builds are for foreign markets, as approximately 82 percent of the 3.2 million vehicles Mexico produced in 2014 were exported to other countries.²⁷ Mexico's automotive exports can be good news for automotive supplier jobs in the United States, because, due to well-integrated North American supply chains, vehicles produced in Mexico may be comprised of up to 40 percent U.S. content.²⁸

In 2014, Mexico exported \$294.1 billion in total goods to the United States, and imported \$240.3 billion. In its trade relationship with the United States, Mexico is a net exporter of motor vehicle-related goods. Likewise, Mexico is a net exporter in its automotive trade with the United States. In 2014, Mexico exported \$87.1 billion worth of motor vehicles, motor vehicle bodies and trailers, and motor vehicle parts, to the United States.

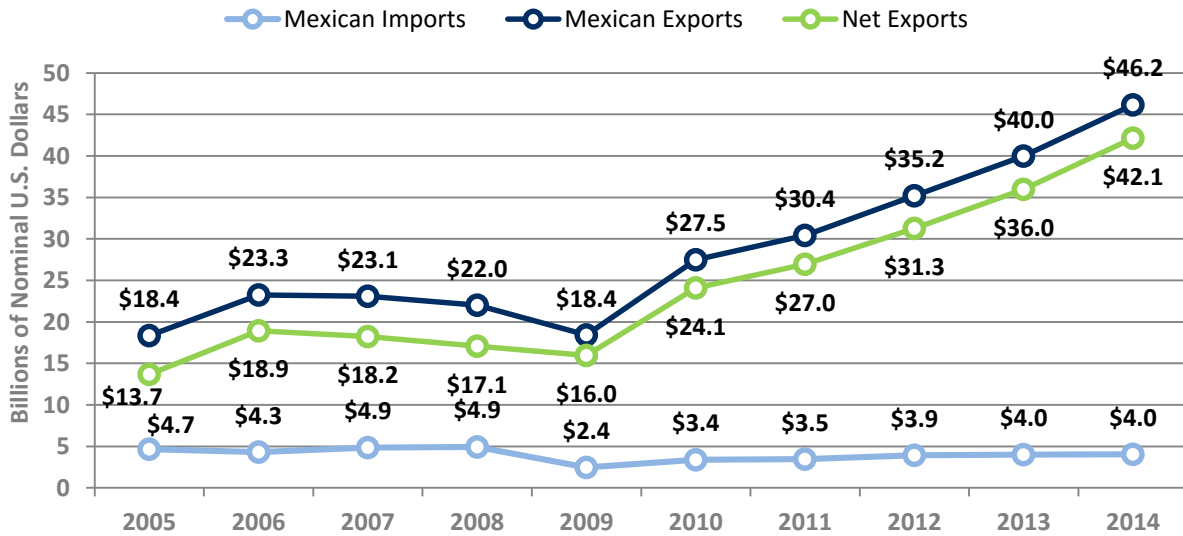
²⁶ Flannery. (2014).

²⁷ Ward's Automotive. Ward's World Motor Vehicle Data 2015. And Althaus, Dudley. (2015). "Mexico Sets Auto Production Record, Aims for More." Wall Street Journal. January 8, 2015. <http://www.wsj.com/articles/mexico-sets-auto-production-record-aims-for-more-1420749573>.

²⁸ Flannery. (2014).

The largest portion of Mexico’s trade surplus in motor vehicle-related goods comes from vehicles, as shown in Figure 14. Since the 2008-2009 recession, Mexican motor vehicle exports to the United States have increased at an average rate of more than \$5.5 billion per year, surpassing the pre-recession high of \$23.3 billion in 2010 and continuing to grow to \$46.2 billion in 2014. Over the same period, imports from the United States have yet to return to pre-recession levels, and have plateaued at \$4.0 billion.²⁹

Figure 14: Mexican Automotive Imports from and Exports to the United States: Motor Vehicles: 2005-2014



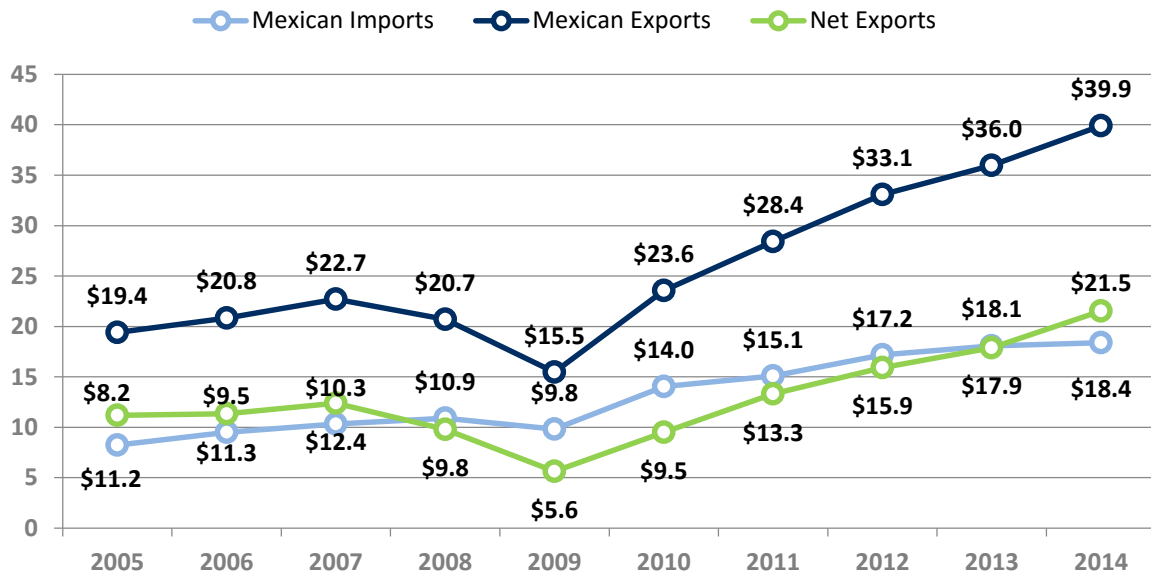
Source: ITA 2015

In 2014, the United States trade deficit in motor vehicles with Mexico was \$44.2 billion, an increase of over 40 percent since 2009. Figure 15 shows that Mexican motor vehicle parts exports to the United States have followed a trajectory similar to motor vehicles, increasing by \$4.9 billion annually since 2009, surpassing pre-recession levels in 2010, and reaching \$39.9 billion in 2014. Motor vehicle parts imports from the United States have shown better growth than motor vehicle imports—they surpassed the pre-recession high of \$10.9 billion and reached \$18.4 billion by 2014.³⁰

²⁹ ITA. (2015) “Global Patterns of U.S. Merchandise Trade.” Interactive Table. Office of Trade and Industry Information, Manufacturing and Services, International Trade Administration, U.S. Department of Commerce. Accessed May 20, 2015. <http://tse.export.gov/TSE/TSEHome.aspx>

³⁰ Ibid.

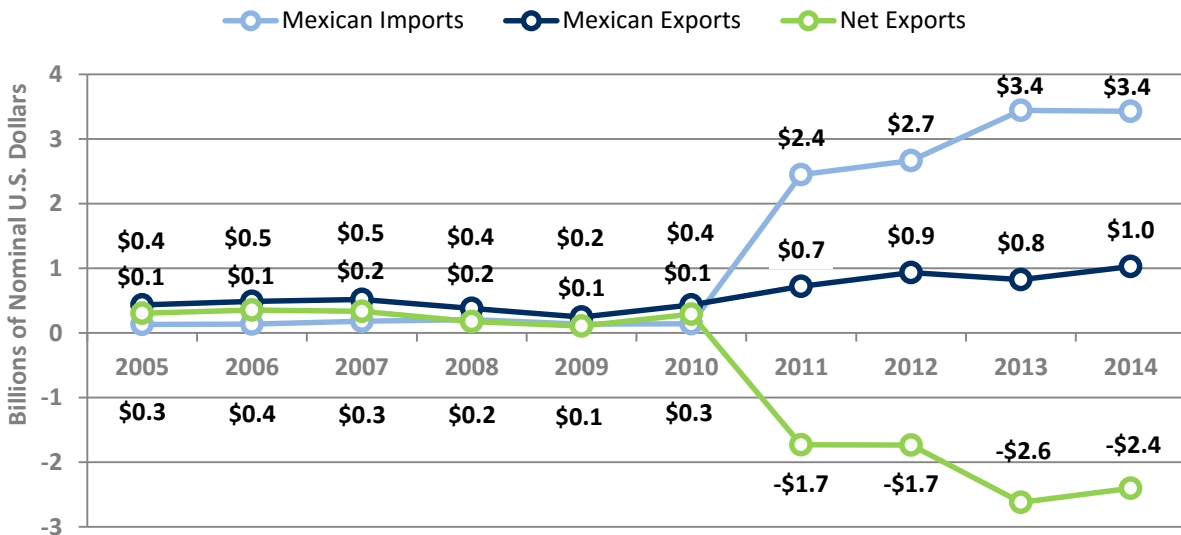
Figure 15: Mexican Automotive Imports from and Exports to the United States: Motor Vehicle Parts: 2005-2014



Source: ITA 2015

In 2014, the United States trade deficit in motor vehicle parts with Mexico was -\$21.5 billion, an increase of over 277 percent since 2009. In 2011, Mexico became a net importer of motor vehicle bodies and trailers with the United States (Figure 16). As of 2014, Mexico imported \$3.4 billion in bodies and trailers from the United States, and exported \$1.0 billion to the United States.³¹

Figure 16: Mexican Automotive Imports from and Exports to the United States: Bodies & Trailers: 2005-2014



Source: ITA 2015

³¹ Ibid.

Auto Supplier Sector Trade

Automotive supplier sector production and trade has grown in parallel with the growth in Mexican vehicle, engine, and transmission production. Automotive suppliers are always encouraged by their automaker customers to locate as close as possible to the final vehicle assembly plant that is using their system assembly or discrete component. This is rational as the automaker wants to optimize supplier response time to production concerns, contain logistic costs, and manage risk. However, suppliers do not want to shoulder the risk of “strained” capacity. That is, suppliers will locate new capacity or consolidate existing capacity to maximize their own utilization rates, minimize their transportation costs in and out of the component facility, and to lower the risk by not having a single, dedicated customer but rather a broad portfolio of automaker customers or numerous end products for a single customer.

There is a great deal of “noise” in the supplier sub-tier trade data; supplier plants are establishing new component capacity in Mexico for the first time or they are expanding off of a very small base in the country. In addition, suppliers often establish capacity to achieve economies of scale, this means production often exceeds local demands, and that excess capacity is filled by exporting out of the facility. As local demand ramps up, suppliers replace exports with local customer demand, and exports may fall off. In the periods in between, trade of discrete parts may grow in unison with their associated final component assembly as a supplier imports parts and exports final assemblies from either side of the border.

While the United States has continued to run a significant trade deficit in motor vehicle parts, bi-lateral trade between the United States and Mexico has increased dramatically between 2010 and 2015. In 2015, the United States imported \$50.1 billion of parts from Mexico, while exporting \$30.0 billion for a trade deficit of \$20.1 billion. From a base of 2010, U.S. motor vehicle parts imports increased 76.3 percent, while U.S. motor vehicle parts exports increased a similar amount of 72.2 percent. The differential between U.S. export and import growth over the five years between 2010 and 2015 nearly doubled the U.S. automotive parts trade deficit with Mexico from \$11.0 billion to \$20.2 billion. The increase in supplier parts trade activity is in context of U.S. vehicle production increasing 57 percent and Mexican vehicle production increasing 54 percent during the same five years.

Table 4: Top Five Auto Parts Exported from the United States to Mexico, 2010-2015

Ranking By Volume 2015	Total Motor Vehicle Parts Exports (In million \$)	2010	2011	2012	2013	2014	2015	5-year change
		17,419	21,429	24,292	26,525	29,051	29,989	72.2%
1	PARTS AND ACCESSORIES FOR VHCLS 8701 TO 8705, NESOI	2,795	4,842	4,981	4,186	3,172	4,596	64.4%
2	PTS AND ACCESSORIES, NESOI, OF BODIES HDG 8701, 8705	2366	1,969	2,065	2,730	2,739	2,686	13.5%
3	COMPRESSION-IGNITION INTERNAL COMBUSTION PISTON ENGINES FOR PROPULSION OF VEHICLES OF CHAPTER 87, TO BE INSTALLED IN ROAD TRACTORS, BUSES, AUTOS, TRUCKS	1,216	1,693	1,863	2,228	3,779	2,635	116.7%
4	PARTS FOR SPARK-IGNITION INTERNAL COMBUSTION PISTON ENGINES FOR USE IN ROAD TRACTORS, MOTOR BUSES, AUTOMOBILES OR TRUCKS	546	934	1,018	1,126	1,257	1,296	137.4%
5	GEAR BOXES FOR VEHICLES OF HEADING 8703	811	805	941	1,113	1,021	1,100	35.6%

Source: U.S. International Trade Administration

Supplier strategies can be discerned in the trade data trends on specific component categories beneath the overall import, export, and trade deficit numbers of the United States and Mexico. As shown in Table 4 the top five supplier exports from the United States to Mexico are a broad category of parts and accessories for vehicles, parts and accessories for bodies, compression ignition internal combustion piston engines, parts for spark-ignition internal combustion piston engines and gear boxes. These are rational as top five exports:

- The broad category of parts and accessories (\$4.6 billion): For parts easily transported, U.S.-based suppliers will fill up existing U.S. capacity as new customers establish operations and demand grows in Mexico. This general category registered the largest year-over-year increase in 2015 of 45 percent.
- Parts and accessories for bodies (\$2.7 billion): Similar to parts and accessories, smaller stampings, hinges, other components can be sourced from the United States until local demand warrants local production or expansion in Mexico.
- Compression ignition internal combustion piston engines (\$2.6 billion): Given the capital investment required, engine “modules” are not added to production until a supplier can anticipate an additional 500,000 to 750,000 units of demand for production close to existing assembly plants.
- Parts for spark-ignition internal combustion piston engines (\$1.3 billion): These components are sourced in clusters around the engines themselves and tend to be produced near the engine plants.
- Gear boxes (\$1.1 billion): The economics of expansion are similar to engines; there must be 500,000 to 750,000 units to justify adding production capacity.

Other notable parts on the trade list are not included in the top five categories in terms of absolute dollars. For example, exports of catalytic converters grew at 26 percent year-over-year, and airbag modules grew at 22 percent. These high value to weight and size ratio justify the additional transportation costs incurred by producing in existing facilities.

There will be variance in the supplier trade data until total production and vehicle mix stabilizes between the United States and Mexico. While one-year declines do not establish a trend, three parts sectors may indicate how trade flows may begin to change. First, combustion piston engine exports declined by 30 percent in 2015 over 2014, as engines are being replaced by local production in Mexico. Second, radial tires declined year-over-year by 12 percent, as U.S. demand for OE and aftermarket tires continued to grow and manufacturers rebalanced the location of their tires sources. Finally, road wheel exports declined by 6 percent even as Mexican assembly production increased by some 230,000 units in 2015. Increases in local supplier capacity or supply from other foreign sources may be the reasons for this decline.

Table 5: Top Five Auto Parts Imported to the United States to Mexico, 2010-2015

Ranking By Volume 2015	Total Motor Vehicle Parts Imports (In million \$)	2010	2011	2012	2013	2014	2015	5-year change
1	INSULATED IGNITION WIRING SETS & WIRING SETS FOR VEHICLES, AIRCRAFT OR SHIPS	3,774	4,743	5,510	5,686	6,522	7,074	87.4%
2	OTHER PARTS AND ACCESSORIES, NESOI, OF BODIES (INC CABS) OF HEADING 8701 TO 8705	2,250	2,654	3,316	3,732	4,082	4,482	99.2%
3	SEAT PARTS OF A KIND USED FOR MOTOR VEHICLES, NESOI	1,398	1,682	2,271	2,634	3,082	3,467	148.0%
4	SPARK-IGNITION RECIPROCATING PISTON ENGINES TO BE INSTALLED IN ROAD TRACTORS, MOTOR	820	1,533	1,832	2,458	2,432	2,279	177.9%
5	PARTS, NESOI, OF MOTOR VEHICLES, NESOI, OF HEADINGS 8701 TO 8705,	1,166	1,385	1,630	1,663	1,895	2,185	87.4%

Source: U.S. International Trade Administration

Table 5 presents the top five U.S. imports from Mexico. Here the supplier strategies and the automaker-drivers are varied.

- Insulated ignition wiring sets (\$7.1 billion): Mexico has been a central NAFTA production hub of these labor-intensive component sets for decades, and the increase of 8.5 percent year-over-year is consistent with increases in automaker production that use these wiring sets.
- Other parts and accessories of bodies (\$4.5 billion): These typically include labor-intensive assemblies that are easily transported. While not in the top three for growth rates (9.8 percent between 2010 and 2015), these components could also fall into the category of exporting from new capacity until sufficient local demand is established.

- Seat parts (\$3.5 billion): Seats—and interior systems in general—are a very price competitive sector where suppliers are always looking to lowest cost production sources to maintain their slim margins.
- Spark ignition reciprocating piston engines (\$2.3 billion): Imports of parts in this import category actually fell in 2015, but it may be a situation where the supply/demand mix is changing within the category. As new engine lines come on-line and vehicle demand for those specific engines decreases.
- Parts not elsewhere specified or indicated (\$2.12 billion): This general category grew 15 percent year-over-year in value in 2015, and again, given the breadth of these components, U.S. vehicle production growth of some 455,000 units may be the driving factor.

Below the top dollar threshold of U.S. parts imported from Mexico, inflators and modules for airbags (at 20.6 percent) and parts for steering systems and other assemblies with universal joints (at 14 percent) showed two of the greatest year-over-year gains for passenger vehicle applications. This indicates the level of cross-border trade occurring with Mexico of discrete components and final assemblies. Year-over-year declines were reported two categories: radio combinations with CD players fell (-14 percent)—primarily driven by vehicle option and sourcing changes and powertrain parts for motor vehicles (-8.1 percent)—most likely reflecting the increase in Mexican-based engine and transmission production.

Foreign Trade Zones

A foreign trade zone (FTZ) is an area where tax and land use policies differ from the surrounding area, and in which foreign goods assembly or other value-added activities can take place without being subject to tariffs or other import duties. FTZs are approved by the state or federal government and are usually located at seaports, airports or manufacturing facilities. Mexico has a new FTZ law.

According to KMPG, changes in Mexico’s customs regulations in recent years have greatly expanded FTZ-like programs beyond conventional Maquiladora operations previously available to importers.^{32, 33} Since 2003, the country has enforced the Strategic Private Bonded Warehouse program (the REFIE), which provides benefits similar to the FTZ programs in the United States and the European Union. “The key benefit under Mexico’s new FTZ law is that when a company is ready to withdraw finished merchandise from the FTZ, tariffs are paid only if the merchandise will be released into local commerce.”³⁴ If the goods are exported to the United States or other markets overseas, they leave Mexico without incurring customs duties or taxes.

Furthermore, since 2007, state governments in Mexico have been authorized to administer REFIEs. When companies deal with state-administered REFIEs, the likelihood of receiving additional tax

³² A program created in the 1960s along the Mexican border with the United States, the maquiladora program helped companies build “twin plants” in Mexico that could import certain material and equipment on a duty-free and tariff-free basis for assembly, processing, or manufacturing and then export the assembled, processed and/or manufactured products, sometimes back to the country of origin.

³³ KMPG

³⁴ Ibid.

incentives increases, since REFIEs at the state level allow companies to communicate directly with the government administering them.

Mexico's Port System

Mexico boasts 10,000 kilometers of coastline, but currently lacks a large number of navigable rivers and natural harbors.³⁵ The country's main automotive ports are situated in Veracruz on the Gulf of Mexico, and Lázaro Cárdenas on the Pacific Ocean. The Port of Veracruz is the largest in terms of automotive exports, handling approximately 80 percent of Mexico's vehicle exports, while Lázaro Cárdenas, the second largest port, handles the remaining vehicle exports. There are currently 97 ports in Mexico, with a variety of ownership structures, ranging from federal ownership to private ports. This variety of structures has meant that port investment and expansion varies considerably from port to port.³⁶

During the past two decades, Mexican commercial cargo growth has increased twice as fast the nation's GDP.³⁷ Commercial cargo levels reached 5.1 million 20-foot equivalent units (TEUs)³⁸ in 2014. For this reason, the Mexican government has planned further expansion of the current system, committing \$5 billion to port-related projects beginning in early 2015.

Figure 17: Mexico's Port System: 2015



Source: [Searates.com](http://searates.com)

Figure 17 depicts major ports along the Mexican coastline. The Mexican federal government is currently working on 25 new projects, which include an expansion many of these key ports—including the port of Veracruz. Veracruz, though not the country's busiest port, is one of Mexico's most important, and has

³⁵ <http://www.country-data.com/cgi-bin/query/r-8753.html>

³⁶ <http://www.explorandomexico.com/about-mexico/6/23/>

³⁷ www.ioc.com

³⁸ An imprecise unit of measure for cargo capacity used to describe that capacity of container ships and terminals

“long-suffered from a lack of developable land across its port system,” according to the General Coordinator of Mexico’s Port and Merchant Marine Fleet. Even Mexico’s busiest port by tonnage, Lazaro Cardenas, has suffered from a lack of proper investment despite its integral position on the Pacific coast. Improvement of the Veracruz and Lazaro Cardenas ports is crucial as they are the only Mexican ports that are currently able to handle automobile shipments.

Although Mexico is quickly becoming a major manufacturing hub and has levels of commercial cargo increasing every year, the expansion of the country’s port system is lagging. In earlier port management efforts, the government approached ports as isolated units, and this system of isolation allowed ports to compete with one another for business. The new plan is to divide the port system into two groups, the Pacific Coast and the Gulf Coast, and encourage shippers to think of Mexican harbors as one “articulated port system.” The General Coordinator expects that these huge financial investments and expansions of Mexico’s key ports will “help the country realize its potential as a transportation hub.”³⁹ Despite these efforts, automakers have expressed their concerns about bottlenecks and capacity constraints in future years, and experts are skeptical as to whether these upgrades will be enough to handle the increasing vehicle production in Mexico.⁴⁰

³⁹ http://www.ioc.com/port-news/international-ports/mexican-government-spending-5-billion-ports_20150420.html

⁴⁰ Cattan and Bein. (2015).

Currency Trends

The gradual but extensive devaluation of the Mexican currency over the past 15 years has had a great impact on the Mexican automotive industry. According to Figure 18, the value of the peso has declined 41 percent against the U.S. dollar since January 2001. This means that making vehicles and parts manufactured in Mexico is less expensive relative to the United States, where the dollar has appreciated against nearly every international currency in recent years.

Figure 18: Exchange Rate between the Peso, Euro, Won, Yen, and Dollar



Source: Google Finance

Figure 18 above compares the current exchange rate of the Mexican peso against the currencies of a number of major automobile-producing countries over the past 5 years. Automakers from these countries have each invested billions of dollars into the Mexican market in the same time period—as the peso has been devalued vis-à-vis the currencies of these countries.

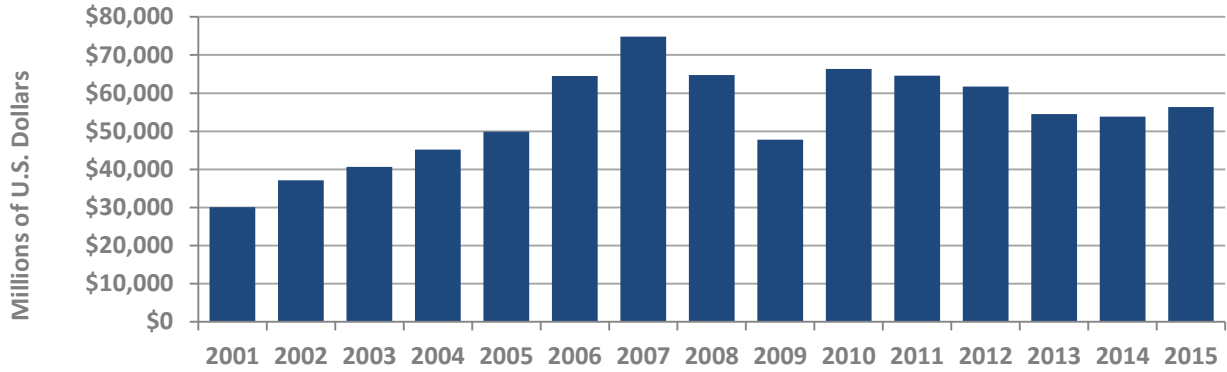
The devaluation of the peso relative to the dollar is a result of competing forces. Trade flows, interest rates, and the relative economic strength of the United States versus Mexican economies influence the peso/dollar exchange rates.⁴¹ As demonstrated in

Figure 19, despite running an overall trade deficit, Mexico has maintained a trade surplus with the United States in every year since 1995.⁴² The Mexican peso also benefits from large infusions of foreign

Figure 19: Mexican Trade Surplus with United States: 2001-2015

⁴¹ The Federal Reserve Bank provides an indepth discussion in this document: <http://www.federalreserve.gov/pubs/ifdp/2009/976/ifdp976.htm>

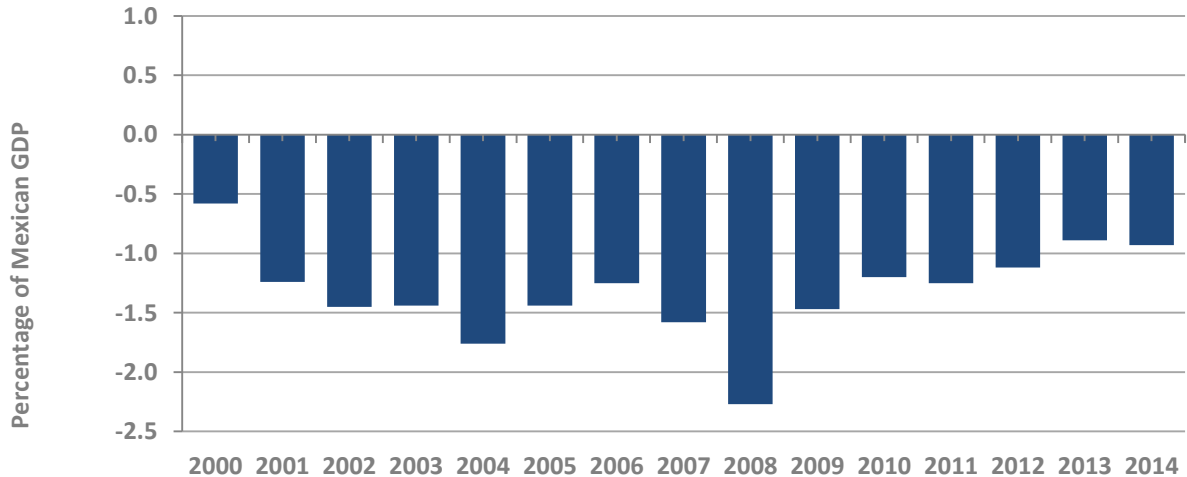
⁴² <https://www.census.gov/foreign-trade/balance/c2010.html>



Source: Census.gov; 2015 data is September 2015 YTD annualized

In theory, Mexico’s trade surplus with the United States should create excess demand for the peso relative to the dollar, as there is greater relative demand for Mexican goods (which are paid for in pesos). If the theory held, the peso should appreciate relative to the dollar. However, the peso has continued to devalue from 2001 to the present against the dollar. Figure 20 shows that despite a trade surplus with the United States, Mexico has maintained an overall global trade deficit for the last 15 years. This would seem to indicate that many of their exported goods are being shipped to the United States instead of balancing trade with other countries.

Figure 20: Mexican National Trade Deficit as Percentage of GDP: 2000-2014



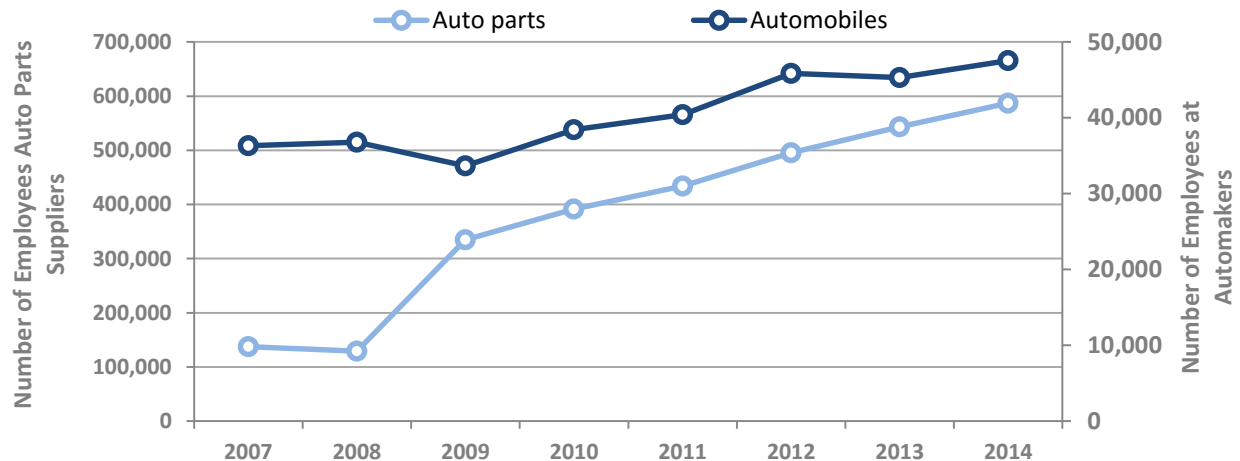
Source: TheGlobalEconomy.com

Employment Trends

Automaker employment in Mexico has remained level in recent years. However, the number of Mexican workers in the auto parts sector continues to increase as the level of exports for manufactured goods grows in the country. The number of total supplier companies located in Mexico has expanded to meet increasing automaker demand for less costly parts. During the U.S. economic recovery between 2009 and 2014, total employment in the Mexican automotive and parts industries increased over 72 percent, while U.S. motor vehicle and parts employment increased 40 percent.⁴³

With the 2014 and 2015 announcements of a number of new automaker assembly plants, employment in light vehicle manufacturing in Mexico is likely to continue to grow in coming years. The anticipated Daimler/Nissan and BMW plants are promising the creation of at least 7,200 jobs.^{44,45} Mexican light vehicle production is projected to grow through the end of the decade, and suppliers are likely to continue to increase employment levels to meet the growing demand of their expanding customer base.

Figure 21: Mexican Automaker and Auto Parts Employment: 2007-2014



Source: INEGI

As shown in Figure 21, light vehicle employment in Mexico has seen relatively steady increases in the last ten years. In 2007, automakers employed 36,300 people in Mexico; by 2013, Mexican automaker employment levels grew to 45,300—an increase of 24.8 percent. Employment levels in Mexican automotive parts manufacturing have increased dramatically between 2007 and 2014 due to the increasing number of auto suppliers in Mexico subsequent to NAFTA enactment. In 2009, employment levels reached nearly 335,000 employees. Much of the large jump from 2008 to 2009 was the result of one-time reporting changes that excluded maquiladoras from the official automotive parts supplier

⁴³ Detroit Free Press, Priddle and Snively. (2015).

⁴⁴ CAR Book of Deals, 2016

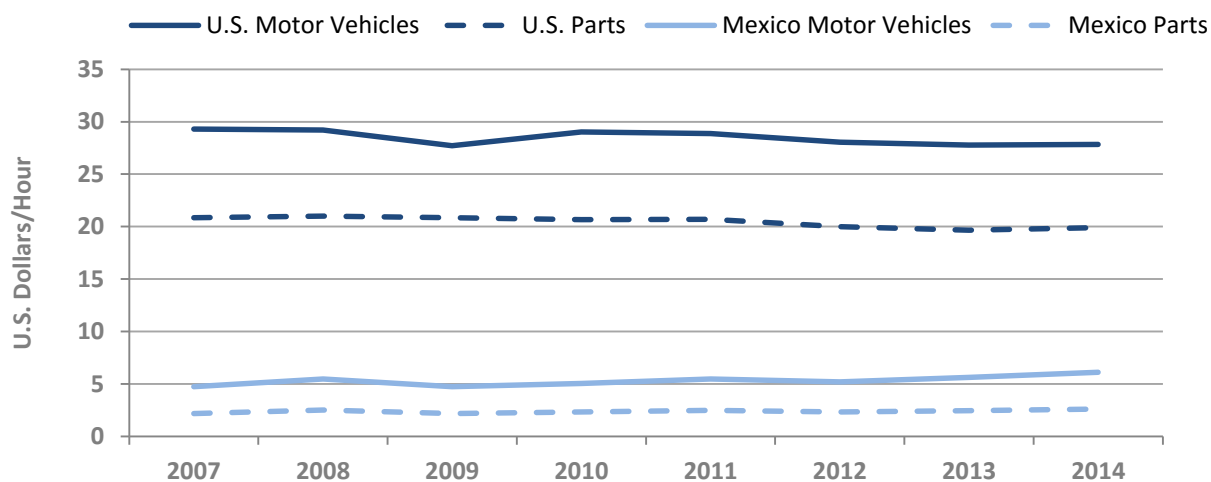
⁴⁵ U.S. Department of Labor, Bureau of Labor Statistics data.

employment figures.⁴⁶ As the economy recovered from the recession, Mexican auto supplier employment levels again climbed, reaching 391,000 in 2010; since then, employment levels have continued to rise. As of 2014, there were 587,000 people employed by auto parts manufacturers in Mexico.

Wages and Compensation

Lower wages coupled with labor productivity that is comparable to workers in the United States have influenced corporate decisions to operate plants in Mexico. In U.S. dollars, hourly wages and benefits have remained relatively constant in recent years. Figure 22 shows that from 2007 to 2013, average hourly wages were \$5.21 (\$US, nominal) for the light vehicle manufacturing sector and \$2.40 (\$US, nominal) for the automotive parts manufacturing sector. These wages are nearly one-eighth and one-fifth of comparable wages in the United States. Minimum wage laws vary by economic region in Mexico. The difference in labor costs, shown in Figure 22, is an important consideration for manufacturers in moving their operations to Mexico.

Figure 22: United States and Mexican Hourly Automotive Wages in Nominal U.S. Dollars/Hour: 2007-2014



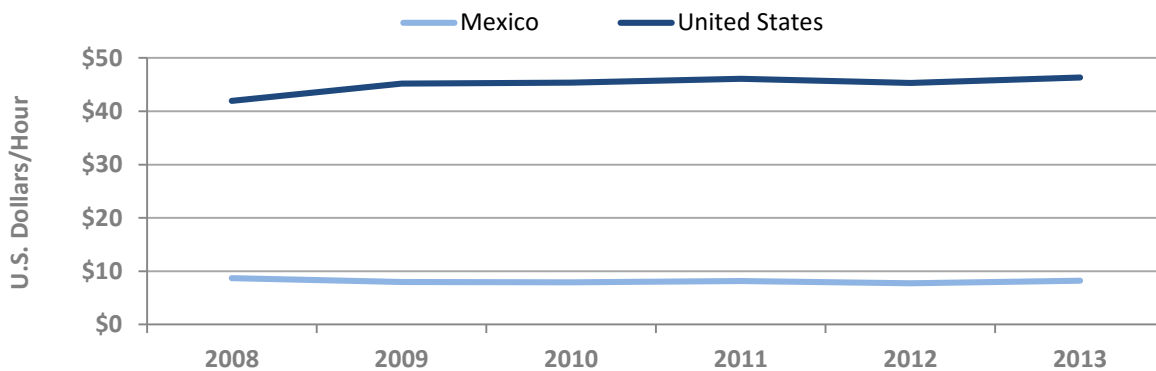
Source: U.S. Department of Labor and INEGI

Total compensation costs (inclusive of non-wage compensation, such as benefits, taxes, and vacation time) are also a consideration. Mexico’s Federal Labor Law requires employers to provide their workers with year-end bonuses equal to at least 15 days wages, a yearly vacation the length of which depends on employee seniority, mandatory paid holidays, a housing fund, and to register employees with and contribute to the Mexican Institute of Social Security. Nonetheless, total compensation costs are far lower in Mexico than in the United States. Data from the Conference Board’s International Labor

⁴⁶ Prior to 2009, the Instituto Nacional de Estadística y Geografía (INEGI) excluded companies that manufacture products solely for export purposes (e.g., maquiladoras); that explains the dramatic increase in auto parts manufacturing employment from 2008 to 2009. From 2009 onwards, data reflects the size of the entire manufacturing industry.

Comparisons series indicate that since 2009, total hourly compensation for vehicle, body, and trailer manufacturing in Mexico has been less than 18 percent of total compensation in the United States. As shown in Figure 23, in 2013, the most recent year for which data is available, total hourly compensation for this industry group was \$8.24 in Mexico, versus \$46.35 in the United States.⁴⁷ This difference in compensation cost between Mexican and U.S. workers continues to incentivize manufacturers to move their operations to Mexico.

Figure 23: Motor Vehicles, Trailers, and Semi-trailers Manufacturing Hourly Compensation: 2008-2013



Source: The Conference Board

Investment Trends

Automotive investment has been on the rise in Mexico ever since automakers began taking advantage of the country's lower costs, advantageous trade position, and proximity to the United States and South American markets. In addition to these benefits, automakers looking to locate in Mexico find their required initial investment is lower than it might otherwise be in other regions of the continent due to lower land prices, rents and construction costs. This, in combination with incentives offered by the Mexican government, led to approximately \$24.2 billion in automaker investments in Mexico between January 2010 and December 2015, which includes announcements for eight new assembly plants in the country. In April of 2016, Ford confirmed previous rumors, and announced that a new car plant will be established in San Luis Potosi.⁴⁸

⁴⁷ The Conference Board. International Labor Comparisons.

⁴⁸ Automotive News. 5APR16. "Ford to invest \$1.6 billion in new Mexico small-car plant, create 2,800 jobs." www.autonews.com/article/20160405/OEM01/160409897/ford-to-invest-1-6-billion-in-new-mexico-small-car-plant-create-2800

Table 6: New Assembly Plants Announced from 2011 to May 2016

Company	State	Country	Plant Name	Announced	Expected Production Year
Nissan	Aguascalientes	Mexico	Aguascalientes 2	2011	2013
Mazda	Guanajuato	Mexico	Mazda Motor Manufacturing de Mexico S.A. de C.V.	2011	2014
Honda	Guanajuato	Mexico	Celaya Assembly Plant	2011	2014
Volkswagen	Puebla	Mexico	North American Audi Plant	2012	2016
Hyundai-Kia	Nuevo Leon	Mexico	Kia Motors Nuevo Leon Plant	2014	2016
Nissan-Daimler JV	Aguascalientes	Mexico	COMPAS (Cooperation Manufacturing Plan Aguascalientes)	2014	2017
BMW	San Luis Potosi	Mexico	Plant San Luis Potosi	2014	2019
Volvo (Geely)	South Carolina	USA	Volvo CAR USA LLC North American Assembly Plant	2015	2018
Toyota	Guanajuato	Mexico	Toyota Celaya Assembly Plant	2015	2019
Ford	San Luis Potosi	Mexico	Yet To Be Announced	2016	2018

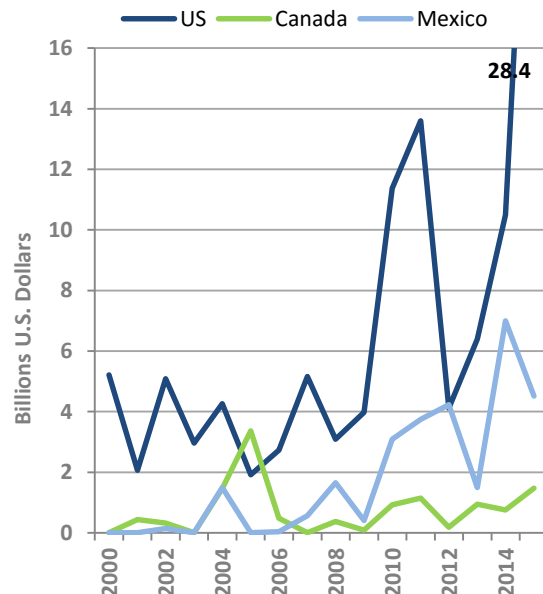
Source: CAR. Book of Deals, 2016

In addition to automakers, suppliers are also investing in Mexico. Supplier companies are often encouraged to locate in close proximity to automakers and their growing base of assembly plants in Mexico. More than \$3 billion in investment is or will be coming to Mexico from auto supplier companies.⁴⁹

Table 7: Total Announced Automaker Investment by Country (\$US): CAR Book of Deals: 2000-2015

	U.S.	Canada	Mexico
2000	\$5,216,700,000	\$0	\$0
2001	\$2,065,000,000	\$440,000,000	\$0
2002	\$ 5,085,800,000	\$322,000,000	\$140,000,000
2003	\$2,965,600,000	\$0	\$0
2004	\$ 4,260,200,000	\$1,468,000,000	\$1,500,000,000
2005	\$1,920,919,877	\$3,360,000,000	\$0
2006	\$2,734,000,000	\$ 480,700,000	\$37,000,000
2007	\$5,161,000,000	\$0	\$570,000,000
2008	\$3,089,600,000	\$370,000,000	\$1,650,000,000
2009	\$3,981,700,000	\$ 85,100,000	\$ 410,000,000
2010	\$11,374,805,862	\$927,200,000	\$3,088,000,000
2011	\$13,605,200,000	\$1,150,300,000	\$3,740,000,000
2012	\$4,109,700,000	\$183,000,000	\$4,236,000,000
2013	\$6,398,700,000	\$946,850,000	\$1,500,000,000
2014	\$10,493,800,000	\$750,000,000	\$7,000,000,000
2015	\$28,372,000,000	\$1,475,515,745	\$4,513,000,000

Figure 24: Total Announced Automaker Investment by Country (\$US): CAR Book of Deals: 2000-2015



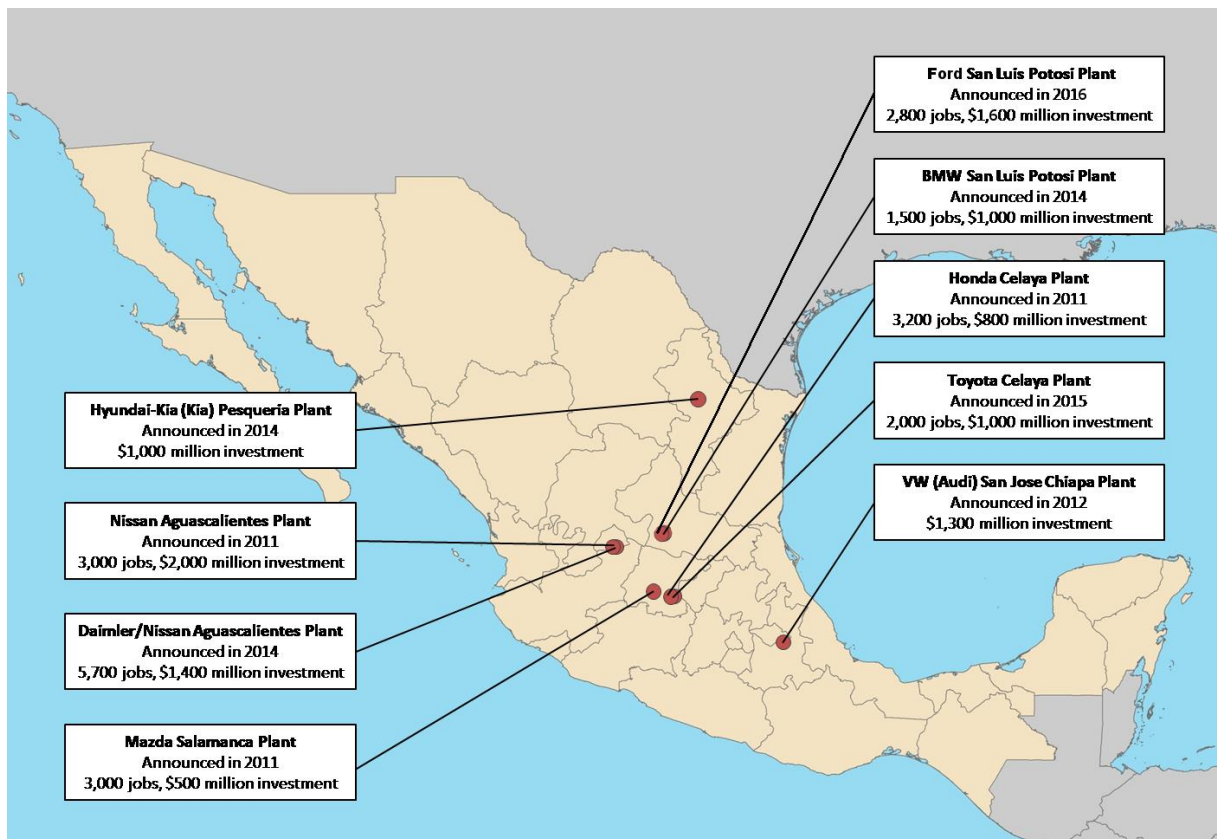
Source: CAR. 2015 U.S. figure includes UAW-negotiated contract commitments of about \$16 billion.

⁴⁹ CAR, Book of Deals. December, 2015.

Automotive investment in Mexico has recently attracted a great deal of attention. As shown in Table 7 and also Figure 24, automakers announced investment projects in Mexico amounting to \$7 billion in 2014 and \$4.5 billion in 2015. The most significant announcement came from GM, which publicized a \$3.6 billion investment across its Mexican plants in 2014. In early 2015, Ford announced it will invest \$2.5 billion to expand two of its plants, and Volkswagen and Toyota each announced \$1 billion investments for an expansion and a new assembly plant respectively. As of May 2016, only one additional automaker investment project has been announced for Mexico: Ford will construct a new, \$1.6 billion car plant.

The nine recently announced Mexican light vehicle assembly plants will employ more than 22,000 workers. Based on nearly 30 years of researching the economic impact of new assembly plants, CAR estimates that another 29,000 jobs will be created in the automotive supplier sector in Mexico. If these plants were built in the United States instead, the employment impact of the 22,000 assembly plant workers plus the 29,000 supplier jobs would not change, but given typical spending patterns of U.S. workers, another 162,000 jobs in downstream industries (e.g., retail, healthcare, education, real estate, construction) would have been created in the United States.⁵⁰

Figure 25: Mexican Automotive Assembly Investment: 2009-2016:Q2



Source: CAR Book of Deals, 2016

⁵⁰ Jobs in downstream industries are those jobs considered to be expenditure-induced employment resulting from spending by direct (automaker) and intermediate (supplier) employees.

According to the latest data from Instituto Nacional de Estadística y Geografía (INEGI), in 2012, automakers spent \$2.0 billion on capital expenditures in Mexico. Of this, 89 percent was spent on production machinery and equipment, with buildings and structures accounting for just 9 percent of expenditures. Other forms of capital expenditure, for example the purchase of vehicles, accounted for the remaining 2 percent.

Mexico continues to receive substantial investments from automakers. Figure 25 marks the location of Mexican automotive assembly plants that were announced from 2009 through 2015, and ties each to its projected employment level, as well as the initial amount invested in the facility. Since the start of 2012, annual announcements have averaged approximately \$4.3 billion, with total cumulative announcements reaching nearly \$18.8 billion as of May 2016.

With increasing automotive manufacturer investment, automotive supplier presence in the country has also increased considerably in recent years. According to Promexico, close to 90 of the Global 100 Tier-1 suppliers have established operations in Mexico to supply parts and components to automakers.⁵¹

⁵¹ Promexico, April 2015.

Decision Factors: Locate In Mexico?

This section of the paper explores various factors that have the potential to influence a small and medium-sized manufacturer's decision to locate operations in Mexico. This discussion is most applicable to smaller and medium-sized companies as opposed to the large OEMs and Tier 1 companies who have standardized and sophisticated global operations. Topics discussed include labor force, workforce specialization, Mexican trade advantages, and incentives provided by the Mexican government to businesses and manufacturers. Each section reports on the current situation in Mexico, as well as future plans for the government to make changes or improvements in each of these categories.

Labor Availability and Trends

Workforce Availability

The Mexican economy has a surplus of unskilled workers. For instance, 13.4 percent of Mexico's labor force works in agricultural production, which compares to only 1.6 percent of workers in the United States.⁵² Despite Mexico's abundance of unskilled workers, the country has fewer technically skilled workers and engineers than the United States, in general.⁵³ In interviews with industry representatives, respondents reported that Mexico has a viable university structure, and Mexican universities graduate people who are able to work in research and development (R&D) facilities with skill levels similar to those found in the United States.⁵⁴ As in the United States, the urban areas in Mexico have a sufficient supply of educated people to support R&D operations.

The Centro de Entrenamiento en Alta Tecnológica (CENALTEC) technical school has helped Mexico to develop the educated and trained workers needed in advanced manufacturing operations.⁵⁵ Its programs primarily focus on practical training and produce graduates that are immediately able to join the workforce. The center was established in Juarez in 2000 and was expanded to Chihuahua in 2006. It supports several industrial sectors including plastics, automotive, electronics, aerospace, and medical device manufacturing. CENALTEC is funded by the Chihuahua state government, the Ministry of Education, and industry partners, and offers programs that are officially recognized by the Mexican Public Education Secretariat (SEP) and the Labor Department (STPS).

⁵² CIA. (2016). The World Factbook. U.S. Central Intelligence Agency. January 2016. www.cia.gov/library/publications/the-world-factbook

⁵³ BEBA. (2013).

⁵⁴ CAR. (2014).

⁵⁵ MFI. (2012). "High-Tech Training for Companies Looking at Manufacturing in Mexico." MFI International, Flexible Manufacturing Services. May 29, 2012. <http://info.mfiintl.com/blog/bid/127282/High-Tech-Training-for-Companies-Looking-at-Manufacturing-in-Mexico>

Mexico's aerospace industry includes large investments from Boeing, European Aeronautic Defense and Space Company, Embraer, and Bombardier, to name a few. The country's success in aerospace manufacturing may be in part due to the large pool of skilled Mexican labor that has been trained in the electronics and automotive industries. While the number of U.S. engineering graduates has not risen in recent years and the number of engineering courses offered has declined, in Mexico, both the number of graduates and courses have been rapidly increasing.⁵⁶ The Mexican government has supported the creation of schools and training programs to help Mexican automotive service technicians improve their ability to work on a wide range of vehicles—including both foreign and domestic brands. With its pool of domestic engineering graduates, Mexico is now home to some of the engineering that once only took place north of the border.⁵⁷

Automakers have also brought in their own production training resources to Mexico, as well as training Mexican workers at other company training sites. For instance, Audi has sent approximately 600 Mexican autoworkers to Germany for training to ensure that the production quality in the Audi San Jose Chiapa plant is the same as it is in the Ingolstadt assembly plant. The employees receive training in German language, German culture, and how Audi is organized. When production begins in Mexico, these internationally trained workers will be supervisors and team leaders in the assembly plant.⁵⁸ Audi has also built a 215,000 square foot training facility at its Mexican assembly plant.⁵⁹ The training center will offer more than 1,500 training courses each year in the Audi Production System, quality assurance, sustainability, language, and other topics. The training center was created in partnership with the state of Puebla and the Universidad Tecnológica de Puebla.

“According with the provisions of the Federal Labor Law, it is required for at least 90 percent of the employees of a Mexican entity to be Mexican nationals.”⁶⁰ This provision does not apply to directors, managing directors, and general managers.

Educational Programs in Mexico

As stated in the section above, the country is home to a surplus of untrained workers; however, specialized or highly-trained workers are in shorter supply and may command wages similar to their counterparts in the United States. Many Mexican states with an automotive presence are developing worker training programs. The list below includes Mexican states with an automaker presence, and Figure 26 shows the training programs being developed in these states:

⁵⁶ Rhoda, Richard and Tony Burton. (2011). “The Reasons Why Mexico Is Fast Becoming a Key Player in Aerospace Manufacturing.” Geo-Mexico. September 17, 2011. <http://geo-mexico.com/?p=4977>

⁵⁷ Flannery, Nathaniel Parish. (2014). “Is Industrial Mexico A Friend or Foe To The U.S. Auto Sector?” Forbes. August 18, 2014. <http://www.forbes.com/sites/nathanielparishflannery/2014/08/18/is-industrial-mexico-a-friend-or-foe-to-the-u-s-auto-sector/>

⁵⁸ Boston, William. (2015). “In Germany, Mexican Workers Learn Audi's Ways.” Wall Street Journal. March 17, 2015. <http://blogs.wsj.com/corporate-intelligence/2015/03/17/in-germany-mexican-workers-learn-audis-ways/>

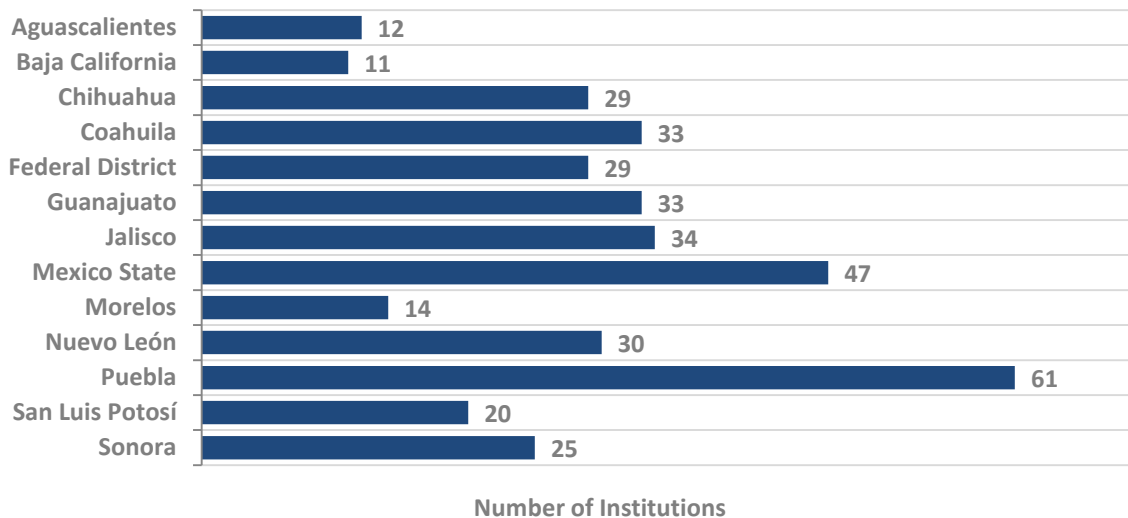
⁵⁹ Volkswagen. (2014). “Audi México: New Training Center Opened.” Volkswagen AG. October 21, 2014. http://www.volkswagenag.com/content/vwcorp/info_center/en/news/2014/10/training.html

⁶⁰ PWC

- Aguascalientes
- Baja California
- Chihuahua
- Coahuila
- Federal District⁶¹
- Guanajuato
- Jalisco
- Mexico State
- Morelos
- Nuevo León
- Puebla
- San Luis Potosí
- Sonora

Figure 26 depicts the number of Mexican institutions with educational programs related to the automotive industry, by state. This graph shows that there are a large number of institutions with these types of programs. These institutions are heavily concentrated in urban areas, while rural areas continue to offer a ready supply of unskilled workers.

Figure 26: Institutions Granting Automotive-Related Degrees by State: 2014



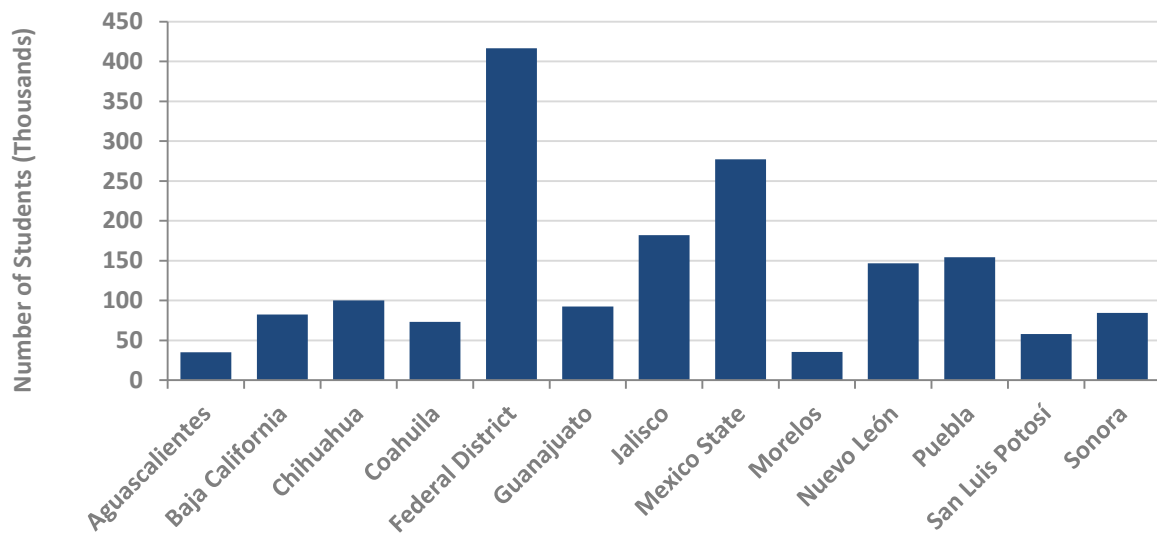
Source: ANUIES and CAR

⁶¹ Included due to its geographic location (surrounded by Mexico State and Morelos)

Within these 13 Mexican states, 396 institutions grant degrees in the following automotive-related areas:⁶²

- Engineering
 - Chemical, electrical, industrial, manufacturing, metallurgical, computer engineering and others
- Technology
 - Computer software, systems, instrumentation, production and others
- Drafting and design
 - Industrial, product, electrical, mechanic, electronic, and others
- Industrial production and manufacturing
 - Plastics and polymers, metals, and others

Figure 27: Student Enrollment by State: 2014



Source: National Center for Education Statistics and CAR

Note: Enrollment data is limited to schools offering automotive-related degrees

Figure 27 shows that student enrollment is sizeable in urban areas of Mexico, such as Mexico State and the Federal District; whereas many of the rural areas of the country—such as Coahuila and San Luis Potosí, both of which have a large automotive industry presence—do not have workers participating in workforce training and education programs in large numbers.

⁶² The primary source for this report was the ANUIES-Asociación Nacional de Universidades e Instituciones de Educación Superior (National Association of Universities and Institutions of Higher Education). Data includes certificates and degrees similar to associate degrees, bachelor’s degrees, and advanced degrees.

Mexico's Economic Development and Incentive Practices

Mexico Manufacturing Investment Incentives

In response to high unemployment rates in the 1970s and 1980s, Mexico granted large incentive packages to manufacturers that made investments along the U.S.-Mexico border and in the country's interior.⁶³ The government awarded these incentive packages to large manufacturing companies—particularly those in automotive, electronics, and consumer goods industries. In addition, the federal government offered incentive packages to the suppliers of these large manufacturers locating in Mexico.

In the 1990s, the focus was on attracting higher-wage jobs, and government incentives were focused on companies that fit specific geographic industry clusters. The automotive industry investments in Saltillo, Leon, Toluca, and Puebla are examples of these clusters. Incentives included training programs, capital equipment grants, and subsidized real estate. In 2006-2008, Mexican economic development focused on the aerospace industry, which received capital equipment grants, infrastructure assistance, subsidized real estate, and a government-sponsored training center. In 2011, the automotive industry attracted several investments from automakers and tier one suppliers.⁶⁴ A Mexican tax reform, which took effect in January 2014, withdrew several of the country's tax incentives.⁶⁵ Though many former federal tax incentives no longer exist, incentives are available from several non-federal government sources and vary by industry, location, quantity and quality of jobs created, and level of financial investment.⁶⁶

Mexican investment incentives do not include the broad-based and far-reaching federal and state tax incentives that are common in the United States, though consideration of implementing these types of incentives has been given to specific projects that were of particularly high interest.⁶⁷ Because most taxes in Mexico are federal, the states' ability to offer tax incentives is limited. However, competition to attract new investments is high, and most Mexican states have economic development programs. State-level incentives include subsidized real estate, employee-training programs, provision of new or improved infrastructure, and state tax reductions (e.g., state payroll, real estate, land transfer, and deed registration taxes).⁶⁸

Since 2010, CAR has documented two instances of announced automaker investment that received incentives from the Mexican government. Shown in Table 8, these include a \$236 million package in the form of economic development aid and tax credits for BMW's \$1 billion investment for their new assembly plant in San Luis Potosi, and a \$400 million loan from the Mexican government for FCA's \$550

⁶³ MexicoGov. (2015). "Incentives" Mexico Manufacturing Startup Information: Labor Costs, Incentives, Real Estate, Shelters and Mexico Contacts. Website. Accessed May 4, 2015. <http://www.mexicogov.org/incentives.php>

⁶⁴ MexicoGov. (2015).

⁶⁵ Deloitte. (2014). "Taxation and Investment in Mexico 2014: Reach, Relevance and Reliability" Deloitte Touche Tohmatsu Limited. 2014. <http://www2.deloitte.com/content/dam/Deloitte/global/Documents/Tax/dttl-tax-mexicoguide-2014.pdf>

⁶⁶ MexicoGov. (2015).

⁶⁷ Russell, Alan. (2015). "Investment Incentives in Mexico." Tecma Group of Companies. February 3, 2015. <http://www.tecma.com/investment-incentives-in-mexico/>

⁶⁸ BEBA. (2013). "2013 Investment Climate Statement - Mexico" Bureau of Economic and Business Affairs, U.S. Department of State. February 2013. <http://www.state.gov/e/eb/rls/othr/ics/2013/204693.htm>

million 2010 retooling of Toluca Assembly. BMW received its incentives from the state, while FCA received incentives on a federal level.

Table 8: Example Comparison of Incentives and Investments: 2010-2015

Country	Company	Investment (\$US)	Incentives (\$US)	Incentives per Investment Dollar
Mexico	Fiat-Chrysler	550,000,000	400,000,000	0.73
Mexico	BMW	1,000,000,000	236,000,000	0.24
Average New U.S. Assembly Plant, 2010 and After		500,000,000	115,500,000	0.23
Average U.S. Retooling Project, 2010 and After*		215,671,429	34,706,536	0.16

Source: CAR Book of Deals 2015

*Excludes the 2010 deal for Sterling Heights Assembly, as this arrangement was an extreme outlier

In a series of CAR interviews with industry representatives, company leaders reported that Mexican incentive packages are similar in size to those in the United States. Respondents also said that incentive packages are becoming more relevant to automotive suppliers as automakers locate more operations in Mexico, since customer location is frequently cited as a major determinant of site location for suppliers.⁶⁹ One company representative observed that Mexico helps defer many upfront costs in its incentive packages, which are flexible (particularly for large investments) and often include funding for training programs.

In Mexico, a company considering making an investment often works with a representative of the Mexican federal government who can coordinate with local and federal government officials and regulatory agencies.⁷⁰ This designated point-person is particularly useful early in the site selection process when a company may be more generally looking around the country for a community in which to locate its new facility. In contrast, the United States does not have an equivalent role in its federal government. If considering investment in the United States, the company must approach each individual state independently, and then work with multiple levels of public officials and regulators within each state, which creates a considerable increase in complexity and workload.

Import/Export-Related Incentives

Mexico has incentive programs that encourage export sales.⁷¹ Policies known as maquiladoras (tariff-free manufacturing facilities) make Mexico an attractive place to manufacture goods for export. The 2013 tax reform, however, tightened some of the requirements for maquiladora status and limited some of the benefits. For instance, the reform abolished the partial income tax exemption and value added tax (VAT) exemption on temporarily imported materials, machines, and equipment.⁷² Another policy, the Sectoral Promotion Programs (PROSEC), provides preferential tax treatment for some manufacturing inputs. This benefit is available regardless of whether the goods produced are intended

⁶⁹ CAR. (2014). Interviews. Center for Automotive Research. <http://www.cargroup.org/>

⁷⁰ CAR. (2014).

⁷¹ Deloitte. (2014).

⁷² Deloitte. (2014).

for export or for domestic sale.⁷³ The United States, of course, has the Export/Import Bank⁷⁴ which finances and insures foreign purchases of United States goods for customers unable or unwilling to accept the credit risk.

Financing New Investments

Although Mexican government-owned development banks have begun to expand lending to small and medium-sized enterprises (SMEs), lack of available credit is commonly cited as an obstacle for these smaller companies. Private banks in Mexico are reluctant to lend to SMEs because due diligence can be difficult to conduct. Many Mexican SMEs rely on supplier credit as a major source of financing. Commercial loans to established companies with well-documented accounts are readily available, although many of the larger companies fund expansions using retained earnings. Large companies are also able to issue debt (bonds) and have access to non-bank financing.⁷⁵

Cost of Doing Business

Cost Comparison

This section compares the costs and key advantages of producing a vehicle in Mexico.

⁷³ SE. (2015). "Sectoral Promotion Programs." Secretaría de Economía, Government of Mexico. Accessed May 4, 2015. <http://www.economia.gob.mx/industry/foreign-trade-instruments/prosec>

⁷⁴ Congressional authorization for the bank lapsed as of July 1, 2015; in December 2015, Congress voted to reauthorize the bank through September 2019.

⁷⁵ BEBA. (2013).

Table 9 below shows the cost savings for producing a mid-size car in Mexico for sale in the United States, versus producing that same car in the United States (column 2). The third column shows the cost savings for producing a mid-size car in Mexico for sale in Europe, versus producing that same car in the United States to be sold in Europe.

The remainder of this section details the costs of labor, transportation, parts, environmental regulations, added security, and compliance and fines associated with doing business in Mexico.

Table 9 analyzes some of these benefits but most importantly, demonstrates the true advantages of Mexico's numerous trade agreements as FTA tax savings for vehicles shipped outside of North America can exceed \$4,000 per vehicle.

Table 9: Total per Vehicle Cost Advantages of Producing a Vehicle in Mexico for U.S. or European Markets (compared to cost of producing that vehicle in the United States)



Ford Fusion – Export

Produced in Flat Rock, MI and Hermosillo, Mexico

Cost Advantages	Difference between U.S. and Mexican Production for Sale in the United States	Difference between U.S. and Mexican Production for Sale in Europe
Assembly plant labor	\$600 less in Mexico	
Parts	\$1,500 less in Mexico	
Transportation to market	\$900 more from Mexico	\$300 more from Mexico
FTA tariff advantages	\$0	\$2,500 less in Mexico
Total cost advantage	\$1,200 less costly to produce in Mexico for sale in the United States	\$4,300 less costly to produce in Mexico for sale in Europe

Labor

An important benefit for automakers and suppliers that operate in Mexico is the lower cost of labor. Between 2008 and 2013, Mexican manufacturing labor costs for motor vehicles, trailers, and semi-trailers decreased approximately five percent, versus an approximate 10 percent increase in the United States during the same period. As of 2013, automotive manufacturing labor compensation in Mexico was \$8.24/hour, or almost 18 percent of the \$46.35/hour compensation earned by American manufacturing workers.⁷⁶

Mexican automotive manufacturing wages are also a fraction of the wages paid to U.S. workers. Mexican automotive assembly workers were paid \$5.64/hour in wages in 2013, while their U.S. counterparts earned as high as \$27.78/hour. In total, wages and labor compensation per car in Mexico can be less than 25 percent of those manufactured at even the least expensive assembly plants in the United States. CAR estimates the average difference in labor costs to be \$674 per car. However, some of the benefit of lower labor costs in Mexico is offset by the higher worker attrition rates than found in U.S. assembly plants, and lower labor productivity growth in Mexico.⁷⁷

Transportation

The total cost of transporting the vehicle from Mexico to the United States is difficult to estimate precisely, given the multitude of possible destinations as well as insurance costs. Furthermore, since 2001, rail rates in the United States have increased almost three times more than truck freight rates.⁷⁸ Transporting vehicles from Mexico to the United States frequently means using a combination of both rail and road transport.⁷⁹ Utilizing a blended average truck freight rate per mile with rail freight rates per ton-mile, and using an example distance for automobile transport to the United States of 1,100 miles, CAR estimates a potential cost of transporting a vehicle from Mexico to the United States is approximately \$900.

The cost of transporting a vehicle from Mexico to other worldwide automotive markets, such as Europe and South America, is also important. Mexican shipping rates are slightly higher than transportation costs from the United States. The standard rate for shipping an individual vehicle from the Port of Veracruz in Mexico to Europe is approximately \$2,500, while shipping the same vehicle from the Port of Newark in New York to Europe would be about \$1,700—nearly \$800 less expensive.⁸⁰ However, automotive manufacturers are able to negotiate discounts for bulk vehicle shipments. Utilizing a 300 percent markup on individual vehicles rates to estimate bulk OEM rates, as suggested by industry sources, means the true difference in shipping costs between Mexico and Europe versus the United States to Europe is likely around \$300.

⁷⁶ The Conference Board. International Labor Comparisons.

⁷⁷ INEGI. Encuesta mensual de la industria manufacturer and U.S. Department of Labor, Bureau of Labor Statistics.

⁷⁸ <http://www.americanchemistry.com/Policy/Rail-Transportation/Full-Report-Analysis-of-Freight-Rail-Rates-for-US-Shippers.pdf>

⁷⁹ Ibid.

⁸⁰ <http://worldfreightrates.com/freight>

At the time NAFTA was being negotiated, the U.S. Office of Technology Assessment estimated that the non-labor costs (parts, components, and subassemblies; component shipping; finished vehicle shipping; and inventory costs) of producing and shipping a fully completed car from Mexico to the United States were \$970.⁸¹ This number was integral in securing the passage of NAFTA, as many proponents of the deal argued that the non-labor savings were far in excess of labor savings that could be gained from moving production facilities to Mexico, and thus the American automotive industry's competitive position would be secure. However, as cost factors in Mexico improved over time, producing vehicles there and transporting them to the United States became less cost prohibitive.

Automaker or Supplier Cost Analysis

Availability of Raw Materials

Suppliers seeking to establish or expand operations in Mexico have to consider factors such as raw material availability.⁸² While the supply chain has largely been able to handle the demands of the automotive industry thus far, many of the conventional materials produced in Mexico are not automotive grade. Specialty raw materials such as stainless steel, resins, and other materials are typically sourced from the United States, Asia or Europe.⁸³

Materials Cost Differentials

Materials costs between Mexico and the United States differ despite globalized commodities markets. However, these differences are small. For example, for conventional steel products, cold- and hot-rolled coil prices differed by 2.6 percent and 4.4 percent, respectively, between the United States and Mexico as of December, 2015—with Mexican-produced steel less expensive in both cases.⁸⁴ However, while Mexico produces a large amount of steel, little of its output is automotive-grade.⁸⁵ Consequently, the Mexican automotive industry imports 90 percent or more of the steel it uses each year—much of this from the United States.⁸⁶ Due to a lack of domestic availability, higher logistical costs can be incurred importing steel vis-a-vis U.S. based production. However, offsetting this is that some specialty steels and materials are imported from Asia or Europe, and it is cheaper to import these into Mexico than the United States because the imports into Mexico are not charged tariffs.

⁸¹ OTA. (1992). "Table 7-12—Cost Structure for Auto Assembly in the United States and Mexico" U.S.-Mexico Trade: Pulling Together or Pulling Apart? U.S. Congress, Office of Technology Assessment. OTA-ITE-545. U.S. Government Printing Office, Washington, DC. September 1992.

⁸² Gifford. (2015)

⁸³ Promexico, 2013

⁸⁴ https://www.steelbb.com/login/?r=%2F%3FPageID%3D157%26amp%3Barticle_id%3D148398%3B%2520https%3A%2F%2Fwww.steelbb.com%2F%3FPageID%3D157%26amp%3Barticle_id%3D148397%3B%2520http%3A%2F%2Fwww.steelorbis.com%2Fsteel-prices%2Fsteel-prices-market-analyses%2Fflats-and-slab%2Fmexican_crc_prices_drop_despite_auto_demand_forecast_-911408.htm%3B%2520%2520http%3A%2F%2Fwww.steelorbis.com%2Fsteel-prices%2Fsteel-prices-market-analyses%2Fflats-and-slab%2Fas_mexican_hrc_prices_decline_producers_seek_to_diversify_their_businesses_-911813.htm

⁸⁵ <http://www.bloomberg.com/news/articles/2013-04-17/automakers-spur-3-billion-boom-for-made-in-mexico-steel>

⁸⁶ <http://www.wsj.com/articles/chinese-steel-imports-cause-industry-rift-in-mexico-1436468945>

Table 10: Total per Vehicle Cost Advantages of Producing in Mexico for U.S. and European Markets

Materials:	Cost Advantage (%)
Composites:	
Propylene	(14.3)
Polyethylene	(6.7)
Metals:	
HRC Steel	(4.4)
CRC Steel	(2.6)
Aluminum	+5.5
Operations:	
Factory Labor	(87.6)
Utilities	+71.9
Corporate Taxes	(14.3)
Building:	
Rent & Property Costs	(55.7)
Construction Labor	(79.2)

Source: AMM, Deloitte, ICIS, Numbeo, Platts, CAR, et al.

Note: Cost estimates for materials are extremely sensitive to quality of material required, as Mexico is yet largely incapable of domestically producing higher grade metals. For example, although steel appears cheaper in Mexico as presented above, galvanized steel is not available in large quantities and would have to be imported from the United States, at additional cost. CAR estimates the cost of importing materials from the United States to Mexico to be approximately \$100/metric ton.

As shown in Table 10 there is a difference in the cost of materials for manufacturers producing in Mexico for the U.S. and European markets versus production in the United States or Europe. Important to note in the above chart is that a negative number reflects a cost *advantage* to producing in Mexico, while a positive number indicates the expense is higher in Mexico. The difference in these costs tends to depend on the technology involved in producing the material, and overall differences in government policy that lead to different costs in categories such as labor and tax rates.

Establishing Operations: Start-Up through Construction

Data from the World Bank's *Doing Business* project enables international comparisons of regulatory costs, as well as the cost of administrative and bureaucratic procedures.⁸⁷ To register a new company in Mexico requires completion of six procedures, which, at the median, takes a little over six days to complete. This is slightly longer than the 5.6 days needed to complete the same procedures required to start a company in the United States. Governmental fees associated with these processes total 17.9 percent of the per capita income in Mexico, and 1.1 percent in the United States. Using the World Bank's per capita income data reporting \$9,980 in average per capital income for Mexico and \$55,200 in the United States, governmental fees amount to about \$1,800 to register a business in Mexico, compared to \$600 in the United States.

After a business has been formed, the new legal entity must acquire property on which to conduct its business. In Mexico, almost 7 procedures must be completed to purchase land and a building that is already registered and free of title dispute, with a median time requirement of 63.7 days; this is substantially longer than the 15.2 days needed to complete just over 4 procedures are required in the

⁸⁷ <http://www.doingbusiness.org/data>

United States for the same transaction. The cost of these procedures is presented as 5.1 percent of the property's value in Mexico, and 2.4 percent in the United States. The World Bank utilizes an assumed property value of 50 times the per capita income level, leading to cost figures of roughly \$25,450 in Mexico, and a substantially higher \$66,240 in the United States.

If there is any construction required to begin a business, the World Bank data indicates that there are 10.5 procedures to complete to start construction in Mexico, which take a median time of 86.4 days; in the United States, there is a larger number of procedures, 15.8, but a smaller time requirement, at 80.6 days. Costs associated with these procedures are presented as 10.2 percent of the construction value for Mexico, and 1 percent for the United States. As with property, the construction value is assumed to be 50 times the per capita income level, suggesting total construction permit fees of \$50,900 in Mexico, with a far lower figure of \$27,600 in the United States.

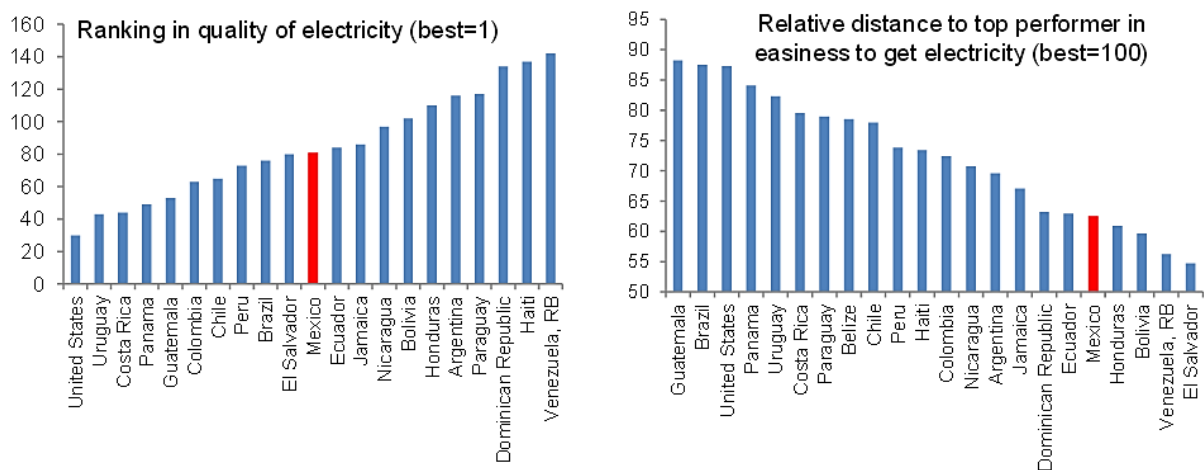
Overall, from first registering the business, through completion of construction of a new building, the World Bank's *Doing Business* data indicate a median time requirement of 155.4 days to complete these processes in Mexico, and a swifter 101.4 days required in the United States. In total, the costs of these procedures come to \$78,130 in Mexico, compared to a figure of \$94,450 in the United States.

Utilities

According to a 2015 report from the International Monetary Fund, electricity and natural gas are two factors that are limiting output growth in Mexico. In the past, limited investment in Mexican infrastructure “led natural gas pipelines to operate close to maximum capacity in recent years.”⁸⁸

Infrastructure shortcomings have forced Mexico to continuously rely on the import of liquid natural gas, mainly from countries like Qatar, Peru, Nigeria, and Indonesia in order to prevent shortages. There was a natural gas shortage in Mexico in 2013 that accounted for an estimated loss of 0.3 percent of GDP growth during the second half of that year.

Figure 28: Mexican Quality and Ease of Access of Electricity



Source: International Monetary Fund 2015

⁸⁸ <https://www.imf.org/external/pubs/ft/wp/2015/wp1545.pdf>

In December 2013, the Mexican government reformed the constitution in order to approve energy legislation affecting oil, gas, and electricity markets. The reform aimed to increase oil and gas production by eliminating an existing monopoly held by PEMEX—a state-owned utility company, and by increasing private participation in the electricity sector. An International Monetary Fund study estimated that Mexico’s reform in favor of natural gas and away from fuel oil could lead to a 13 percent decrease in electricity prices and an increase in overall GDP by up to 0.6 percent as shown in Figure 29. Roughly a year after the reforms, Mexico had changed the electricity infrastructure enough to reduce electricity costs for industrial consumers by 10 percent.

Figure 29: Average Price of Electricity to Industrial and Commercial Consumers (U.S. Cents per kilowatt/hour)



Source: <http://www.eia.gov/electricity/data.cfm#sales>; Comisión Federal de Electricidad (CFE). Luz y Fuerza del Centro (LFC).

In August 2015, CNBC reported that opening the Mexican energy markets will draw investors—helping the country to develop its remaining oil reserves, and later its “vast shale gas deposits.” Furthermore, in March 2014 Mexico’s electricity rates for industrial customers fell “between 18 and 26 percent,” according to Enrique Ochoa Reza, the chief executive of Mexico’s Federal Electricity Commission. In December 2013, the Mexican government reformed the constitution in order to approve energy legislation affecting oil, gas, and electricity markets. The reform aimed to increase oil and gas production by eliminating an existing monopoly held by PEMEX—a state-owned utility company, and by increasing private participation in the electricity sector. An International Monetary Fund study estimated that Mexico’s reform in favor of natural gas and away from fuel oil could lead to a 13 percent decrease in electricity prices and an increase in overall GDP by up to 0.6 percent as shown in Figure 29. Roughly a year after the reforms, Mexico had changed the electricity infrastructure enough to reduce electricity costs for industrial consumers by 10 percent.

Figure 29 illustrates this recent drop in Mexican electricity prices, but also shows that Mexican electrical consumers are still paying, on average, much more than their U.S. counterparts. The numerous announcements of new automotive manufacturing facilities are partially due to this decrease in the price of electricity, which made Mexican rates more competitive with the United States. In the past,

rates for industrial electricity were often between 120 and 130 percent higher in Mexico than the rates paid by industrial consumers in the United States. Though many automakers already had production in Mexico, this rush of new investment “comes as Mexico has boosted efficiency in its state-owned electricity provider, and made investments in retooling its electricity grid to run on natural gas, instead of the petroleum the country has been using.”⁸⁹

Investment or Retention Opportunity Matrix

Table 11 indicates which factors could influence a company to either relocate U.S. or Canadian production or site new operations in Mexico. This table is most applicable to smaller and medium-sized companies as opposed to the large OEMs and Tier 1 companies who have standardized and sophisticated global operations and sourcing contracts. Because each investment decision is unique, the table serves as only a guideline for how each of these factors might influence these decisions. Likewise, many suppliers indicate that they located a given facility in Mexico at the request of their automaker customer – these factors must therefore be considered in balance with such requests. The decision factors include amount of labor content, automation and tooling support requirements, advanced material utilization, how process-intensive production is, how energy-intensive production is, whether or not products will be exported outside of the NAFTA region, and whether or not a specially trained workforce is necessary. The degree to which a potential investment is dependent on each of these factors can help determine the company’s likelihood to shift to or locate production in Mexico.

⁸⁹ <http://www.cnbc.com/2015/08/10/mexicos-falling-electricity-rates-draw-manufacturers.html>

Table 11: Cost Factors that Would Encourage Automotive Manufacturers to Produce in the United States

Factor	High	Low	Why?
Labor Content	Mexico	U.S.	Labor is undeniably less expensive in Mexico. Cost savings can be achieved in Mexico for processes with high labor content, but production that requires low labor content is more likely to stay or locate in the United States.
Automation and Tooling Support	U.S.	Mexico	Mexico does not have as robust a base of tooling expertise to support, maintain, and replace tooling as that found in the automotive clusters of the U.S. and Canada. Particularly for smaller firms, who have less developed internal tooling support capability, production that is highly dependent on automated processes is more likely to stay or locate in the United States and Canada
Advanced Materials	U.S.	Mexico	Advanced materials, such as certain grades of high strength steel, high grade aluminum, carbon fiber, etc., are generally more readily available in the U.S. and Canada. Because materials sourced from the US and Canada are less expensive if they are used near where they were produced, supplier manufacturing operations that are highly dependent on these materials are less likely to locate in Mexico.
Process-Intensive	U.S.	Mexico	Secondary processing providers (e.g. heat-treating and powder-coating) are more difficult to find in Mexico. U.S. locations that have access to these processes are more likely to retain or attract production for businesses that require these processes. Manufacturers that do not require these processes are more likely to produce in Mexico.
Utility-Cost	U.S.	Mexico	Utility costs are higher in Mexico, so energy-intensive production may not realize savings in Mexico. Therefore, processes that require high utility usage are more likely to remain or locate in the United States.
Non-NAFTA Exports	Mexico	U.S.	Due to Mexico's numerous Free Trade Agreements, a Mexican vehicle or component exported outside of the NAFTA region may avoid the tariffs that U.S. exports face. For this reason, manufacturers shipping outside of North America may choose to move to or locate in Mexico.
Specialized Workforce	U.S.	Mexico	Mexican workers, in general, have less specialized training in automotive production. Manufacturing that requires a great deal of specialized labor is often done in the United States, while production requiring little or no specialization may move to or locate in Mexico.

The matrix suggests that production requiring high-energy consumption or a specialized workforce might face challenges in Mexico. Both labor-intense manufacturing, and production destined for export outside the NAFTA region are particularly likely to locate in Mexico. Conversely, manufacturing which features highly automated processes, reliance upon specialized materials, is sensitive to energy and other utility costs, and/or needs a specialized or high-skilled labor all benefit from U.S. and Canadian based production.

Crime and Security

Security concerns are the number one issue for Mexican voters, according to the *Financial Times*. Mexico's crime problem is an issue of safety for not only the people who live there, but also those who might move there, potentially stunting Mexico's economic growth. The prevalence of crime not only creates an image problem for Mexico, which can deter investment, but is also estimated to be costing the developing country between 2 and 3 percent of its GDP annually. Most of these losses come from direct costs of crime, while approximately one-third result from the cost of public and private crime-prevention measures. Mexico's national statistical agency suggests that the burden of these costs is absorbed by the private sector, and have a disproportionate affect "...on smaller companies that find it harder to bear the additional costs of security."⁹⁰ Figure 30 depicts where crime is more prevalent in Mexico, ranking crime by state. Rural areas of Mexico tend to have higher instances of crime.

Figure 30: Medley Global Advisors Security Index Map: 2015



Source: *Financial Times* 2015

Note: The MGA security index is composed of quantitative indicators of crime such as intentional homicide, kidnapping and extortion rates, and qualitative variables such as institutional weakness and the presence of drug cartels.

President Nieto has been frequently criticized for his inaction on all forms of crime. His popularity continues to plummet as his "ambitious reform program has—so far—failed to revive the economy, while personal scandals are undermining his ability to govern effectively," according to the *Financial Times*.⁹¹

The business cost of crime is nearly 50 percent higher in Mexico—and that means higher security costs, insurance, and losses.⁹² The good news for Mexico is that the issues with crime and security have not greatly affected the levels of foreign direct investment pouring into the country. Most of the large companies investing in Mexico consider additional security measures to be part of the cost of doing business there. Historically, international investors have allocated around four percent of operating cost to crime-prevention measures.

⁹⁰ <http://www.ft.com/cms/s/3/e9e21282-1345-11e5-ad26-00144feabdc0.html#axz3t4wIziK>

⁹¹ Ibid.

⁹² <https://www.competitivealternatives.com/industries/indsummary.aspx?id=883>

Environment

The Mexican Secretaria de Medio Ambiente y Recursos Naturales (SEMARNAT) oversees matters related to the environment and natural resources, and all laws and norms are published in the official government publication, Diario Oficial de la Federacion. The SEMARNAT website includes a compilation of rules and regulations that directly relate to environmental matters. There are likely other regulations that apply to companies depending on their area of businesses and operations.

The format of most regulations issued by the Mexican government is similar. For the most part, the sections of regulatory documents are as follows:

- Explanation of why there is a need for that particular regulation.
- Legal considerations that allow the issuance of the regulation.
- List of the organizations involved in the process of researching, preparing, and issuing the regulation; organizations may include government and business entities.
- Objective, scope, references, definitions, specifications, inspections, sanctions, bibliography, similarities with international regulations, date the regulation becomes effective, and appendix/notes.

Mexican regulations are issued and updated as deemed necessary. Some regulations date back to the 1980s and have been updated throughout the years. When the Mexican government views regulations as too outdated or needing considerable modifications, a new one is issued. Many Mexican regulations cite the U.S. Environmental Protection Agency as a reference for methods and procedures.

Conclusion

Mexico's ability to compete for new North American automotive investments stems largely from the country's relatively lower labor costs, and advantages from numerous free trade agreements with the rest of the world. Through continued development of infrastructure and government-sponsored workforce training programs, Mexico remains a competitive destination for manufacturing companies, especially the automotive industry.

Any regional competitive analysis regarding the potential for automotive new investment or reinvestment must consider the home region's strengths as well as those of competing areas. One of the more important aspects of attracting or retaining automotive investment is the industry's need for research, development and testing facilities. High-tech labs and R&D centers draw highly skilled workers, and importantly, are where new products and technologies are developed that have the potential to support industries beyond automotive. Automakers frequently locate supporting R&D, and engineering facilities near their manufacturing operations. Initially, the engineering done at or near manufacturing operations tends to deal with product launch, quality, and other fields related to manufacturing. Eventually, if the labor pool is available to support expansion, automakers and suppliers may add engineering related to product and process development.

Despite unprecedented economic growth and billions of dollars of automaker and supplier investment, Mexico's continued growth may be limited by other factors in the future. Ongoing automaker and supplier investment in Mexico, as well as continued investment in education and job training, could lead to a more competitive labor market and drive up the nominal wages paid to Mexican workers, though the U.S. dollar-Mexican peso exchange rate may still provide Mexico with a labor cost advantage. There are other challenges to running manufacturing operations in Mexico which include high crime rates, government corruption, and an inefficient judicial system deter potential investors. International shipping costs and congestion combined with the need to provide additional security measures to protect product, property, and personnel are also sources of risk associated with investment in Mexico. These added costs may counterbalance labor cost savings.

Emphasizing the degree to which these factors are less problematic in the United States offers U.S. economic developers advantages they can use to attract or retain automotive investment in their own communities. It is important, however, not to assume the U.S. advantages over Mexico will always exist. The Mexican government has actively been engaging in programs to alleviate infrastructure congestion, crime and legal issues, therefore reducing the degree to which these factors deter investment. If recent history is a guide for Mexico's automotive future, the rapid pace of automaker and supplier investment and associated job creation in the country may continue to impact U.S. automotive communities.

Appendix I – Research Centers

Centro de Desarrollo de la Industria Automotriz en Mexico⁹³ (Center for the Development of the Automotive Industry in Mexico)

This research center, also known as CeDIAM, is part of the Instituto Tecnológico de Monterrey and has offices in Nuevo Leon, Sonora, Coahuila, Guanajuato, Jalisco, Puebla, Queretaro, Aguascalientes, Morelos, San Luis Potosi, and Mexico State. This organization offers consulting services, training, and research and development. There is a focus on research, engineering, manufacturing, and electronics oriented towards the auto industry. GM has an alliance with CeDIAM; CeDIAM provides training programs for GM employees.

Centro de Investigación y Asistencia Técnica del Estado de Queretaro, A.C. (CIATEQ)⁹⁴ (Research and Technical Assistance Center of the State of Queretaro)

This research center, also known as CIATEQ, was constructed with the support of the Government of Querétaro, the federal institutions CONACYT and LANFI (the latter no longer in operation), Grupo ICA and Grupo SPICER. CIATEQ helps develop products and parts, industrial machinery, and equipment. CIATEQ has offices in Querétaro, Aguascalientes, San Luis Potosí, Hidalgo, Tabasco, Veracruz, and Mexico State. CIATEQ has been involved in multiple projects for the automotive and auto parts industry.

- CIATEQ Querétaro – specializes in measurement systems, engineering and design of factories, mechanical systems, tools, and prototypes. It has design and training areas and three factories to manufacture machinery and prototypes.
- CIATEQ Aguascalientes – focuses on technological developments, development of products, and metrology (measurement & equipment of measure). It also has a factory that can produce, assemble, and test prototypes.
- CIATEQ San Luis Potosí- has a factory that possesses machine tools and CNC (computerized numerical control) machines for the manufacture and assembly of prototypes and molds. It also has a metrology lab, a design lab, and an information center.
- CIATEQ Hidalgo – this research center has labs for the following: metallurgic, chemical, analysis of oils, dimensions, resistance, destructive tests, among others.
- CIATEQ Tabasco – focuses on design and development projects for the oil industry.
- CIATEQ Veracruz – focus on the oil industry, particularly petro chemistry.
- CIATEQ Mexico State – plastics R&D, prototype labs, nondestructive testing, biodegradation, and elaboration of polymers and advanced materials.

⁹³ <http://cediam.mx/acerca/>

⁹⁴ <http://www.ciateq.mx/>

Centro de Tecnología Electrónica Vehicular ITESO⁹⁵ (Center of Electric Technology for Vehicles ITESO)

This organization is part of the ITESO, Universidad Jesuita de Guadalajara and was formed by an alliance between the university and the company Soluciones Tecnológicas. This research center mainly focuses on the automotive, electronic, and software industries, as well as designing and testing electronic systems for cars. The institution also provides testing and design of electronic systems for OEMs and suppliers.

Consejo Nacional de Ciencia y Tecnología (CONACYT)⁹⁶ (National Council of Science and Technology)

This government entity is very similar to the U.S. National Science Foundation. As a government institution, CONACYT focuses on programs that support critical needs in areas such as science and technology. They also fund university research projects and support various research groups. CONACYT grants scholarships for graduate students. This institution also funds the Sistema Nacional de Investigadores (National System of Researchers), which is an organization that provides recognition to scientists and researchers.

Public and private universities, research centers and labs, public and private companies and anyone registered at the Registro Nacional de Instituciones y Empresas Científicas y Tecnológicas (National Registry of Institutions and Scientific and Technological Companies) can make use of programs and funds for research purposes. This national registry is maintained by CONACYT and serves the purpose of identifying institutions, companies, or people that perform research activities in the areas of science and technology. Members of the registry include Ford and General Motors.

Additional efforts include research centers and networking, such as Strategic Alliances and Innovation Networks (AERIS), the Industrial Engineering and Development Center (CIDESI), and the Advanced Materials Research Center.

Cluster Automotriz de Nuevo León (CLAUT) (Nuevo Leon Automotive Cluster)

According to their website, the Cluster Automotriz de Nuevo León is a civil association of OEMs, suppliers, manufacturers and government institutions involved in the auto industry. OEMs include Caterpillar, Daimler, John Deere, and Navistar International. Tier 1 suppliers include Accuride, Alcoa, Cemm Thome, Mitsuba, Nematik, San Luis Rassini, Vitro, Yazaki, and other. Tier 2 suppliers include Acerotek, ABT, Demaq, Estampados Monterrey, and more. Among the members of the cluster are universities such as the Tecnológico de Monterrey, Universidad Autónoma de Nuevo León, UNAM, and other. The government of Nuevo Leon is also part of this organization.

CLAUT brings representatives of companies, institutions, and the government together for conferences, events, and activities that foster collaboration. It also has strategic alliances with AMIA (Asociación Mexicana de la Industria Automotriz) and INA (Industria Nacional de Autopartes).

⁹⁵ http://www.magis.iteso.mx/antiores/021/021_tecnologia_ctev.htm

⁹⁶ <http://www.conacyt.mx/>

Appendix II- Environmental Laws

Federal Laws (Leyes Federales)

Federal laws regulate aspects such as environmental protection, national resources, and climate change. The “*Ley General del Equilibrio Ecologico y la Proteccion al Ambiente*” (general law regarding ecological equilibrium and environmental protection) was passed in 1988 and has been updated throughout the years. It establishes the foundation for environmental regulations. All environmental regulations reference this law because it establishes the principles on environmental regulations and compliance. The “*Ley General Para la Prevencion y Gestion Integral de los Residuos*” (law regarding residue) establishes classifications for residue, limits, measures to handle these residues, and compliance.

Environmental Rules (Reglamentos del Sector)

These documents include general guidelines and procedures and mention the official norms that apply to situations when the environment might be compromised. Topics include assessment of environmental impact and protection of natural resources.

Environmental Norms (Normas Oficiales Mexicanas)

On their website, SEMARNAT has a list of national regulations divided into the following categories:

- Water
- Noise pollution
- Emissions from fixed sources
- Emissions from sources in motion
- Environmental impact
- Mud and bio solids
- Measuring concentrations
- Methodology
- Protection of flora and fauna
- Residue
- Soil
- In collaboration with other agencies

Water

There are six regulations listed in this category. In general, these regulate public water systems, dwells, sewer systems, and methods to measure water availability. The water section doesn't include regulations pertaining to water pollution by companies; those regulations are discussed in other sections. The water section is more oriented towards public supply and not for industrial use.

Noise Pollution

This section includes four norms that establish noise limits on motorcycles, automobiles, and fixed sources of noise. The norms include procedures on how to measure noise and compliance. These regulations date back to 1994 and have been updated a few times. For example, the norm that regulates noise limits on fixed sources was issued in 1994 and revised in 2013. New noise limits were established in 2013. For industrial and commercial establishments, the maximum limit is 68 decibel (dB) from 6 am to 10 pm and 65 decibel from 10 pm to 6 am.

Emissions from fixed sources

There are 12 regulations pertaining to emissions of lead, sulfur, particulates, nitrogen oxides, sulfur dioxide and trioxide, carbon monoxide, et cetera. These regulations apply depending on the substance produced and the combustion method used. Other regulations include emissions and byproducts related to the elaboration of glass, cement, cellulose, paint for domestic use, and petroleum products.

Regulations

- June 2013 - regulations put in place to regulate CO₂ emissions and fuel efficiency on vehicles weighing up to 3,857 Kg.⁹⁷
- These regulations emulate the regulations set in place in the United States and Canada.
- The new set of regulations demands a fuel economy of 14.6 km/L (34.34 miles/gallon) in 2016.
- ICCT points out that vehicles sold in Mexico tend to be both smaller (average footprint of 4.1 m² as opposed to 4.5 m²) and less powerful (approximately 25 percent lower for MY2008) than vehicles sold in the United States. The average fuel economy of new vehicles was also 3 percent higher in 2011 in Mexico. While the new regulations requires manufacturers to meet a very similar overall fleet average in Mexico and in the United States, Mexico's standard requires a lower overall annual rate of improvement—2.2 percent in Mexico compared to 3.6 percent in the United States—from model year 2011.⁹⁸
- In addition, auto companies would be able to get credits if they implemented these policies promptly and introduced innovative and efficient technologies.
- In terms of emissions, there are several regulations put in place to regulate contamination and the emission of substances into the atmosphere.

In terms of sulfur dioxide emissions, companies must reach a level of emissions of 600 ppmv (parts per million by volume) of sulfur dioxide (SO₂) no later than 2019. Companies must reduce their emissions gradually and issue a report during January of each year. Limits on emissions of solid particles depend on the area where the company is located. The regulation on solid particles was issued in 1993, replacing a similar regulation issued in 1988.

The following tables contain emission limits applicable to existing equipment (prior to 2012) and new equipment.

⁹⁷ NORMA Oficial Mexicana NOM-163-SEMARNAT-ENER-SCFI-2013, (2013, July 21). In *Diario Oficial de la Federación*. Retrieved April 3, 2015, from http://dof.gob.mx/nota_detalle.php?codigo=5303391&fecha=21/06/2013

⁹⁸ Blumberg, K. (2013, July 23). Mexico Light-Duty Vehicle CO₂ and Fuel Economy Standards. In *The International Council on Clean Transportation*. Retrieved April 3, 2015, from <http://www.theicct.org/mexicos-ldv-co2-and-fuel-economy-standards>

Table 12: Maximum emission levels for existing equipment (prior to 2012)

(Applies to furnaces or any source of direct or indirect heat); Values expressed in concentration units

Thermal capacity of equip. GJ/h	Fuel type	Smoke print	Particulates, mg/m ³			Sulfur dioxide, ppm _v			Nitrogen oxide, ppm _v			Carbon monoxide, ppm _v		
			ZVM	ZC	RP	ZVM	ZC	RP	ZVM	ZC	RP	ZVM	ZC	RP
From 0.53 to 5.3 (15 to 150 CC)	Liquid	3	NA	NA	NA	550	1,100	2,200	NA	NA	NA	400	450	500
	Gas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	400	450	500
5.3-42.4 (150-1,200 CC)	Liquid	NA	75	350	450	550	1,100	2,200	190	190	375	400	450	500
	Gas	NA	NA	NA	NA	NA	NA	NA	190	190	375	400	450	500
From 42.4 to 106 (from 1200 to 3,000 CC)	Liquid	NA	60	300	400	550	1,100	2,200	110	110	375	400	450	500
	Gas	NA	NA	NA	NA	NA	NA	NA	110	110	375	400	450	500
From 106 to 530 (from 3000 to 15,000 CC)	Liquid	NA	60	250	350	550	1,100	2,200	110	110	375	400	400	500
	Gas	NA	NA	NA	NA	NA	NA	NA	110	110	375	400	450	500
> 530 (> 15,000 CC)	Liquid	NA	60	250	350	550	600 ³	2,200	110	110	375	400	400	500
	Gas	NA	NA	NA	NA	NA	NA	NA	110	110	375	400	450	500

Source: SEMARNAT⁹⁹

⁹⁹ <http://biblioteca.semarnat.gob.mx/janium/Documentos/Ciga/agenda/DO3098.pdf>

Table 13: Maximum emission levels for new equipment (from 2012 onwards)

Values expressed in concentration units

Thermal capacity of equipment GJ/h	Fuel type	Smoke print	Particulates, mg/m ³			Sulfur dioxide, ppm _v			Nitrogen oxide, ppm _v			Carbon monoxide, ppm _v		
			ZV M	ZC	RP	ZV M	ZC	RP	ZV M	ZC	RP	ZV M	ZC	RP
From 0.53 to 5.3 (from 15 to 150 CC)	Liquid	2	NA	NA	NA	275	1,100	2,200	NA	NA	NA	400	450	500
	Gas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	400	450	500
From 5.3 to 42.4 (from 150 to 1,200 CC)	Liquid	NA	60	350	450	275	1,100	2,200	190	190	375	400	450	500
	Gas	NA	NA	NA	NA	NA	NA	NA	190	190	375	400	450	500
From 42.4 to 106 (from 1200 to 3,000 CC)	Liquid	NA	60	300	400	275	1,100	2,200	110	110	375	400	450	500
	Gas	NA	NA	NA	NA	NA	NA	NA	110	110	375	400	450	500
From 106 to 530 (from 3000 to 15,000 CC)	Solid	NA	25	60	150	30	70	700	25	110	375	250	300	350
	Liquid	NA	30	60	280	30	220	1,100	25	110	375	250	350	350
	Gas	NA	NA	NA	NA	NA	NA	NA	25	110	375	250	300	350
More than 530 GJ/h (more than 15,000 CC)	Solid	Maximum opacity 20%	25	50	50	30	110	220	25	110	220	250	350	350
	Liquid		30	50	50	30	110	220	25	110	220	250	300	350
	Gas	NA	NA	NA	NA	NA	NA	NA	25	110	220	250	350	350

Source: SEMARNAT¹⁰⁰

Emissions from Sources in Motion

Under this section, SEMARNAT lists 10 regulations related to emissions produced by cars, motorcycles, etc. Regulations include limits on emissions of carbon monoxide, nitrogen oxide, particles, and other byproducts of gasoline and diesel. Other regulations refer to measurement methods for emissions and limits on volatile organic compounds (VOC) resulting from painting the body of a light or heavy vehicle.

¹⁰⁰ <http://biblioteca.semarnat.gob.mx/janium/Documentos/Ciga/agenda/DO3098.pdf>

The following table contains limits on VOCs when painting automobiles, vehicles for multiple uses (like buses), and trucks/semi-trucks.¹⁰¹

Table 14: Limits on VOCs

Vehicle Type	Limits on VOCs in grams per square meter (g/m ²)
Automobiles	55
Vehicles for multiple uses (passenger/cargo)	60
Trucks/semi-trucks	75

Source: SEMARNAT

During July 2013, the government published a regulation pertaining to fuel economy standards and CO₂ emissions for passenger vehicles weighting 3,857 kilograms (8,500 lbs.) or less¹⁰². The document explains that Mexico is emulating emission standards set in 2010 in the United States and Canada.

Table 15: Shadow U.S. and Canada Rules

Classification	Shadow section (m ²)		
Passenger vehicles	3.81	>3.81 and <5.20	5.20
Semi-trucks	3.81	>3.81 and <6.13	6.13

Source: SEMARNAT

For each segment, net CO₂ emissions should be determined as follows:

Passenger vehicles

- a) Passenger vehicles with a shadow equal or lower than 3.81 m², the net emission value should be selected for the respective year and model.
- b) Passenger vehicles with a shadow equal or greater than 5.2 m², the net emission value should be selected for the respective year and model.
- c) Passenger vehicles with a shadow greater than 3.81 m² and less than 5.20 m², the net emission value should be calculated and rounded to the nearest decimal, according to the respective year and model.

Table 16: Values and parameters used to calculate net emissions applicable to passenger vehicles

Year/Model	Net Emissions			
	A [g CO ₂ /km]	B [g CO ₂ /km]	C [g CO ₂ /km]	D [g CO ₂ /km]
2012	155.1	199.5	31.8616	33.7630
2013	151.5	196.0	31.8671	30.1593
2014	147.7	192.1	31.8428	26.4381
2015	142.1	186.5	31.8570	20.7744
2016	135.7	180.1	31.8662	14.3406

Source: SEMARNAT

Environmental Impact

Regulations included in this section focus on environmental impact due to various activities such as mining, installation and maintenance of oil and natural gas pipes, extraction of geothermal energy,

¹⁰¹ <http://biblioteca.semarnat.gob.mx/janium/Documentos/Ciga/agenda/PPD02/NOM121.pdf>

¹⁰² http://dof.gob.mx/nota_detalle.php?codigo=5303391&fecha=21/06/2013

extraction of oil from the sea and inland, and telecommunication systems using fiber optic cables. These regulations include measurement methods and adequate procedures.

Mud and Bio Solids (lodos y biosólidos)

This section has one regulation that refers to the treatment of residual waters. It includes limits on chemical content and residue (like mud and bio solids) resulting from water treatment.

Measuring Concentrations

There are six regulations listed in this category. As the subtitle suggests, this section focuses on methods to measure air quality, particle concentrations, and concentration of substances like ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. It includes guidelines on equipment and procedures.

Methodology

This section consists of one regulation about methods to make maps that identify the location of federal maritime zones and their limits. Organizations that wish to operate in or near the sea must present a map of the location, according to the specifications set in this regulation to determine if it will be located in an appropriate area or not.

Protection of Flora and Fauna

This section has 29 regulations related to the protection of endangered species and natural resources in general such as wood, turtles, whales, et cetera. This section focuses on flora and fauna, methods to handle certain animals, and sustainability.

Residue (and byproducts)

There are 15 regulations listed in this section and regulate residue, byproducts, and appropriate disposal. Types of residue include residue that is considered dangerous due to their properties, urban residue (domestic or public activities), and non-compatible residue (reacts with other substances). One of these regulations focuses on handling and disposal of residue that doesn't fit into the urban residue category or the dangerous residue category. If this is the case, companies must have a plan to properly dispose of residue such as items at the end of their life cycle, packaging materials, plastic, batteries, et cetera.

Other regulations include mining processes and leaching of substances. With regards to dangerous residue, it is considered as such if it's corrosive, reactive, flammable or explosive, toxic, or infectious. The regulation describes the criteria used to establish whether or not the substance is a dangerous residue. Dangerous residue must be stabilized and confined according to specifications. Generally, confinement sites must be surrounded by a 100-meter area and located at a minimum distance of five kilometers (3.11 miles) from cities or towns. Other regulations include specifications that confinement sites must meet for any type of residue and limits on incineration of residue.

Soil

This category includes six regulations pertaining to the protection of soil, evaluation of nutrient content, and sustainability.

In Collaboration with Other Agencies

This section includes 10 regulations done by SEMARNAT and other government agencies regarding issues with overlapping jurisdiction. There are regulations about genetically modified animals, oyster, forest areas, efficiency of appliances, and other. This section includes the previously mentioned regulation about fuel economy standards and CO₂ emissions.

Appendix III - Compliance

- The Procuraduría Federal de Protección al Ambiente (PROFEPA) is a branch of SEMARNAT that oversees environmental issues and compliance.
- PROFEPA lists a series of procedures and requirements to obtain a plant certification for automobiles assembled, imported, and/or commercialized in Mexico.
 - Companies must present required documentation and a certificate of gas emissions.
 - If there is a problem with the application, the company will be notified within 15 days; if there are no issues with the application, the certification process will take approximately 30 days.¹⁰³
- PROFEPA follows “administrative procedures” when companies are not complying with environmental laws.
 - Visit from a PROFEPA inspector.
 - The inspector determines compliance or noncompliance.
 - There is a five-day period to present proof that was not presented during inspection. If there is evidence of noncompliance, PROFEPA will grant the company a 15-day period to present proofs of compliance.
 - Once the 15 days are over, PROFEPA will accept or reject the proofs. After that, companies generally cannot present more proof.
 - Then, companies have a three-day period to send their written claims/arguments to PROFEPA.¹⁰⁴
 - Once the argument period is over, PROFEPA will emit an “administrative resolution” that will then determine the sanctions imposed on the company, depending on the situation:
 - Penalties ranging from 20 to 50,000 days of minimum wage currently paid in the Federal District.
 - Partial or total closing, temporary or definitive.
 - Administrative arrest of up to 36 hours.
 - Suspension or revocation of licenses, permits, or authorizations.¹⁰⁵

After a sanction has been determined, companies have a 15-day period to appeal PROFEPA’s decision.¹⁰⁶

- If noncompliance continues, every day that goes by the company will get more fees.
- If the company was found noncompliant and continues noncompliance more than once in a two year period, fines could be three times higher than the original fine.¹⁰⁷

¹⁰³ Certificación en Planta. (n.d.). In *Procuraduría Federal de Protección al Ambiente*. Retrieved April 6, 2015, from http://www.profepa.gob.mx/innovaportal/v/190/1/mx/certificacion_en_planta.html

¹⁰⁴ Procedimiento Administrativo. (2014, November 25). In *Procuraduría Federal de Protección al Ambiente*. Retrieved April 6, 2015, from http://www.profepa.gob.mx/innovaportal/v/511/1/mx/procedimiento_administrativo.html

¹⁰⁵ Resolución Administrativa. (n.d.). In *Procuraduría Federal de Protección al Ambiente*. Retrieved April 6, 2015, from <http://www.profepa.gob.mx/innovaportal/file/511/1/ResolucionAdministrativa.pdf>

¹⁰⁶ Ibid, Procedimiento Administrativo

¹⁰⁷ http://www.diputados.gob.mx/LeyesBiblio/pdf/148_090115.pdf pg. 81

Table 17: Air and GHG emissions, Carbon dioxide (CO₂), Million tons

Location	2006	2007	2008	2009	2010	2011	2012
Canada	540.4	569.39	554.16	519.89	531.36	536.66	533.74
Mexico	394.94	410.1	404.01	399.94	417.94	432.5	435.79
U.S.	5684.44	5761.89	5585.23	5182.49	5427.14	5288.43	5074.14

Source: Data from the Organization for Economic Cooperation and Development (OECD)

Table 17 analyzes the difference in air quality between the three North American countries. This data indicates that emission rates have increased in Mexico between 2006 and 2012, while emission rates in the United States have fallen during the same period. Though this increase of 40.85 million tons seems insignificant, the fact that there is any positive change becomes a cause for concern when Mexico is compared to neighboring countries, where emission rates have only fallen in recent years. These changes can be attributed to new emission standards in the United States that have created better air quality in the country, while heavy manufacturing has increased in Mexico, lowering air quality.

References

- Althaus, Dudley. (2015). "Mexico Sets Auto Production Record, Aims for More." Wall Street Journal. January 8, 2015. <http://www.wsj.com/articles/mexico-sets-auto-production-record-aims-for-more-1420749573>
- Althaus, Dudley. (2015). "Why Auto Makers Are Building New Factories in Mexico, not the U.S." The Wall Street Journal. March 17, 2015. <http://www.wsj.com/articles/why-auto-makers-are-building-new-factories-in-mexico-not-the-u-s-1426645802>
- Alvarez, Jorge and Fabian Valencia. (2015). "Made in Mexico: Energy Reform and Manufacturing Growth." IMF Working Paper. International Monetary Fund. February 2015. <https://www.imf.org/external/pubs/ft/wp/2015/wp1545.pdf>
- Arteta, Carlos, Steven B. Kamin, and Justin Vitanza. (2009). "The Puzzling Peso." The Federal Reserve Board. June 2009. <http://www.federalreserve.gov/pubs/ifdp/2009/976/ifdp976.htm>
- ANUIES. "Anuarios Estadísticos de Educación Superior 2012-2013" [Statistical Report on Higher Education]. Asociación Nacional de Universidades e Instituciones de Educación Superior (National Association of Universities and Institutions of Higher Education). <http://www.anuies.mx/iinformacion-y-servicios/informacion-estadistica-de-educacion-superior/anuario-estadistico-de-educacion-superior>
- Barrera, Adriana and Figueroa, Ricardo. (2015). "Ventas de Vehículos Ligeros en México Repuntan 15.6 pct en Mayo." Reuters América. June 2, 2015. <http://lta.reuters.com/article/businessNews/idLTAKBN00J04Q20150603>
- BEBA. (2013). "2013 Investment Climate Statement - Mexico" Bureau of Economic and Business Affairs, U.S. Department of State. February 2013. <http://www.state.gov/e/eb/rls/othr/ics/2013/204693.htm>
- BLS. (2012). "International Comparisons of Hourly Compensation Costs in Manufacturing, 2011." News Release. Bureau of Labor Statistics, U.S. Department of Labor. December 9, 2012. <http://www.bls.gov/news.release/pdf/ichcc.pdf>
- Bogler, Dan. (2015). "Crime and Punishment: Mexico Suffers the Costs of Lawlessness." Financial Times. June 15, 2015. <https://next.ft.com/content/e9e21282-1345-11e5-ad26-00144feabdc0#axzz3t4wZliK>
- Boston, William. (2015). "In Germany, Mexican Workers Learn Audi's Ways." Wall Street Journal. March 17, 2015. <http://blogs.wsj.com/corporate-intelligence/2015/03/17/in-germany-mexican-workers-learn-audis-ways/>
- Cámara de Diputados. (2015). "Ley General del Equilibrio Ecológico y la Protección al Ambiente." Electronic File. Page 81. Cámara de Diputados, Mexican Congress, Government of Mexico. September 1, 2015. http://www.diputados.gob.mx/LeyesBiblio/pdf/148_090115.pdf
- CAR. (2014). Interviews. Center for Automotive Research. www.cargroup.org
- CAR. (2015). Book of Deals. Database. Center for Automotive Research. December 2015.

- Case, Brendan. (2013). "Automakers Spur \$3 Billion Boom for Made-in-Mexico Steel." Bloomberg. April 17, 2013. <http://www.bloomberg.com/news/articles/2013-04-17/automakers-spur-3-billion-boom-for-made-in-mexico-steel>
- Cattan, Nacha. (2016). "In Hot Mexico Market, Even Troubled VW is Thriving." Automotive News. January 5, 2016. <http://www.autonews.com/article/20160105/RETAIL01/160109963/in-hot-mexico-market-even-troubled-vw-is-thriving>
- Cattan, Nacha and Ben Bain. (2015). "Carmakers' \$23 Billion Mexico Venture May Face Snarls at Ports." Bloomberg. May 25, 2015. <http://www.bloomberg.com/news/articles/2015-05-26/carmakers-23-billion-mexico-venture-may-face-snarls-at-ports>
- CeDIAM. (n.d.). "Centro de Desarrollo de la Industria Automotriz en México, Historia." Centro de Desarrollo de la Industria Automotriz en México, Tecnológico de Monterrey. <http://cediam.mx/acerca>
- Cattan, Nacha. Bloomberg. Ford Said to Plan \$1 Billion Plant in Boost to Mexico Auto Boom. January, 2016. <http://www.bloomberg.com/news/articles/2016-01-14/ford-said-to-plan-1-billion-plant-in-boost-to-mexico-auto-boom>
- Centro de Tecnología Electrónica Vehicular. (n.d.) ITESO, Universidad Jesuita de Guadalajara. http://www.magis.iteso.mx/anteriores/021/021_tecnologia_ctev.htm
- CIA. (2016). The World Factbook. U.S. Central Intelligence Agency. January 2016. www.cia.gov/library/publications/the-world-factbook
- CIATEQ. (2016). CIATEQ, Centro de Investigación y Asistencia Técnica del Estado de Queretaro - (Queretaro Center for Research and Technical Assistance), A.C., CONACYT. <http://www.ciateq.mx/>
- CONACYT. (n.d.). Consejo Nacional de Ciencia y Tecnología, Government of Mexico. <http://www.conacyt.mx/>
- Country Listing. (n.d.). Nations Encyclopedia, Mexico – A Country Study. <http://www.country-data.com/cgi-bin/query/r-8753.html>
- Dawson, Ruth. (2014). "What can Mexico Learn from its Neighbours?" Automotive World Megatrends Magazine. June 9, 2014. <https://www.automotiveworld.com/megatrends-articles/can-mexico-learn-neighbours/>
- Deloitte. (2014). "Taxation and Investment in Mexico 2014: Reach, Relevance and Reliability" Deloitte Touche Tohmatsu Limited. 2014. <http://www2.deloitte.com/content/dam/Deloitte/global/Documents/Tax/dttl-tax-mexicoguide-2014.pdf>
- Diario Oficial de la Federación (Official Journal of the Federation). (2013). "NORMA Oficial Mexicana NOM-163-SEMARNAT-ENER-SCFI-2013" [Official Regulation NOM-163-SEMARNAT-ENER-SCFI-2013]. Press Release. Official Journal of the Federation, Ministry of Economy, Government of Mexico . June 21, 2013. http://dof.gob.mx/nota_detalle.php?codigo=5303391&fecha=21/06/2013
- Escalation Consultants, Inc. (2014). "Analysis of Freight Rail Rates for U.S. Shippers." Escalation Consultants, Inc., American Chemistry Council. March 2014. <http://www.americanchemistry.com/Policy/Rail-Transportation/Full-Report-Analysis-of-Freight-Rail-Rates-for-US-Shippers.pdf>

Explorando Mexico. (2016). "Mexico's Most Important Ports." Explorando Mexico. 2016. <http://www.explorandomexico.com/about-mexico/6/23/>

Ferris, Robert. (2015). "Mexico's Falling Electricity Rates Draw Manufacturers." CNBC LLC. August 10, 2015. <http://www.cnbc.com/2015/08/10/mexicos-falling-electricity-rates-draw-manufacturers.html>

Flannery, Nathaniel Parish. (2014). "Is Industrial Mexico A Friend Or Foe To The U.S. Auto Sector?" Forbes. August 18, 2014. <http://www.forbes.com/sites/nathanielparishflannery/2014/08/18/is-industrial-mexico-a-friend-or-foe-to-the-u-s-auto-sector/>

Gifford, Daron. (2015). "How Suppliers Can Seize New Opportunities in Mexico." Automotive News. May 27, 2015. <http://www.autonews.com/article/20150527/BLOG06/150529887/how-suppliers-can-seize-new-opportunities-in-mexico>

González, Lilia. (2015). "Venta de Autos Perfila Récord Histórico" [Vehicle Sales Set Historical Record]. El Economista. June 2, 2015. <http://eleconomista.com.mx/industrias/2015/06/02/venta-autos-perfila-record-historico>

Hutchins, Reynolds. (2015). "Mexican Government Spending \$5 Billion on Ports." The Journal of Commerce. April 20, 2015. http://www.joc.com/port-news/international-ports/mexican-government-spending-5-billion-ports_20150420.html

ICCT. (2013). "Mexico Light-Duty Vehicle CO2 and Fuel Economy Standards." The International Council on Clean Transportation. July 23, 2015. <http://www.theicct.org/mexicos-ldv-co2-and-fuel-economy-standards>

ITA. (2015) "Global Patterns of U.S. Merchandise Trade." Interactive Table. Office of Trade and Industry Information, Manufacturing and Services, International Trade Administration, U.S. Department of Commerce. Accessed May 20, 2015. <http://tse.export.gov/TSE/TSEHome.aspx>

Jelmayer, Rogerio. (2015). "Brazil, Mexico Agree to Extend Auto Trade Agreement." The Wall Street Journal. March 9, 2015. <http://www.wsj.com/articles/brazil-mexico-to-renew-auto-trade-agreement-1425899470>

Kaplan, Jay. (1998). "The 1994 Mexican Currency Crisis." University of Colorado Boulder. January 9, 1998. <http://www.colorado.edu/economics/courses/econ2020/6550/readings/Mexico-currency.html>

KPMG. "Competitive Alternatives 2016." KPMG International. 2016. <https://www.competitivealternatives.com/>

KPMG. "Comparative Review of Select Free Trade Zones around the World." KPMG International. 2009. http://www.integrationpoint.com/documents/KPMG_FTZ_ComparativeReview_FactSheet.pdf

LMC Automotive. North American Production Forecast. 2015.

MexicoGov. (2015). "Incentives" Mexico Manufacturing Startup Information: Labor Costs, Incentives, Real Estate, Shelters and Mexico Contacts. Website. Accessed May 4, 2015. <http://www.mexicogov.org/incentives.php>

Mexico News Daily. (2015). "Heavy truck and bus exports soar in 2015 Mexico now a close second behind Germany in tractor-truck production." <http://mexiconewsdaily.com/news/heavy-truck-and-bus-exports-soar-in-2015/#sthash.rIH0zoPD.dpuf>

- MFI. (2012). "High-Tech Training for Companies Looking at Manufacturing in Mexico." MFI International, Flexible Manufacturing Services. May 29, 2012. <http://info.mfiintl.com/blog/bid/127282/High-Tech-Training-for-Companies-Looking-at-Manufacturing-in-Mexico>
- Montez, Juan. (2015). "Chinese Steel Imports Cause Industry Rift in Mexico." The Wall Street Journal. July 9, 2015. <http://www.wsj.com/articles/chinese-steel-imports-cause-industry-rift-in-mexico-1436468945>
- Organisation Internationale des Constructeurs d'Automobiles (OICA). World Motor Vehicle Sales, by Country and Type, 2005-2015: All Vehicles. <http://www.oica.net/wp-content/uploads//total-sales-20151.xlsx>
- Ortiz, Guillermo. (2015). "La Crisis de 1994-95 y la Actual Crisis" [The Crisis of 1994-95 and the Current Crisis]. CNN Expansión. February 3, 2015. <http://www.cnnexpansion.com/economia/2009/01/30/la-crisis-del-199495-y-la-actual-crisis>
- OTA. (1992). "Table 7-12—Cost Structure for Auto Assembly in the United States and Mexico" U.S.-Mexico Trade: Pulling Together or Pulling Apart? U.S. Congress, Office of Technology Assessment. OTA-ITE-545. U.S. Government Printing Office, Washington, DC. September 1992.
- Platts Steel Industry News. Accessed November, 2015. <https://www.steelbb.com/>
- Priddle, Alisa and Brent Snavelly. (2015). "Why Mexico is Winning the Auto Jobs War." Detroit Free Press. June 14, 2015. <http://www.freep.com/story/money/cars/2015/06/13/auto-investment-plants-jobs-us-canada-mexico-nafta/27551801/>
- PROFEPA. (2013). "Certificación en Planta" [Plant Certification]. Procuraduría Federal de Protección al Ambiente (Federal Attorney for Environmental Protection), Government of Mexico. 2013. http://www.profepa.gob.mx/innovaportal/v/190/1/mx/certificacion_en_planta.html
- PROFEPA. (2014). "Procedimiento Administrativo" [Administrative Procedures]. Procuraduría Federal de Protección al Ambiente (Federal Attorney for Environmental Protection), Government of Mexico. November 25, 2014. http://www.profepa.gob.mx/innovaportal/v/511/1/mx/procedimiento_administrativo.html
- PROFEPA. (n.d.). "Resolución Administrativa" [Administrative Resolution]. Electronic File. Procuraduría Federal de Protección al Ambiente (Federal Attorney for Environmental Protection), Government of Mexico. <http://www.profepa.gob.mx/innovaportal/file/511/1/ResolucionAdministrativa.pdf>
- Promexico. (2013, 2015). Promexico, Ministry of Economy, Government of Mexico.
- PwC Network. (2013). "Malquiladora Guide Doing Business in Mexico". Electronic File. PricewaterhouseCoopers S.C.
- Rhoda, Richard and Tony Burton. (2011). "The Reasons Why Mexico Is Fast Becoming a Key Player in Aerospace Manufacturing." Geo-Mexico. September 17, 2011. <http://geo-mexico.com/?p=4977>
- Russell, Alan. (2015). "Investment Incentives in Mexico." Tecma Group of Companies. February 3, 2015. <https://www.tecma.com/investment-incentives-in-mexico/>
- SE. (2015). "Sectoral Promotion Programs." Secretaría de Economía (Ministry of Economy), Government of Mexico. Accessed May 4, 2015. <http://www.economia.gob.mx/industry/foreign-trade-instruments/prosec>
- SEMARNAT. (2003). "NORMA OFICIAL MEXICANA NOM-121-SEMARNAT 1997" [Official Regulation NOM-121-SEMARNAT 1997]. Secretaría de Medio Ambiente y Recursos Naturales (Ministry of

- Environment and Natural Resources), Government of Mexico. April 23, 2003.
<http://biblioteca.semarnat.gob.mx/janium/Documentos/Ciga/agenda/PPD02/NOM121.pdf>
- SEMARNAT. (2012). "NORMA Oficial Mexicana NOM-085-SEMARNAT-2011" [Official Regulation NOM-085-SEMARNAT-2011) Secretaría de Medio Ambiente y Recursos Naturales (Ministry of Environment and Natural Resources), Government of Mexico. February 2, 2012.
<http://biblioteca.semarnat.gob.mx/janium/Documentos/Ciga/agenda/DO3098.pdf>
- SteelOrbis. (2015). "As Mexican HRC Prices Decline, Producers Seek to Diversify their Businesses." SteelOrbis Electronic Marketplace Inc. December 18, 2015. http://www.steelorbis.com/steel-prices/steel-prices-market-analyses/flats-and-slab/as_mexican_hrc_prices_decline_producers_seek_to_diversify_their_businesses_-_911813.htm
- SteelOrbis. (2015). "Mexican CRC Prices Drop Despite Auto Demand Forecast." SteelOrbis Electronic Marketplace Inc. December 16, 2015. http://www.steelorbis.com/steel-prices/steel-prices-market-analyses/flats-and-slab/mexican_crc_prices_drop_despite_auto_demand_forecast_-_911408.htm
- The Conference Board. (2013). International Labor Comparisons database. The Conference Board. 2013.
- United States Census Bureau. (2015). U.S.Trade in Goods with Mexico. 2015.
<https://www.census.gov/foreign-trade/balance/c2010.html>
- Volkswagen. (2014). "Audi México: New Training Center Opened." Volkswagen AG. October 21, 2014.
http://www.volkswagenag.com/content/vwcorp/info_center/en/news/2014/10/training.html
- Ward's Automotive. (2015). Ward's World Motor Vehicle Data 2015. Ward's Automotive.
- World Bank. (2016). Doing Business Data. Database. Doing Business Project, World Bank Group, The World Bank. 2016. <http://www.doingbusiness.org/data>
- World Economic Forum. (2014). Global Enabling Trade Report. The World Economic Forum. 2014.
<https://www.weforum.org/reports/global-enabling-trade-report-2014/>
- World Freight Rates. (2013). Freight Calculator. Interactive Website. World Freight Rates. 2013.
<http://worldfreightrates.com/freight>