Contribution of the Automotive Industry to the Economies of All Fifty States and the United States

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All statements, findings, and conclusions in this report are those of the authors and do not necessarily reflect those of the Alliance of Automobile Manufacturers.

Contribution of the Automotive Industry to the Economies of All Fifty States and the United States

Center for Automotive Research

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Kim Hill

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EXECUTIVE SUMMARY

- **Over 7 million private sector jobs supported by auto manufacturers, suppliers and dealers in the United States**
- **$500 billion paid in annual compensation to employees supported by the automotive industry**
- **Every vehicle manufacturer job creates almost 7 other jobs in industries across the economy**
- **All direct auto industry employment creates almost 4 additional jobs in other industries across the economy**

The automotive industry continues to be one of the most important industries in the U.S. economy, supporting more than seven million private sector jobs and $500 billion in compensation, along with attracting foreign direct investment (FDI) currently valued at $74 billion—approximately 3 percent of all FDI in the United States.[1] Additionally, the industry has collectively invested almost $46 billion expanding and retooling U.S.-based facilities since 2010.

Fourteen automotive companies have numerous facilities in the United States, with some companies supporting fully integrated operations in the country including research, development, design, engineering, headquarters, and manufacturing operations, while others have a much smaller footprint. Beyond the number of jobs created, the industry contributes substantially to federal, state and local tax revenues, providing more than $200 billion to the federal and state governments. This study highlights these contributions to the U.S. economy.

Only half a dozen years after the worst recession in the U.S. since the 1930s, the American economy demonstrates many signs of strengthening, and the auto industry is helping to drive the recovery. Despite recent economic hardships, auto manufacturers, suppliers and dealers themselves employ over 1.5 million people and directly contribute to the creation of another 5.7 million jobs. In total, the auto industry is now responsible for 7.25 million private sector jobs, according to Center for Automotive Research (CAR) analysis.

CAR researchers also found the millions of employees whose jobs are supported by the auto industry collect almost $500 billion in annual compensation, delivering nearly $65 billion in personal tax revenues to government entities. This figure underscores another recent CAR study, which found that motor vehicle manufacturing and use generated at least $110 billion in state government tax revenue and another $96 billion in federal government tax revenue, amounting to about $206 billion in taxes – or more than the Gross National Product of 142 countries across the globe.[2]

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[1] BEA. (2015). "Foreign Direct Investment in the United States: Selected Items by Detailed Industry of U.S. Affiliate, 2008–2013." Bureau of Economic Analysis, U.S. Department of Commerce. Accessed January 16, 2015. <http://www.bea.gov/international/xls/fdius-current/FDIUS%20Detailed%20Industry%202008-2013.xlsx>.

[2] Hill, Kim, Debra Maranger Menk, and Joshua Cregger. (2015). "Assessment of Tax Revenue Generated by the Automotive Sector for the Year 2013." Center for Automotive Research. January 2015. <http://www.cargroup.org>. and World Bank. (2014). "GDP Ranking." The World Bank. Website. Accessed December 16, 2014. <data.worldbank.org>.

The industry as a whole employs about 1,553,000 people directly engaged in designing, engineering, manufacturing, and supplying parts and components to assemble, sell and service new motor vehicles. CAR found vehicle manufacturers—automakers, also known as original equipment manufacturers (OEMs)—directly employed 322,000 people in the U.S. in their respective headquarters and in other operational facilities, such as assembly and manufacturing plants and on research and development campuses. Additionally, there are 521,000 people employed in the automotive parts sector, including workers in the rubber, plastics, battery, aftermarket, and parts export sectors, and another 710,000 people employed in the dealer network selling and servicing new vehicles.

But jobs related to the auto industry go far beyond designing, building and selling vehicles. America's automakers are also among the largest purchasers of aluminum, copper, iron, lead, plastics, rubber, textiles, vinyl, steel and computer chips. CAR models discerned that every OEM employee had an employment multiplier effect of 7.6 (or 6.6 additional jobs for every direct OEM job), while the employment multiplier for the entire industry is 4.7.[3] There are many workers in intermediate and spinoff jobs from the auto industry due to the complex manufacturing supply network with many tiers of suppliers across a wide array of industries.

Breakout of the employment and economic contributions by OEM, all automotive manufacturing, and dealer sectors are as follows:

Direct, intermediate, and spin-off employment from OEM activities estimated at 2.4 million

- Total compensation of $168 billion
- Estimated personal tax payments of nearly $23 billion

Total employment generated by all automotive manufacturing (including automakers) is estimated to be 5.6 million

- Total compensation of $375 billion
- Estimated personal tax payments of nearly $45 billion

Total employment generated by the dealership network is estimated to be 1.65 million

- Total compensation of $116 billion
- Estimated personal tax payments of approximately $20 billion

These figures are likely to rise as well. CAR's U.S. automotive employment forecast projects hiring will increase by approximately 10.8 percent, with a compound average growth rate of 2.1 percent from 2013 to 2018. U.S. production is forecast to continue expanding, growing at a compound average growth rate of 2.4 percent, resulting in a projected rise of 12.6 percent in production from 2013 to 2018. CAR's econometric analysis also suggests auto sales over the next several years will continue to increase, from 15.6 million units in 2013 to 17.6 million units in 2018.

[3] The employment multiplier derived from manufacturing vehicles is lower than the previous study completed in 2010, while the parts manufacturing, sales and total industry multipliers are slightly higher than multipliers seen in previous studies. The authors believe that since the recession, increases in productivity, as well as the tendency for manufacturing operations to run three shifts, have dampened the employment contribution, as day-time, office and business services jobs provide support for around-the-clock production.

INTRODUCTION

The automotive industry is a critical component of economic growth, with extensive connections across the industrial and cultural fabric of the United States. This report outlines many known elements and highlights tremendously important associations beyond the market space of automotive manufacturing. National and regional employment; research, development and innovation; state and local government revenues; foreign direct investment; education; health care; U.S. trade; and quality of life are all tied to the automotive industry. This report reviews many of the factors that support the auto industry's importance and standing in the national economy, and provides a current estimate of the industry's employment and economic contribution to the national economy and to each of the 50 states and the District of Columbia.

The paper is organized into several sections: Section I provides qualitative context and current market metrics for the automotive industry, both of which are needed to truly appreciate the contributions of the industry to the broader economy and gauge where the industry may be heading. Section II features an in-depth quantitative analysis of employment and personal income associated with the automotive industry. Section II captures the distinct contributions of assemblers, motor vehicle and parts manufacturing, and dealers to the national economy. Section III describes the state-level employment associated with the automotive industry. Section IV discusses the methodology of the economic modeling used to produce the results discussed in Section II and Section III. This study updates the economic contribution estimates from a 2010 study published by the Center for Automotive Research (CAR) on the national contribution of the automotive industry in the United States.[4]

The auto industry is one of the most important industries in the United States. It historically has contributed 3.0 – 3.5 percent to the overall Gross Domestic Product (GDP). The industry directly employs more than 1.5 million people engaged in designing, engineering, manufacturing, and supplying parts and components to assemble, sell and service new motor vehicles. In addition, the industry is a huge consumer of goods and services from many other sectors, including raw materials, construction, machinery, legal, computers and semi-conductors, financial, advertising, and healthcare. Automakers spend an average of $1,200 for research and development (R&D) per vehicle[5] – 99 percent of which is funded by the industry itself. Due to the industry's consumption of products from many other manufacturing sectors, it is a major

[4] Hill, Kim, Debra Maranger Menk, and Adam Cooper. (2010). "Contribution of the Automotive Industry to the Economies of all Fifty State and the United States." Center for Automotive Research. Prepared for the Alliance of Automobile Manufacturers, the Association of International Automobile Manufacturers, the Motor and Equipment Manufacturers Association, the National Automobile Dealers Association, and the American International Automobile Dealers Association. April 2010. <http://www.cargroup.org/?module=Publications&event=View&pubID=16>.

[5] Hill, Kim, Debra Menk, Bernard Swiecki, and Joshua Cregger. (2014). "Just How High-Tech is the Automotive Industry?" Center for Automotive Research. Page 9. January 8, 2014. <http://www.cargroup.org/?module=Publications&event=View&pubID=103>.

driver of the 12 percent manufacturing contribution to GDP. Without the automotive industry, it is difficult to imagine manufacturing surviving in this country.

During the recession, North American vehicle sales and production fell sharply. In 2007, U.S. automotive plants built nearly 11 million vehicles; by 2009, production had fallen to slightly more than half of that, 5.8 million vehicles. To add pressure to the supply chain, prior to the recession, many suppliers were competing for automaker business primarily on price, leading them to operate at very narrow margins. The loss of business coupled with razor-thin margins led to a reduction in the number of supplier companies. Some companies restructures or consolidated, but many simply went out of business.[6]

The U.S. turnaround in vehicle sales happened much more quickly than recovery in other sectors of the economy. After a low point of 10.4 million vehicles sold in 2009, sales in the United States have steadily increased and exceeded 16 million units in 2014. Correspondingly, U.S. automotive production is expected to exceed 11 million vehicles. As production has increased, suppliers are operating their facilities at very high capacity utilization levels. With the financial pain of the recession fresh in memory, most suppliers have been reluctant to reopen closed plants or build new facilities.

As a result of transformation of the automotive industry at the highest levels, coupled with a faster than expected resurgence in sales, many auto suppliers now find themselves under intense customer pressure to increase their capacity and capabilities by investing capital, adding new technologies, increasing efficiency, improving quality, upgrading workforce skills, and collaborating with other firms.[7]

As previously mentioned, more than 1.5 million people are employed by the auto industry. In addition, the industry is a huge consumer of goods and services from many other sectors and contributes to a net employment contribution in the U.S. economy of more than 7 million jobs. Approximately 3.8 percent of all U.S. private sector jobs are supported by the strong presence of the auto industry in the U.S. economy. People in these jobs collectively earn nearly $500 billion annually in compensation and generate $65 billion in tax revenues. Going forward, motor vehicle sales, production and employment in the industry are expected to continue to rise. Coupled with relentless technological advances, the automotive industry will continue to be a significant sector of the U.S. economy.

[6] Ibid. Hill, Kim, Debra Maranger Menk, and Adam Cooper. (2010).
[7] OESA. (2014). "Automotive Supplier Barometer." Original Equipment Suppliers Association. November 3-5, 2014. <http://www.oesa.org/Knowledge-Center/Automotive-Supplier-Barometer/2014-Supplier-Barometers/2014-November-OESA-Automotive-Supplier-Barometer.pdf>.

SECTION I - AUTOMOTIVE INDUSTRY BACKGROUND

This section gives a brief overview of the U.S. automotive industry. It discusses the changing market share and geography of the industry, the effects of the recent recession and subsequent recovery, near-term forecasts, recently announced investments, automotive innovation, and important sectors within the automotive industry, including suppliers, dealers, medium- and heavy-duty vehicle manufacturers, and automotive aftermarket firms.

Overview of the Automotive Industry

The U.S. automotive landscape is dynamic and constantly shifting. Traditionally, the "Detroit 3" (D3) domestic automotive assembly firms (Chrysler, Ford, and General Motors) were the dominant industry force particularly in the U.S. Midwest, the undisputed home of the industry. However, with the entry of international firms (BMW, Honda, Hyundai-Kia, Mercedes, Nissan, Toyota, and Volkswagen) and their investments across the country, the industry is now more vibrant and complex. Decades of intense competition from many rival automakers have led to increased quality and choice for consumers. These changes have also led to new job opportunities and expanded production to new locations.

U.S. Automotive Geography

Within the United States, the top three states for establishments related to automotive production (including companies producing vehicles, bodies, and parts) are Michigan, Indiana, and Ohio. Texas is also high on the list, as are other Midwestern (Illinois and Missouri) and Southern (Tennessee, Kentucky, Alabama, and Mississippi) states. Table 1.1 shows the establishment count for the top 10 states in the United States, and provides total establishment counts for the United States, Canada, and Mexico.

Table 1.1: North American Automotive Manufacturing Establishments, by State and Country

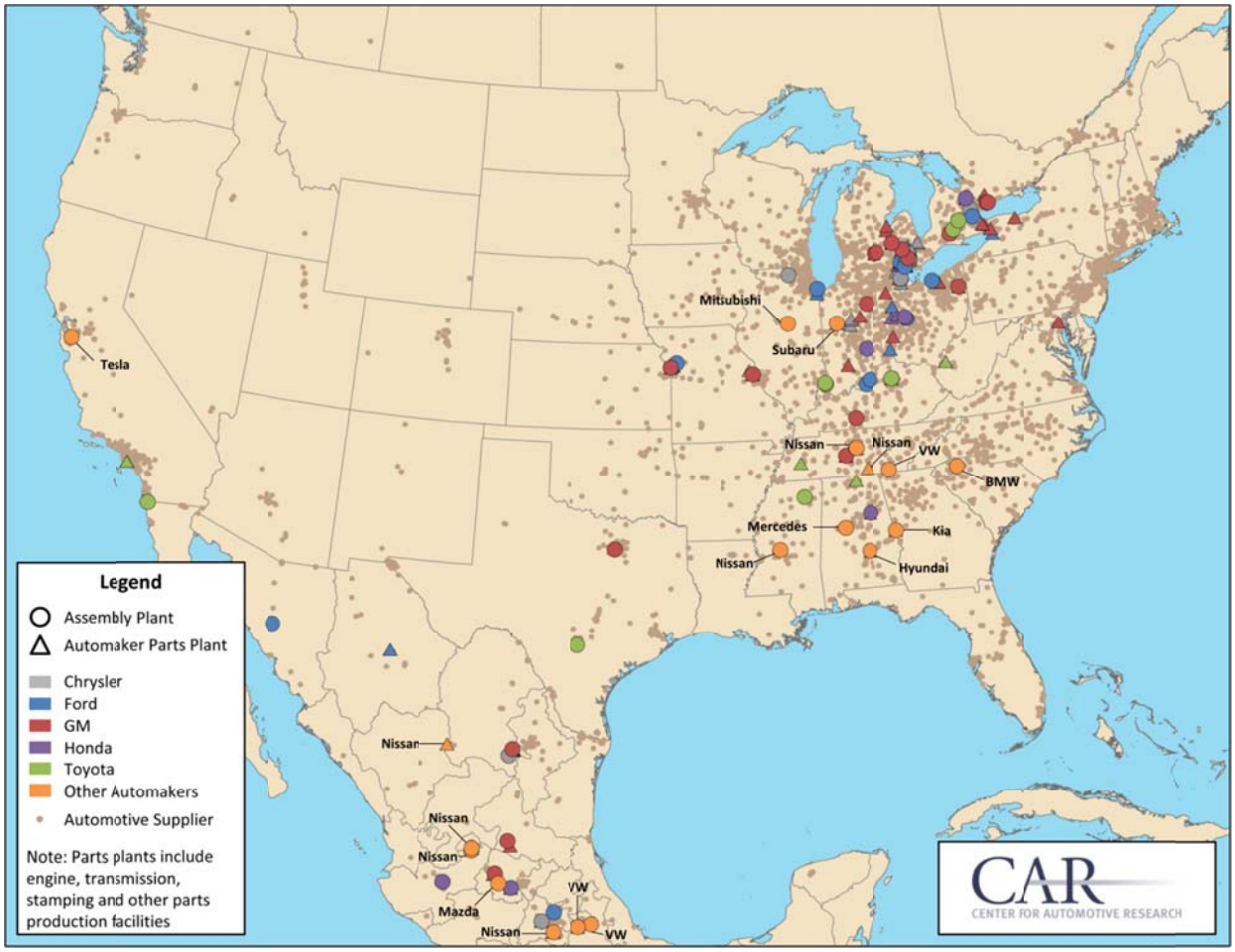
State / Country	Motor Vehicle Manufacturing (NAICS 3361)	Body and Trailer Manufacturing (NAICS 3362)	Parts Manufacturing (NAICS 3363)	All Establishments (NAICS 3361-3363)
Michigan	90	95	790	975
Ohio	24	96	479	599
Indiana	23	165	331	519
Texas	31	178	293	502
Illinois	24	55	292	371
Tennessee	9	53	218	280
Missouri	15	74	136	225
Kentucky	11	26	179	216
Alabama	10	41	149	200
Mississippi	8	22	55	85
All Other U.S.	221	1,183	2,659	4,063
United States	466	1,988	5,581	8,035
Canada	157	600	1,080	1,837
Mexico	23	61	670	754

Sources: Bureau of Labor Statistics, Statistics Canada, Instituto Nacional de Estadistica y Geographia, 2014
Note: U.S. and Canadian figures represent 2013 data. Mexican figures are for 2012.

Traditionally, the geographic center of the automotive industry has been located in the Midwestern states of Illinois, Indiana, Michigan, Missouri, and Ohio, as well as the province of Ontario in Canada. U.S. automakers have also historically had assembly capacity in other states in the form of branch assembly plants (e.g., General Motors and Ford assembly plants in states such as California, Georgia, New York, and Texas),[8] though most of those plants have since closed.[9] U.S. foreign direct investment has facilitated the expansion of the automotive industry beyond the industrial Midwest, as international automakers are largely located in the Southern states of Alabama, Georgia, Mississippi, and Tennessee. The current automotive footprint, sometimes referred to as the "automotive corridor" in North America, which can be seen in Figure 1.1, stretches from the upper Midwest to the Gulf of Mexico.

[8] Rubenstein, James M. (1992). "The Changing U.S. Auto Industry: A Geographical Analysis." Routledge, New York, New York. 1992.
[9] Brugeman, Valerie Sathe, Kim Hill, and Joshua Cregger. (2011). "Repurposing Former Automotive Manufacturing Sites: A report on closed auto manufacturing facilities in the United States, and what communities have done to repurpose the sites." Center for Automotive Research. Prepared for the Office of Recovery for Auto Communities and Workers, U.S. Department of Labor. November 2011. <http://www.cargroup.org/?module=Publications&event=View&pubID=2>.

Figure 1.1: North American Automaker and Automotive Supplier Production Facility Locations



Sources: Center for Automotive Research, 2014 (supplier locations from ELM Analytics and MarkLines)

The supplier footprint follows roughly the same course as the automaker plant footprint, though it is more fully developed in areas that have been engaged with automotive manufacturing for a longer period of time. The greatest density of suppliers is located in Michigan, which also hosts more automotive assembly plants than any other state.

Recent Developments in the Automotive Industry

In the early part of this century, annual U.S. light vehicle sales peaked at 17.4 million, and sustained levels of 16 million units or more through 2007. This unprecedented sales activity was supported by a booming stock market, housing development patterns necessitating increased vehicle ownership, an enhanced sense of personal wealth, and generous vehicle purchasing incentives.

In 2008 and 2009 the financial crisis and subsequent recession resulted in a sharp contraction of automotive sales. Vehicle assemblers, suppliers and dealers assemblers that had expanded capacity during the early part of the decade were vulnerable when vehicle sales fell 40 percent

in 2009. While the U.S. automotive industry had been restructuring for many years, the 2009 market crash—and subsequent bankruptcy of two automakers and scores of suppliers—provided impetus for further reductions in U.S. automakers' and suppliers' production capacity.

Since 2010 the U.S. automobile industry has steadily recovered. Many of the leading economic indicators have come back to pre-crisis levels.[10] Cumulative vehicle sales have registered double-digit growth rates each year since the crash, and 2014 U.S. auto sales through December have increased by 5.8 percent compared to figures from 2013.[11]

During the recession, automakers and suppliers reduced their liabilities and rationalized capacity by closing, selling, or consolidating plants. As the economy began to recover, automakers and automotive suppliers were reluctant to over-expand and met industry demands by running extra shifts and overtime at existing facilities rather than building new capacity. With higher levels of capacity utilization, many companies are now looking to invest in incremental capacity expansion both in the United States and abroad.[12]

Many manufacturing companies are also "reshoring" jobs, or bringing previously outsourced jobs back to the United States.[13] A major reason for reshoring jobs is that the wages in formerly low-cost countries have increased while real wages have seen little growth in the United States. A more flexible and productive workforce and intensive use of automated manufacturing methods has reduced the importance of labor cost when choosing to produce domestically or abroad, while other factors such as freight and energy costs have become more important. One example of reshoring in the automotive industry is Ford's recent decision to relocate some production from China and Mexico to Ohio and Michigan.[14]

Concerns with logistics, as well as freight-in and freight-out costs, have resulted in pressure on supplier firms to locate facilities near their customers. Manufacturing firms are also sensitive to indirect costs, such as the risk associated with more distant supply chains. These concerns have not only resulted in some companies bringing manufacturing back to the United States, but also encouraged a re-agglomeration of automotive suppliers to core automotive-producing regions.

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[10] FRED. (2014). "Federal Reserve Economic Data." Economic Research, Federal Reserve Bank of St. Louis. Accessed June 6, 2014. <http://research.stlouisfed.org/>.

[11] Automotive News. (2014). "U.S. Car and Light-truck Sales by Make – Dec. 2014 (Ranked by Total Sales)." Automotive News Data Center. January 5, 2015. <http://www.autonews.com/section/datacenter>.

[12] CAR. (2015). "Book of Deals." Center for Automotive Research. January 2015.

[13] Northam, Jackie. (2014). "As Overseas Costs Rise, More U.S. Companies Are 'Reshoring'." National Public Radio. January 27, 2014. <http://www.npr.org/blogs/parallels/2014/01/22/265080779/as-overseas-costs-rise-more-u-s-companies-are-reshoring>.; CSG. (2014). "'Made in the USA' Reshoring Brings Manufacturing Back." *Capitol Ideas: Council of State Governments – Insights & Innovations*. March/April 2014. <http://www.csg.org/pubs/capitolideas/2014_mar_apr/2014_mar_apr_images/CIMarApr14.pdf>.; and Economist. (2013). "Reshoring Manufacturing – Coming Home." Special report: Outsourcing and offshoring. *The Economist.* January 18, 2013. <http://www.economist.com/news/special-report/21569570-growing-number-american-companies-are-moving-their-manufacturing-back-united>.

[14] Ibid. Economist. (2013).

Economic Significance of Automotive Industry

For more than a century, the automotive industry has been a major contributor in shaping the U.S. economy, and has generated and supported millions of jobs. As of September 2014, the U.S. motor vehicle and parts manufacturing industry employed more than 870,000 workers.[15] Beyond those direct employees working in assembly, body/trailer, and parts plants, there are many more workers in intermediate and spin-off jobs that are supported through automotive production activities.

The economic performance of the automotive industry, as well as manufacturing more broadly, is important for the continued development and growth of national and regional economies. Manufacturing and automotive industry trends can be indicators of the state of the economy, with periods of growth in automotive manufacturing closely linked to periods of growth in the economy as a whole. As of the second quarter of 2014, the value of U.S. light vehicle sales was $519 billion on an annualized rate; this is the highest rate ever recorded.[16]

The economic implications of the automotive industry's activities extend beyond people directly employed in the industry, due to the complex manufacturing supply network with many tiers of suppliers across a wide array of industries. A few of the more obvious industries supported by automotive manufacturing include motor vehicle parts, primary and fabricated metal, plastics, and rubber products. Outside of manufacturing, the automotive industry supports jobs in professional and technical services, administration and services, wholesale and retail trade, transportation and warehousing, finance and insurance, and management of companies.

In January 2015, the Center for Automotive Research (CAR) published the study, "Assessment of Tax Revenue Generated by the Automotive Sector for the Year 2013" for the Alliance of Automobile Manufacturers.[17] The study examined multiple instruments of tax revenue generation and focused primarily on state and federal tax revenues. Taxes are generated at various points in the automotive product lifecycle. For instance, in addition to the sales taxes generated when vehicles are purchased, government agencies collect taxes from a variety of sources—payroll taxes from employees working in the automotive industry, fuel taxes from gas stations, registration and license taxes from drivers and vehicle owners, and corporate income taxes and licensing fees from the automakers, automotive suppliers, and dealerships. These taxes support a variety of government services throughout the country, such as constructing and maintaining the highway system, and support a number of jobs in a variety of other industries.

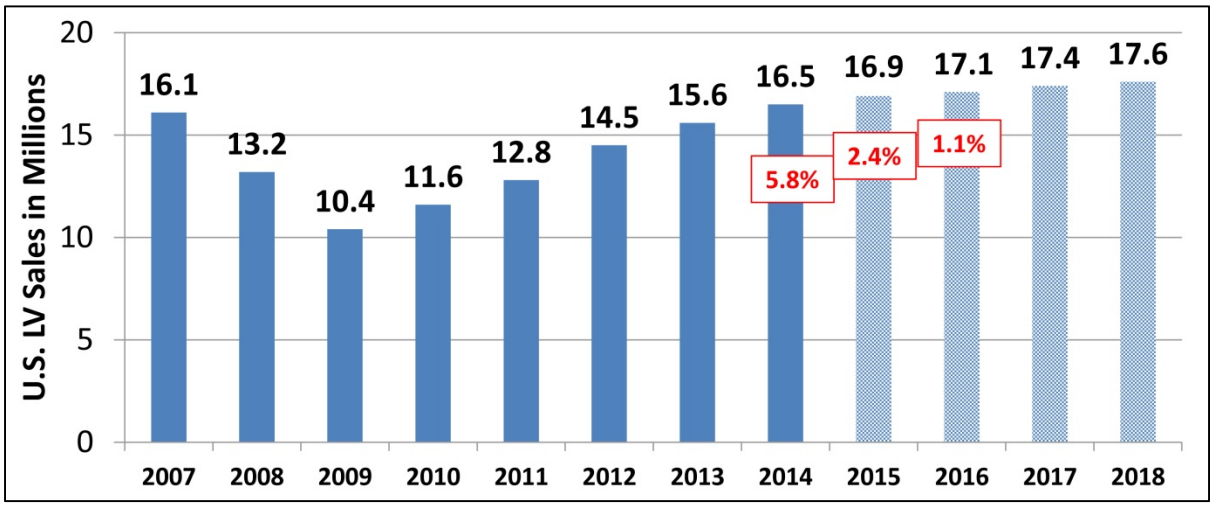
[15] BLS. (2014). Bureau of Labor Statistics, U.S. Department of Labor. Website. Accessed October 24, 2014. <http://www.bls.gov/>.
[16] BEA. (2014). Bureau of Economic Analysis, U.S. Department of Commerce. Website. Accessed October 24, 2014. <http://bea.gov/>.
[17] Hill, Kim, Debbie Maranger Menk, and Joshua Cregger. (2015). "Assessment of Tax Revenue Generated by the Automotive Sector for the Year 2013." Center for Automotive Research. January 2015. <http://www.cargroup.org>.

As a result of the depth and breadth of the automotive industry, every state in the nation generates tax revenues related to motor vehicle production and use. CAR researchers produced estimates[18] of taxes that are generated by operations related to motor vehicles. In 2013, the automotive industry generated at least $110.0 billion in state government tax revenue (This represents approximately 13 percent of state government revenues).[19] The estimates of the federal tax revenues in the tax study do not exhaust all of the contributions made by the automotive industry, and therefore, the estimates serve as a lower-bound estimate. In 2013, the automotive industry generated at least $95.5 billion in federal government tax revenue (This represents approximately 3.4 percent of federal government revenues).[20]

Sales, Production, and Employment Forecasts

CAR produces an annual vehicle sales forecast based on an econometric analysis of key variables of automotive demand. From 2013 to 2018, sales are forecast to increase by approximately 12.8 percent. Figure 1.2 displays historical and forecasted sales for the U.S. automotive industry. The forecast suggests that automobile sales over the next several years will continue to increase, returning to the long-term trend from 16.9 to 17.6 million units annually.

Figure 1.2: U.S. Automotive Sales and Forecast, 2007-2018



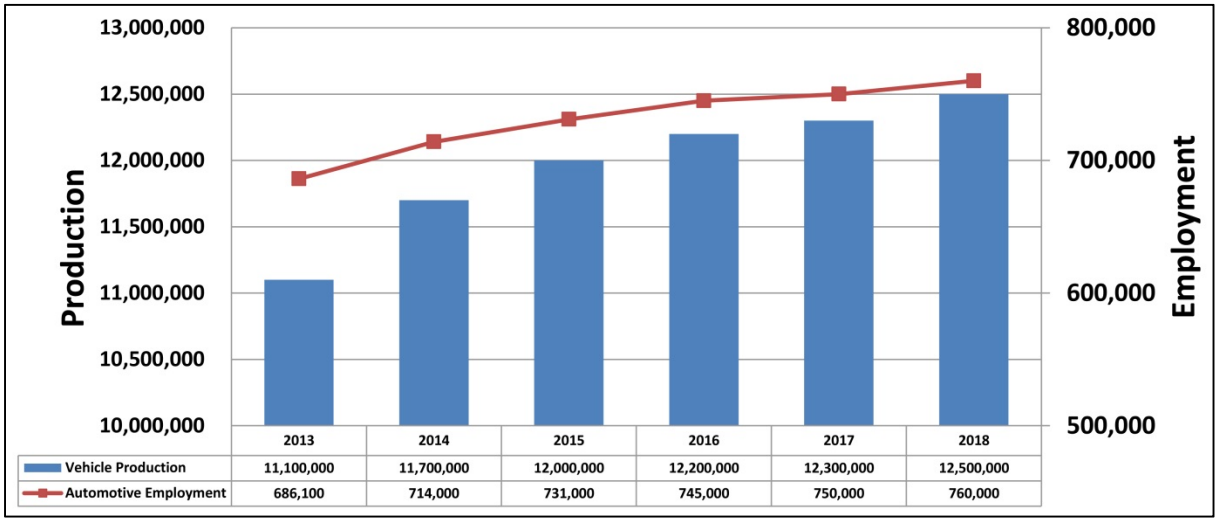
Source: Center for Automotive Research, January 2015

CAR's U.S. automotive employment forecast projects that from 2013 to 2018, employment will increase by approximately 10.8 percent, with a compound average growth rate of 2.1 percent. U.S. production is forecast to continue expanding, growing at a compound average growth rate

[18] All modeled numbers used in the text are rounded.
[19] Total state revenues for 2013 were approximately $846 billion. See Census. (2013). "State Government Tax Collections: 2013." United States Census Bureau, U.S. Department of Commerce. March 2013. <http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=STC_2013_STC003&prodType=table>.
[20] Total federal revenues for 2013 were approximately $2.8 trillion. See CBO. (2013). "Monthly Budget Review—Summary for Fiscal Year 2013." Congressional Budget Office. November 7, 2013. <https://www.cbo.gov/publication/44716>.

of 2.4 percent; the result is a projected increase of 12.6 percent in production from 2013 to 2018. These forecasted trends are displayed in Figure 1.3.

Figure 1.3: U.S. Vehicle Production & Automotive Employment Forecasts, 2013-2018



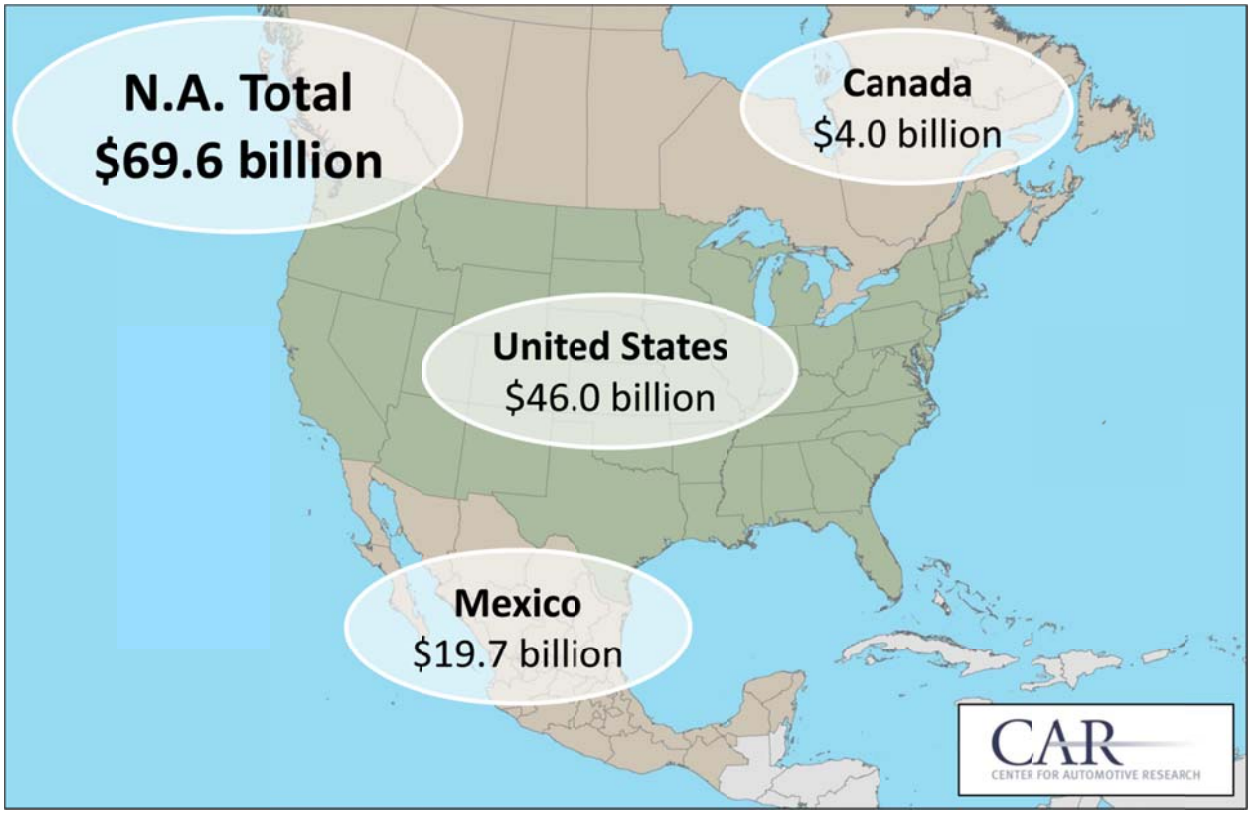
	2013	2014	2015	2016	2017	2018
Vehicle Production	11,100,000	11,700,000	12,000,000	12,200,000	12,300,000	12,500,000
Automotive Employment	686,100	714,000	731,000	745,000	750,000	760,000

Sources: Center for Automotive Research, Automotive News, Bureau of Labor Statistics, October 2014

Automotive Investment

Though the 2008-2009 recession hampered new investments and led many automakers and suppliers to temporarily idle or permanently close many factories, in subsequent years, automakers and suppliers have invested and reinvested in their U.S. facilities. From the beginning of 2010 through the end of 2014, automakers have announced investments totaling nearly $70 billion in North America (see Figure 1.4). These investments include new facilities as well as expanding and retooling existing facilities. The facilities include assembly, engine, transmission, stamping, and parts plants along with other facilities. Of the North American investments made during that period, two thirds of the investment dollars went to facilities located in the United States.

Figure 1.4: Announced North American Automaker Investments, 2010 – 2014



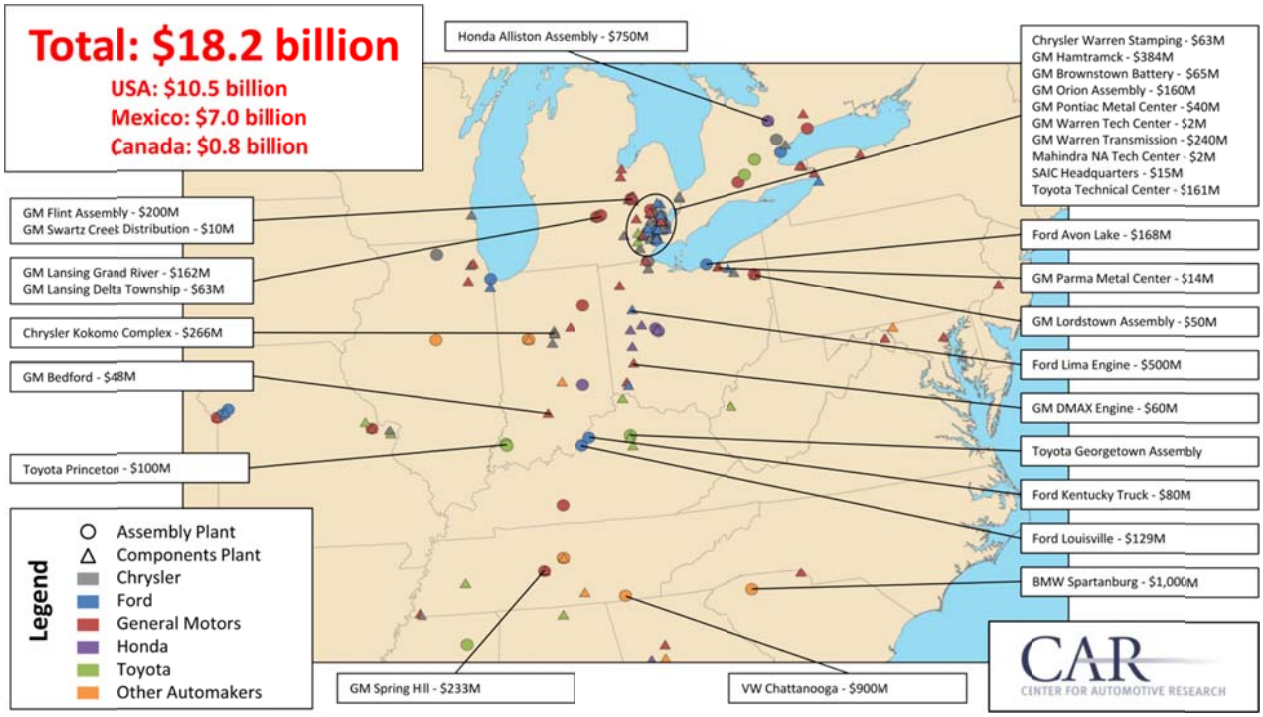
Source: Center for Automotive Research, January 2015

Of the $69.6 billion in announced North American automaker investments from 2010 to 2014,[21] $18.2 billion was announced in 2014. Of that total, $10.5 billion, or 58 percent of the total North American announced automaker investments from 2014 are within the United States. Many of the individual investments and their locations can be seen in Figure 1.5. Foreign direct investment in the United States is currently valued at $74 billion—approximately 3 percent of all FDI in the United States.[22]

[21] The investment totals include announcements for building new and retooling or expanding existing facilities. The totals also cover a range of facility types, including assembly, engine, transmission, stamping, and parts plants.

[22] BEA. (2015). "Foreign Direct Investment in the United States: Selected Items by Detailed Industry of U.S. Affiliate, 2008–2013." Bureau of Economic Analysis, U.S. Department of Commerce. Accessed January 16, 2015. <http://www.bea.gov/international/xls/fdius-current/FDIUS%20Detailed%20Industry%202008-2013.xlsx>.

Figure 1.5: Announced Automaker Investments in North America, January – December 2014



Source: Center for Automotive Research, January 2015

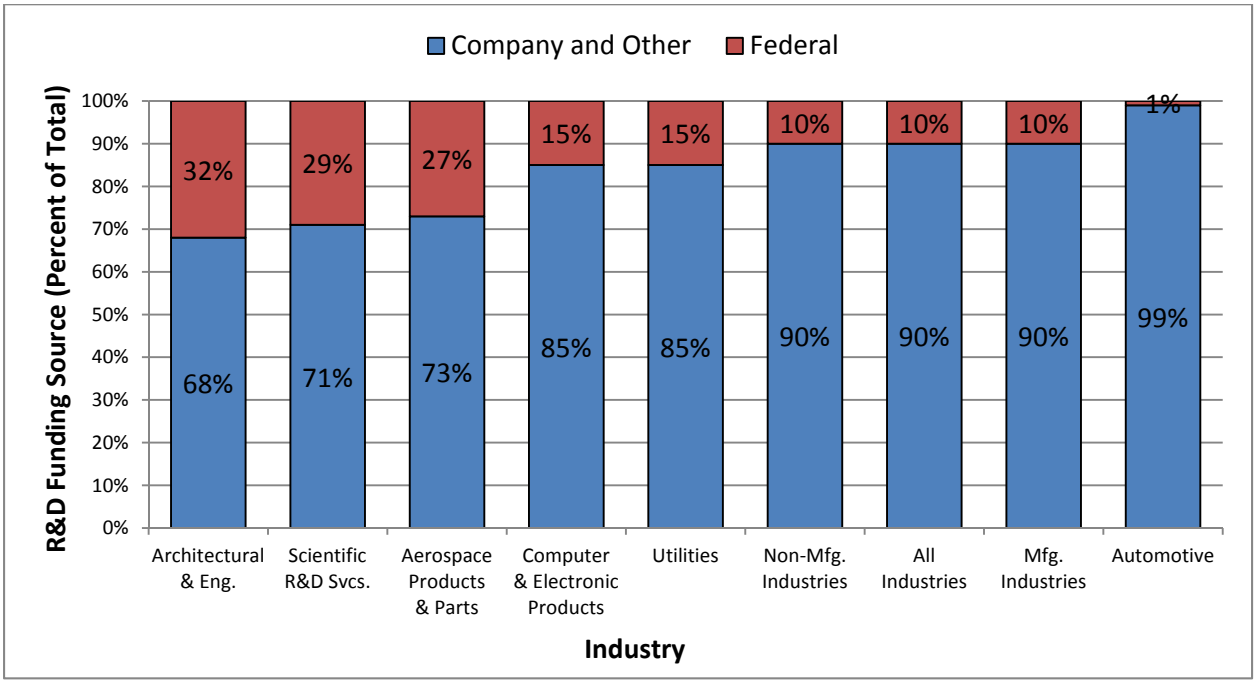
Other U.S. investment announcements not shown in the map (but included in the 2014 total) include:

- BMW opening a new regional parts distribution center in Texas
- Ford opening new technical support center for Ford Racing in North Carolina
- Mercedes building a new vehicle preparation center and other offices in California
- Mercedes expanding its Tuscaloosa assembly plant in Alabama
- Toyota consolidating its manufacturing, sales and marketing, and corporate operations into a single new headquarters in Texas (moving operations from Kentucky and California)
- Tesla establishing a small manufacturing site at a former Chrysler service parts operation in California
- Tesla building a $5 billion battery "Gigafactory" in Nevada

Research, Development, and Innovation in the Automotive Industry

The automotive industry invests heavily in research and development. Unlike other industries, automotive research and development efforts are largely funded by the industry, rather than through public sources. In 2007, the last year when federal funding for the automotive industry was disclosed, only one percent of R&D in the automotive industry was funded through the federal government, leaving the industry to bear essentially the full cost of creating, designing, testing, and implementing new technologies (see Figure 1.6).

Figure 1.6: R&D Funding Sources by Industry, 2007

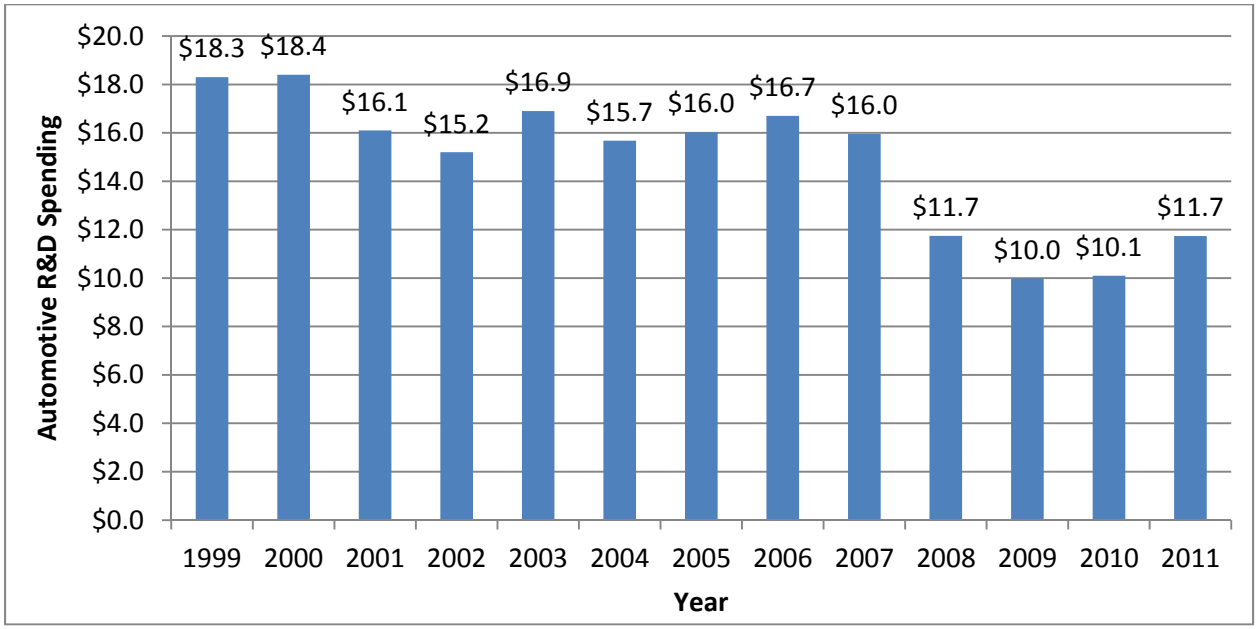


Source: National Science Foundation, 2009

In 2011, the U.S. automotive industry, responding to the need to improve safety in vehicles, consumer demands for new model types with enhanced cosmetic and drive performance characteristics, and regulation of emissions, invested $11.7 billion into R&D. From 1999 to 2007, automotive R&D spending levels ranged between $15 billion and $18 billion. In 2008, U.S. automotive R&D spending fell to $11.7 billion and in 2009 it continued to decline to just under $10 billion. Annual automotive R&D expenditures can be seen in Figure 1.7. Several other industries, all of which comprise a smaller share of GDP and national employment than automotive, often receive a substantial amount of R&D funding from the federal government.[23]

[23] NSF. (2014). "Business R&D and Innovation Survey," and "Survey of Industrial Research and Development." National Science Foundation. Multiple Years. Accessed December 8, 2014. <http://www.nsf.gov/>.

Figure 1.7: U.S. Automotive R&D Spending, 1999-2011



Source: National Science Foundation, 2014

Motor vehicle manufacturing is complex and requires a highly-skilled, highly-educated labor force. Diversity in skill sets, education, and equipment also affords parts suppliers the opportunity to diversify and develop products for a variety of industries outside of automotive. If it were not for the R&D investments within the automotive industry, this dynamic cross-fertilization of the R&D process would not be available to other industries.

Technology Trends in the Automotive Industry

Automotive R&D spending and requirements are expanding rapidly to keep pace with the demands for ever more sophisticated and effective new technologies. Automakers spend an average of $1,200 for R&D per vehicle.[24] Improved fuel economy and emissions targets continue to drive automaker improvements in vehicle powertrain, lightweighting, aerodynamics, and other vehicle attributes. Consumer preferences, increasing congestion, and more mobility choices mean that cars have to incorporate a variety of creative technologies to attract buyers. Areas of particular focus are powertrain, materials, and electronics. A combination of powertrain improvements, new materials, and new material processes comprise the strategies for automakers to achieve greater performance and provide better utility while still improving fuel economy.

Advanced and Alternative Powertrains

The powertrain continues to be an important vehicle system for fuel economy improvements. Vehicle manufacturers are developing a wide range of advanced powertrain technology options

[24] Hill, Kim, Debra Maranger Menk, Bernard Swiecki, and Joshua Cregger. (2014). "Just How High-Tech is the Automotive Industry?" Center for Automotive Research. Page 9. January 8, 2014. <http://www.cargroup.org/?module=Publications&event=View&pubID=103>.

to meet environmental regulations, consumer preferences, and energy-saving goals. While the spark-ignited internal combustion engine (ICE) will remain the dominant technology for the foreseeable future, other powertrain options will see increased market acceptance, and no single option is expected to emerge as the best solution. Areas of technology growth related to powertrain systems include advanced internal combustion engines (gasoline and diesel), transmissions, vehicle electrification, and alternative fuels. Each of these categories presents a wide range of technology options and cost considerations.

The internal combustion engine (ICE) has undergone remarkable change in the past decade and newly developed advanced internal combustion engines are expected to improve ICE environmental performance and also have a cost advantage vis-à-vis other powertrain options. Automakers continue to improve fuel economy of ICE engines using advanced technologies such as downsizing, turbocharging, variable compression ratio capability, and lean-burn engine operation.

Automatic transmissions will remain the dominant choice for U.S. consumers. In coming years, consumers should expect to see more vehicles with dual clutch transmissions (DCT), continuously variable transmissions (CVT), and higher-geared (seven-speed or higher) transmissions.

Electrified vehicles hold both promise and uncertainty. Electric vehicles such as the Chevrolet Volt, Nissan Leaf, Ford Focus Electric, and Tesla Model S have entered the mainstream—but certainly not mass market. Vehicle electrification—including mild hybrids, hybrid electric vehicles, plug in hybrid electric vehicles, and battery electric vehicles—is highly dependent upon further battery development and consumer acceptance.

Alternative fuels, such as natural gas, hydrogen, and biofuels, will also have a place in the advanced powertrain mix. Natural gas has been used in vehicles for many years, but has been mostly limited to heavy-duty and fleet applications. Promoters of natural gas suggest that its abundance and relatively clean burning characteristics make it an ideal candidate for increased usage in motor vehicles. Hydrogen is another alternative fuel that has been researched for decades. Some automakers are already selling or leasing fuel cell electric vehicles, and s everal others have announced they will introduce fuel cell electric vehicles in the near future. Biofuels had strong government support in recent years with tax incentives and a national Renewable Fuels Standard geared towards increasing biofuels production and use. Issues with the 10 percent ethanol “blend wall” have resulted in regulators reducing biofuels production

requirements.[25] All alternative fuels face infrastructure availability issues as well as the challenge of relatively inexpensive gasoline.

Materials and Joining

Vehicle weight is a considerable factor in vehicle fuel economy; it is estimated that a 10 percent reduction in vehicle mass can result in a fuel economy improvement of up to 5-7 percent.[26] Though achieving greater fuel economy is a main driver for many lightweighting material and process technologies, there are other benefits. Weight reduction is also appealing to automakers because it tends to increase other performance factors valued by consumers: ride and handling, braking, and acceleration. Another key motivation for using new and more highly engineered materials is to improve vehicle safety and crashworthiness.

By switching to lightweighting materials, such as high strength steel, aluminum, magnesium, and composites, and adopting new forming (e.g., hot stamping and high integrity casting) and advanced joining (e.g., adhesives, friction stir welding, fasteners, and laser welding) technologies, automakers will be able to significantly reduce the weight of new vehicles. By 2025, automakers are expected to reduce the average vehicle mass by 10 percent or greater versus 2010 vehicles.[27]

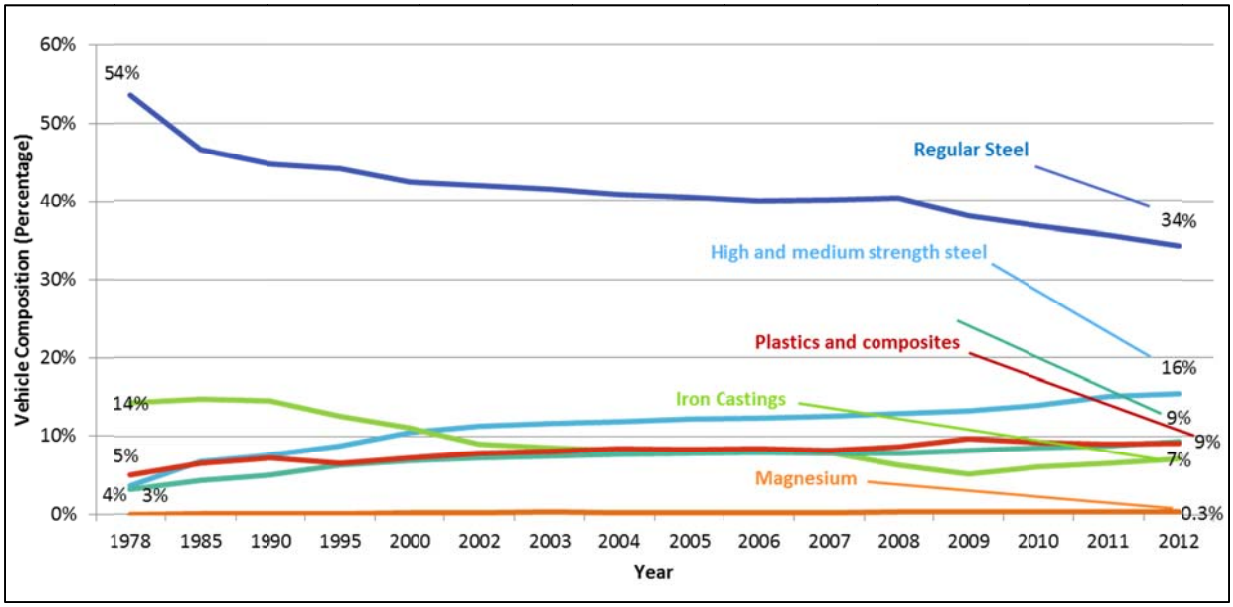
Automakers have historically concentrated on improving the materials used to create vehicles. In the last few decades, there has been increased use of advanced high strength steel (AHSS), composites, and aluminum, as well as a decrease in the use of iron castings and regular (mild) steel. These trends can be seen in Figure 1.8. As automakers continue to implement lightweighting strategies, these material trends will persist and may even accelerate.

[25] CBO. (2014). "The Renewable Fuel Standard: Issues for 2014 and Beyond" Congressional Budget Office. June 2014. <http://www.cbo.gov/sites/default/files/45477-Biofuels2.pdf>.

[26] NHTSA. (2012). "Corporate Average Fuel Economy for MY 2017-MY 2025 Passenger Cars and Light Trucks." National Highway Transportation Safety Administration, U.S. Department of Transportation. Pages 435-436. August 2012. <http://www.nhtsa.gov/staticfiles/rulemaking/pdf/cafe/FRIA_2017-2025.pdf>.

[27] This expectation is based on conversations between CAR and representatives from the automotive industry.

Figure 1.8: Vehicle Material Composition in U.S. Market, 1978 – 2012



Sources: Ward's Auto and American Chemistry Council, 2014

In addition to the materials themselves, much of the advancement in the automotive materials relates to manufacturing and design methods. Some of the biggest developments in materials technology involves application technologies such as joining (e.g., resistance spot welding, fasteners, adhesives, weld bond adhesive, laser welding) and fabrication (hot forming, thin-wall die casting, composite molds, and aluminum forming) techniques. Material assessment is also important, and computer-aided engineering (CAE) is used to model new materials (e.g., mold flow analysis, formability, and crash simulations).

Connected and Automated Vehicles

Road transportation continues to undergo significant technological transformations as wireless technology increasingly enables vehicles to communicate with each other and with surrounding infrastructure while advanced driver assistance systems enable warnings and limited amounts of automation. This transformation is driven by the proliferation of sensors, actuators, wireless connectivity, and artificial intelligence systems that are enabling vehicles to perceive and react to their environment in ways that human drivers cannot. Connected vehicle technology will enable vehicles to instantaneously communicate with each other and the roadway—providing information to make transportation safer and more efficient. Automated vehicle technology can sense dangerous situations and issue driver warnings or even actively control vehicle systems in response.[28]

[28] Wallace, Richard and Gary Silberg. (2012). "Self-driving Cars: The Next Revolution." Center for Automotive Research and KPMG. August 2012. <http://www.cargroup.org/?module=Publications&event=View&pubID=87>.

Connected vehicle technology will enable vehicles to communicate with each other (vehicle-to-vehicle - V2V) and with the roadway, traffic signals, bridges, and other pieces of infrastructure (vehicle-to-infrastructure - V2I) using technologies such as dedicated short-range communications (DSRC) and cellular networks (i.e., 4G LTE connectivity). DSRC is a wireless channel using the 5.9 GHz spectrum that was specifically designed for use in vehicular communications. Connected vehicle systems can be embedded, as with factory installed units, or may be brought into the vehicle in the form of a mobile device that can be plugged into or wirelessly connected to the vehicle. Many vehicles in operation have some form of connectivity (such as Chrysler Uconnect, Ford Sync/MyFord Touch, GM OnStar, Hyundai BlueLink, or Toyota Entune), and vehicles equipped with DSRC will become commercially available in the next two years. Vehicles equipped with V2V and V2I communication capabilities broadcast information (brake status, location, direction, speed, and other vehicle data) as they are driven, and the systems use cues such as sounds, lights, displays, and seat vibrations to alert drivers of various threats.

Automated vehicle technologies use sensor inputs such as video cameras, radar, and LiDAR (a laser-based ranging system) along with computing power and detailed digital maps to issue warnings or actively react to hazards. Several automated features already exist in many vehicles sold today, such as automated emergency braking, lane-keeping assist systems, adaptive cruise control, and active parking assistance. Automakers may soon offer vehicles that combine some of these existing systems, allowing a vehicle's speed, steering, and brakes to be automatically controlled. In the near future, several automakers, including General Motors, Ford, Mercedes, and Volvo, are set to release systems capable of semi-automated driving in certain situations, such as expressway or low-speed stop-and-go (traffic jam) conditions.

The final frontier of automated vehicle technology is the self-driving, fully-automated vehicle capable of operating on the road in mixed-traffic. Despite the complexity involved, multiple stakeholders are working to develop such vehicles. Google is testing fully-automated vehicles on public roads in Nevada and California, and has logged hundreds of thousands of miles in its test vehicles. Traditional automakers, such as General Motors, Toyota, and Volkswagen, are developing advanced automated functionality as well. Additionally, high-tech automotive supplier firms such as Bosch, TRW, Delphi, and others are developing advanced technologies both in cooperation with, and independent from, the automakers.

Currently four states (Nevada, Florida, California, and Michigan) and the District of Columbia have passed laws addressing fully automated vehicles on public roads, and several other states throughout the country have considered similar legislation. In May 2013, the National Highway Traffic Safety Administration released guidelines for states issuing licenses for testing fully automated vehicles on public roads.

Sectors of the Automotive Industry

The automotive industry consists of several different sectors upstream and downstream of the automakers. These other sectors include automotive suppliers, auto dealers, medium- and heavy-duty vehicle manufacturers, and automotive aftermarket suppliers.

Suppliers

In this report, the automotive supplier sector is defined as a large group of independent, non-automaker, parts producers that sell finished goods to both domestic and international automakers, as well as aftermarket parts replacement retailers. For the purpose of this study, the automotive supplier group includes employees beyond NAICS 3363 (the industry classification code for motor vehicle parts) to account for products developed by other manufacturing industries that are used in the production of vehicles.

The total direct employment count at supplier companies is 521,000 workers;[29] this figure includes employees associated with manufacturing tires, hoses, hardware, lighting, batteries, and plastics for motor vehicles as well as firms producing aftermarket parts and parts for export. Without the inclusion of products such as rubber hoses and tires, NAICS 3363 would not be sufficient to fully describe all products used to manufacture a finished vehicle.[30]

In recent years, the suppliers' responsibility to add technology and value to the automobile has grown. Parts R&D, production, and sub-assembly have been shifted onto suppliers, as automakers –facing declining profits and other business operation issues—have spun off many of their in-house parts operations. This transition is significant for two reasons: 1) 28-40 percent of R&D spending undertaken by the suppliers and approximately 40 percent of all R&D scientists and engineers in the automotive industry are employed by suppliers,[31] and 2) the cost of R&D was transferred into an industry sector with a large proportion of small- to medium-sized businesses.

Even though the majority of automotive suppliers are small businesses, many parts manufacturers have considerable engineering capability to continue refining their products, develop new products, and integrate those products into automakers' vehicles.[32] The combination of the added pressure to invest in research without an immediately recognizable revenue stream and the size make-up of suppliers has had substantial effect on the viability of the supplier sector. Not all automotive R&D has been transferred to the supplier sector; however, automakers still largely fund vehicle engine, body, and transmission design, as well as parts integration R&D for the development of future model lines.

[29] This number represents all automotive manufacturing employees less those employed by the automakers. See Table 2.1.
[30] Data from organizations such as Battery Council International and the Rubber Manufacturers Association were used by CAR researchers to determine what percentage of employees in those industries serve the automotive industry.
[31] Ibid. NSF. (2014).
[32] This assessment is based on conversations between CAR and representatives from the automotive industry.

Innovation is key to productivity, yet breakthroughs do not always occur in a timely manner. The responsibility to design new products has put great financial strain on suppliers. In addition, the return of vehicle production volumes to their pre-recession levels has put a tremendous strain on suppliers as they struggle to meet demand after having reduced their production capacity just a few short years ago.

Dealers

To the lay person, the automobile dealership is the most visible and tangible component of the sophisticated automotive manufacturing and distribution system. Dealerships are a perfect reflection of the fabric of the U.S.—family-owned businesses operating in communities across the nation, for generation after generation. Beyond their heartfelt "American Story" aspect, it is important to understand the contribution of dealerships to the regional economies and government revenues, especially given the decline and recovery in automobile sales in recent years and dealership closures during the recession.

Even though the bankruptcies of General Motors and Chrysler were structured, their occurrence shook the foundation of the automotive industry to its core. As assembly facility operations slowed and ultimately stopped, the fate of franchise dealerships was closely followed in communities across the nation. According to company restructuring plans, during 2009-2010, approximately 2,000-plus GM and Chrysler dealerships closed.[33] Even before the financial crisis and subsequent bankruptcies, the number of dealerships in the United States had been declining for decades (from 1988 to 2007, on average, the number of operating dealerships declined by nearly 200 per year).[34] By January 2008, there were 20,770 new-vehicle dealerships operating in the United States, but by January 2012, the number had declined by 3,230 and only 17,540 dealerships were operating. Since January 2012, the number of dealerships has been expanding, albeit slowly. As of January 2014, there were 17,665 new-vehicle dealerships in operation.

Even after the closing of thousands of dealerships in recent years, new and used vehicle dealerships still employ more than 1,000,000 workers (an average of nearly 60 workers per dealership).[35] In 2013, total dealership revenues in the United States were $730 billion, with 57.1 percent of those revenues associated with new vehicles, 31.3 percent with used vehicles, and 11.6 percent with service and parts. The average pretax profit of a dealership was more

[33] Hill, Kim, Debbie Maranger Menk, and Adam Cooper. (2010) "Contribution of the Automotive Industry to the Economies of all Fifty State and the United States." Center for Automotive Research. April 2010. <http://www.cargroup.org/?module=Publications&event=View&pubID=16>.
[34] NADA. (2006). "NADA Data 2006: Economic Impact of America's New-Car and New-Truck Dealers." NADA Data. National Automobile Dealers Association. May 17, 2006. <https://www.nada.org/NR/rdonlyres/538D2699-BF00-4C73-A162-7A4FBBAC62E0/0/NADA_Data_2006pdf.pdf>. and NADA. (2013). NADA Data 2013: State-of-the-Industry Report." NADA Data. National Automobile Dealers Association. July 1, 2013. <http://www.nada.org/NR/rdonlyres/1B512AC7-DCFC-472C-A854-6F5527931A2F/0/2013_NADA_Data_102113.pdf>.
[35] NADA. (2014). "NADA Data 2014: Annual Financial Profile of America's Franchised New-Car Dealerships." NADA Data. National Automobile Dealers Association. May 28, 2014. <http://www.nada.org/NR/rdonlyres/DF6547D8-C037-4D2E-BD77-A730EBC830EB/0/NADA_Data_2014_05282014.pdf>.

than $900,000 (2.2 percent of sales) and all three areas (new vehicles, used vehicles, and service and parts) were profitable. Profitability for service and parts peaked in 2008 (car owners were maintaining their vehicles rather than replacing them in the midst of the recession), and have declined in subsequent years, but parts and service still represents the majority of dealership profits.

Every state in the nation has new car and used car dealerships operating in its communities. The dealerships' support local communities through contributions to charities, paying property taxes, and sponsoring local youth sports teams. These activities are critical to maintaining a high quality of life in towns and cities across the nation. These contributions should be considered when assessing the value of dealerships to regional economies and communities.

Medium and Heavy Duty

While not included in the economic modeling of the contribution analysis, the manufacture of medium and heavy-duty trucks and parts is a key component of the motor vehicle industry. An overview of the activity of this sector of the industry is included in this section. Medium duty trucks include Classes 3 to 6 (10,000 to 26,000 lbs.) and heavy duty trucks include Classes 7 and 8 (26,001 to over 33,000 lbs). A breakout of truck weight classes follows:

Table 1.2: Truck Weight Categories

Type	Category	Gross Vehicle Weight
Class 1	Light-Duty	0-6,000 lb.
Class 2		6,001-10,000 lb.
Class 3	Medium-Duty	10,001-14,000 lb.
Class 4		14,001-16,000 lb.
Class 5		16,001-19,500 lb.
Class 6		19,501-26,000 lb.
Class 7	Heavy-Duty	26,001-33,000 lb.
Class 8		33,001 lb. and over

Note: This table is based on Federal Highway Administration (FHWA) weight classifications. The U.S. Census Bureau, U.S. Environmental Protection Agency, and Ward's Automotive Group each use slightly different metrics for delineating light-, medium-, and heavy-duty truck categories, but the FHWA classifications are used the most consistently throughout the industry.
Source: U.S. Department of Energy 2014

Currently there are nearly 12.3 million medium- and heavy-duty trucks registered in the United States.[36] Together, the medium- and heavy-duty truck markets in the United States sold more than 605,000 units in 2013 with revenues of $33.1 billion in 2013, putting the average revenue

[36] Ward's. (2014). "Truck Registrations by State and Type." *Ward's Motor Vehicle Facts & Figures 2014*. Page 34. Ward's Automotive Group, Southfield, Michigan.

at approximately $54,700 per vehicle sold.[37] Of all Class 4 and above vehicles sold in 2013, over 340,000 were domestically produced and nearly 11,000 were imported.[38]

Medium- and heavy-duty vehicles comprised nearly 3.8 percent of all U.S. motor vehicle sales in 2013, with medium-duty trucks accounting for more than 373,000 units sold and heavy-duty trucks accounting for more than 232,000 units sold.[39] In 2013, the U.S. medium-duty vehicle market consisted primarily of Class 3 vehicles (approximately 68 percent of medium-duty units sold). Class 5 vehicles represented over 16 percent of medium-duty units sold and Class 6 vehicles represented nearly 13 percent of medium-duty units sold. The heavy duty vehicle market consisted primarily of on-road interstate trucks in the Class 8 category (nearly 80 percent of units sold).[40] Table 1.3 contains sales data pertaining to the U.S. truck sales in 2013.

Table 1.3: U.S. Retail Sales of Trucks, 2013

Type	Category	Sales	Percent of Total	Category Total	Percent in Category
Class 1	Light-Duty	5,615,227	67.7%	7,946,365	70.7%
Class 2	Light-Duty	2,077,367	25.0%		26.1%
Class 3	Medium-Duty	253,771	3.1%	373,200	3.2%
Class 4	Medium-Duty	11,909	0.1%		10.0%
Class 5	Medium-Duty	60,045	0.7%		50.3%
Class 6	Medium-Duty	47,475	0.6%		39.8%
Class 7	Heavy-Duty	47,524	0.6%	232,308	20.5%
Class 8	Heavy-Duty	184,784	2.2%		79.5%
Total	-	8,298,102	100.00%	-	-

Source: Ward's 2014

The annual production and sales of heavy-duty vehicles are highly cyclical. The heavy-duty vehicle sector, similar to that of light duty vehicles, is affected by the economic forces of the general economy, but its cycles are also affected by governmental regulation. For instance, Class 8 truck sales peaked in 2006 at 280,000 units as operators wanted to purchase vehicles before new pollution regulations on diesel engines took effect. Since 2006, annual sales fell to just over 150,000 in 2007 and continued to decrease to around 133,000 units in 2008, similar to the sales numbers from 2001 to 2003.[41] From 2008 to 2010, Class 8 truck sales were also down due to the recession, but since 2011, Class 8 truck sales have ranged between 170,000 and 200,000 units per year.

[37] Ward's (2014). "U.S. Sales of Trucks by Manufacturer, Gross Vehicle Weight Rating, and Source." *Ward's Motor Vehicle Facts & Figures 2014*. Page 22. Ward's Automotive Group, Southfield, Michigan.
Datamonitor. (2014). "Medium & Heavy Trucks: North America (NAFTA) Industry Guide." Industry Profile. May 16, 2014. <http://www.datamonitor.com/store/Product/medium_heavy_trucks_north_america_nafta_industry_guide?productid=ML00016-112>.
[38] Ward's (2014). "U.S. Truck Sales by Country of Origin." Ward's Motor Vehicle Facts & Figures 2014. Page 23. Ward's Automotive Group, Southfield, Michigan.
[39] Ibid. Ward's (2014). "U.S. Sales of Trucks by Manufacturer, Gross Vehicle Weight Rating, and Source."
[40] Ibid. Ward's (2014). "U.S. Sales of Trucks by Manufacturer, Gross Vehicle Weight Rating, and Source."
[41] Ward's (2003-2014). "U.S. Sales of Trucks by Manufacturer, Gross Vehicle Weight Rating, and Source." Ward's Motor Vehicle Facts & Figures. Multiple Years 2003-2014. Ward's Automotive Group, Southfield, Michigan.

U.S. production of heavy-duty trucks was over 230,000 units in 2013 with assembly facilities employing 25,900 workers.[42] In 2014, employment in the production of heavy-duty vehicles has increased to more than 27,000 workers. In addition to manufacturing heavy-duty trucks, more than 80,000 individuals were employed manufacturing truck trailers, motor homes, travel trailers, and campers in 2013.[43] This estimate does not include the considerable number of individuals who work at suppliers to the heavy-duty truck manufacturers. These suppliers, in many cases, supply both heavy duty and light duty motor vehicle manufacturers.

Medium- and heavy-duty vehicles are instrumental in keeping America's economy going by transporting goods and products in a timely and cost-effective manner. As of 2012, 70 percent of America's freight tonnage is hauled by truck. When considering the value of shipments, this figure increases to around 74 percent.[44] Between 1980 and the present, use of medium- and heavy-duty trucks on U.S. highways has increased by a factor of two – from nearly 1.3 trillion ton-miles of freight in 1980 to more than 2.6 trillion ton-miles of freight in 2011.[45]

Aftermarket Suppliers

While not explicitly detailed in the economic contribution analysis of this report (Sections II and III), the aftermarket sector is partially included in the supplier and dealership totals.[46] The aftermarket segment consists of suppliers who provide products for the repair and maintenance of light and heavy vehicles. For some automotive products, aftermarket sales are far greater than sales in the new vehicle market. For example, a new car gets only one battery installed by the vehicle assembler, but during the life of that car, five or six replacement batteries may be purchased. For frequently replaced service products like oil filters, as many as 35 replacement parts may be used. These aftermarket products are sold through auto parts stores and used by service technicians in dealerships, garages, and specialty service providers to maintain the vehicles in use on America's roadways. As a result, the automotive aftermarket manufacturers support service and distribution jobs that are not included in this study.

The aftermarket manufacturing supply sector provides parts and equipment for the maintenance, repair, and enhancement of the more than 250 million light duty vehicles currently on the road in the United States. In 2011, aftermarket service and retail outlets

[42] BLS. (2014). "Employment, Hours, and Earnings from the Current Employment Statistics survey (National)." Bureau of Labor Statistics. Accessed November 3, 2014. <http://www.bls.gov/ces/data.htm>.
[43] Ibid. BLS. (2014).
[44] BTS. (2013). "Table 1 - Shipment Characteristics by Mode of Transportation for the United States: 2012." Commodity Flow Survey. Bureau of Transportation Statistics, Research and Innovative Technology Administration. December 2013. <http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/commodity_flow_survey/2012/united_states/table1.html>.
[45] BTS. (2014). "Table 1-50 - U.S. Ton-Miles of Freight (BTS Special Tabulation)." National Transportation Statistics. Bureau of Transportation Statistics, Research and Innovative Technology Administration. July 2014. <http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/index.html>.
[46] For example, parts and service operations at a dealership are considered aftermarket activities. The category of parts and service is the largest portion of dealership profits—contributing more than $290,000 in net profit for the average dealership in 2014 (NADA 2014).

employed nearly 4 million workers and had revenues of nearly $223 billion.[47] Revenues are forecast to increase to $256 billion for 2015. In addition to the light-duty vehicle aftermarket, revenue for the medium- and heavy-duty aftermarket was nearly $74 billion in 2011 and the 2015 forecast suggests it will increase to nearly $85 billion in 2015. In total, the U.S. light-, medium-, and heavy-duty aftermarket value was $296 billion in 2011, and it is forecast to increase to $341 billion in 2015.[48]

Role of Small- and Medium-sized Businesses in the Automotive Industry

The automakers are among the largest and most companies in the nation, which can mask the extent to which the auto industry itself both is comprised of small businesses and supports small and local businesses. Automakers and large Tier 1 suppliers require services, materials and products from a large and diverse supply chain. Industries as diverse as printing services, fabric makers, carpet wholesalers, railroads, employment agencies, design services and software coding companies all supply the auto industry. Many of these companies are very small firms, sometimes with the owner as the sole employee. Commonly, in the automotive corridor (see the map in Figure 1.1), new companies are started as employees of the automakers or large suppliers see opportunities in niche areas and leave their jobs to start their own companies. This study includes an anecdotal examination of the influence of the automotive industry on small businesses within the state of Kentucky as well as the industry's general contribution to the state's economy.

There is no one single definition of small business, but rather a plethora of standards. The National Small Business Association considers any business with fewer than 500 employees to be small.[49] The federal government, via the Small Business Administration, simultaneously holds several definitions, contingent upon either number of employees or annual receipts, with thresholds varying across industries.[50] For example, certain manufacturers may still qualify as small businesses with as many as 1,500 employees, while no form of agricultural business would be considered small with annual receipts in excess of $9 million.

The 500 employee threshold is the most commonly applied standard.[51] Using this standard, 96 percent of automotive establishments are small businesses. In looking at the various sectors of the industry, 81 percent of motor vehicle manufacturing operations are small businesses, as are 96 percent of vehicle parts manufacturing companies. In terms of the broader economy, businesses within the automotive industry are, overwhelmingly, small.

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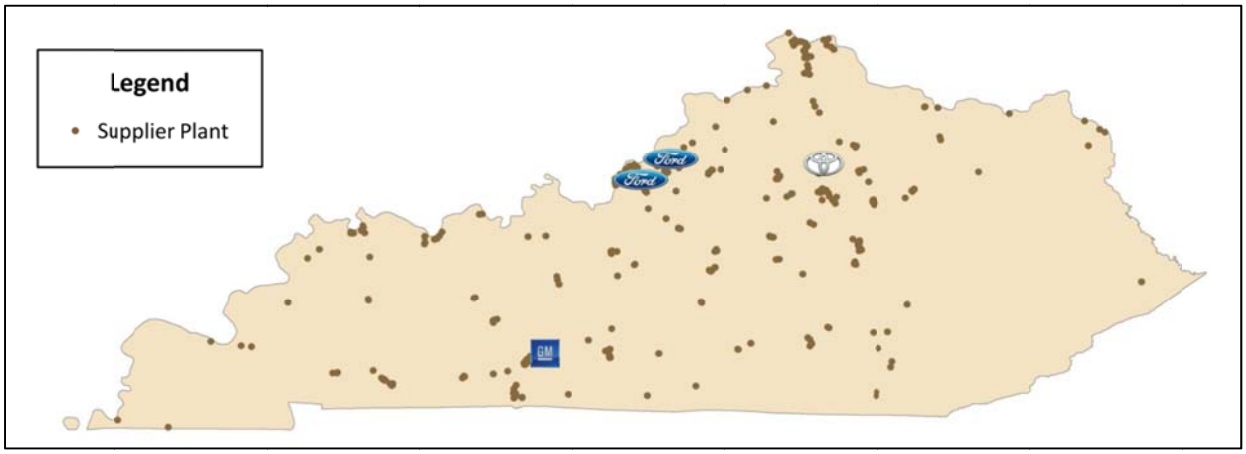
[47] AAIA. (2013). "Digital Automotive Aftermarket Factbook: 22nd Edition, 2013." Automotive Aftermarket Industry Association. 2013.
[48] Ibid. AAIA. (2013).
[49] NBSA. (2014). National Small Business Association. Website. Accessed December 29, 2014. <http://www.nsba.net/>.
[50] SBA. (2014). "What is SBA's Definition of a Small Business Concern?" U.S. Small Business Administration. Accessed December 29, 2014. <https://www.sba.gov/content/what-sbas-definition-small-business-concern>.
[51] FactCheck.org. (2010). "What's a 'Small Business'?" FactCheck.org, Annenberg Public Policy Center. <http://www.factcheck.org/2010/08/whats-a-small-business/>.

Kentucky Case Study

To highlight the contribution of the industry both in supporting small businesses and as a measure of the industry's importance to state economies, CAR researchers interviewed several auto suppliers in Kentucky.[52] Kentucky was chosen because it is centrally located within the automotive corridor and because it has a longstanding and well-established automotive base. The interviews with Tier 1 and Tier 2 suppliers illustrate the extent of their supply chains and the integration of the industry within the state of Kentucky. For a list of discussion questions, please see Appendix A.

Kentucky is home to four vehicle assembly plants: the Ford Motor Kentucky Truck Plant, Ford Motor Louisville Assembly Plant, Toyota Motor Manufacturing Kentucky Georgetown 1&2 Assembly plants, and General Motors Bowling Green Assembly plant. The locations of these plants are displayed in Figure 1.9.

Figure 1.9: Assembly Plants and Suppliers in Kentucky, 2014



Sources: Center for Automotive Research, 2014 (supplier locations from ELM Analytics)

Because of the large automaker assembly plants, only 44 percent of Kentucky's motor vehicle manufacturing establishments are small businesses.[53] The large operations in Kentucky support a large and varied supply chain throughout the state. Nearly 90 percent of the establishments in Kentucky's automotive supply chain (body and parts manufacturing) are considered to be small businesses.

[52] Please see the Acknowledgements section for a list of companies.
[53] Establishments refer to individual production facilities while companies refer to firms that may consist of a single establishment or many establishments (e.g., an automaker or a large Tier 1 supplier is a single company, but may consist of many establishments).

Table 1.4: Kentucky Business Establishments by Size

	All Industries	Manufacturing	Automotive	Vehicle Manufacturing	Body or Parts Manufacturing
All Establishments	89,795	3,776	202	9	193
Less than 50 employees	84,715	2,933	55	4	51
Less than 500 employees	4,840	773	120	0	120
500 or more	240	70	27	5	22
% Below 100	97.40%	86.70%	55.40%	44.40%	51.70%
% Below 250	99.20%	95.00%	77.40%	44.40%	77.60%
% Below 500	99.70%	98.10%	86.40%	44.40%	87.10%

Source: Census, 2012 County Business Patterns, Kentucky Cabinet for Economic Development

Kentucky's top 10 automotive employers provide approximately 34,200 jobs in Kentucky, representing nearly 42 percent of the state's automotive workforce.[54] Toyota and Ford are the top two automotive employers, providing more than 20,000 jobs in the state. Other top automotive employers in Kentucky include Akebono Brake Industry Co., Hitachi, Martinrea International, Johnson Controls, Dana Holding Corporation, Grupo Proeza SA de CV, Toyota Tsusho Corporation, and ZF Friedrichshafen AG.

Most of the companies interviewed by CAR researchers have had a long presence in Kentucky, with some having been established in the state more than thirty years ago. While anywhere from 30 to 90 percent of products made by these Kentucky companies are shipped to other manufacturing plants in Kentucky, almost all export their products worldwide and throughout the United States. Not all of the suppliers are entirely dedicated to the automotive industry; some of the companies derive as much as half of their revenues from industries other than auto manufacturing.

The interviewees expressed an interest in being able to source more materials and purchased parts locally. These manufacturers, on average, purchase about five to ten percent of their raw materials and intermediate components from other Kentucky businesses. Most have active programs to increase their purchases from local businesses and minority-owned companies. For the most part, however, the capacity to do so on a large scale has not yet been developed. Most companies did indicate that small, nearby businesses were critical to operations, particularly because these smaller local companies have the ability to provide special orders or emergency services and componentry rapidly and with high quality. These companies often do not have the capacity to be large-scale suppliers. One company noted that it has a growing program to support small and local suppliers, "We want the local business. The closer we can find them (suppliers) there's benefit, but they have to have the capability for it and the

[54] KYEDC. (2014). Kentucky Cabinet for Economic Development. Website. Accessed January 8, 2015. <http://www.thinkkentucky.com/>.

experience. I think this can be improved for our area." Another company mentioned a goal to increase domestic sourcing, "We want to have 90 percent domestic sourcing and as close as we can get inside 200 miles."

The state of Kentucky's support of its businesses ranked highly among all of the executives interviewed. Kentucky has numerous programs to stay engaged with and support its resident companies. Interviewees all commented that they have a great relationship with the Economic Development Cabinet and a strong relationship with the governor, "Whether it's training support or other grants the state offers to any industry, they are always willing and able to provide us support." A few of the companies are subsidiaries of foreign-based corporations, and representatives from those companies noted that the state and the governor maintain good relationships with their corporate headquarters and executives, "They do everything possible within their power to support us."

From the tour of Kentucky and visits throughout the state, the contributions of the industry to local economies are evident and valued. The challenge for the industry within the state mirrors an overall industry concern – namely, the capacity and availability of small suppliers deep into the supply chain. The state and local economic developers of Kentucky received universally high marks for their commitment, support, and responsiveness to the concerns of each of the companies interviewed.

SECTION II - ESTIMATES OF THE ECONOMIC CONTRIBUTION OF THE MOTOR VEHICLE INDUSTRY TO THE UNITED STATES ECONOMY

The tables in this section detail the estimated employment contributions to the economies of each of the 50 states, and the country as a whole, by the U.S. motor vehicle industry. Employment estimates are broken out by direct employment (people employed directly by automotive companies), intermediate employment (people employed by suppliers to the motor vehicle industry), and spin-off employment (expenditure-induced employment resulting from spending by direct and intermediate employees).

Employment and income estimates are derived from analyses using a regional economic model, supplied by Regional Economic Models, Inc. (REMI), of Amherst, Massachusetts. The model and methodology used will be discussed further later in this study (Section IV). The employment and compensation data used to perform the research were provided by motor vehicle companies or gathered through publicly available data; the intermediate and spin-off effects were generated by the model. The remaining data on the U.S. economy and the automotive industry were collected by CAR from a wide variety of publicly available sources and are listed in the references. Direct employment data include headquarters, office, research, design and development, manufacturing, assembly and logistics job classifications. All employment numbers cited below are rounded; income and tax receipt numbers are also rounded.

Table 2.1 sums the combined effects from all motor vehicle manufacturing and retail operations. Summing the direct employment from all operations (1,553,000), intermediate employment (2,316,000) and spin-off employment (3,381,000), more than 7 million jobs are supported or directly provided by the industry to the U.S. economy. Comparing total employment to direct employment produces an overall employment multiplier of 4.7[55]. This means that there are 3.7 additional jobs in the U.S. economy for every job in the industry. The industry comprises 3.8 percent of all private sector employment in the United States.

[55] The multiplier is determined by dividing the total employment contribution by the number of direct employees: (7,250,000 / 1,553,000) = 4.7.

Table 2.1: Total Contribution of all Motor Vehicle Manufacturing and Dealership Operations to the Economy of the United States

Economic Impact	Automakers	All Motor Vehicle-related Manufacturing (incl Automakers)	Auto Dealerships	TOTAL
Employment				
Direct employment	322,000	843,000	710,000	1,553,000
Intermediate	805,000	2,069,300	246,700	2,316,000
Total (Direct + Intermediate)	1,127,000	2,912,300	956,700	3,869,000
Spin-off	1,316,000	2,687,700	693,300	3,381,000
Total (Direct + Intermediate + Spin-off)	**2,443,000**	**5,600,000**	**1,650,000**	**7,250,000**
Multiplier	7.6	6.6	2.3	4.7
Compensation ($billions nominal)	167.7	375.3	116	491.3
Less: transfer payments & social insurance contributions	-21.6	-41.5	-15.9	-57.4
Less: personal income taxes	-23	-44.7	-19.4	-64.1
Equals private disposable personal income ($billions nominal)	123.2	289.1	80.7	369.8
Contribution as % of total private economy				
Employment	1.6	2.9	0.9	3.8
Compensation	1.7	2.7	0.6	3.3

Source: Center for Automotive Research, 2014

Total compensation for all 7.25 million private sector jobs is nearly $500 billion, which represents 3.3 percent of the private sector compensation in the U.S. economy. From this amount, more than $64 billion is paid for personal income taxes and $57 billion in other public contributions, such as FICA. Net disposable income for these workers totals $370 billion.

Vehicle Manufacturer Activities

Information on U.S. automotive manufacturing and related operations employment was supplied by each of the major the automakers operating in the United States.[56] Together these automakers employed a total of 322,000 employees in the United States. Automaker employment was classified according to the North American Industry Classification System (NAICS) into multiple job-type categories for input into the model — motor vehicle and motor vehicle parts manufacturing (category numbers: NAICS 3361-3363); management of companies (NAICS 551); professional, scientific and technical services (NAICS 541); securities, commodity

[56] Automakers contribution employment data to this study included BMW, Chrysler, Ford, General Motors, Honda, Hyundai, Kia, Mazda, Mercedes, Mitsubishi, Nissan, Subaru, Toyota, and Volkswagen.

contracts and investments (NAICS 523); warehousing and storage (NAICS 493); administrative services, facilities and support services (NAICS 521) and wholesale trade (NAICS 42).

As can be seen in Table 2.1, there are 2,069,300 intermediate jobs that support the direct employment at auto manufacturers and parts makers. The spin-off jobs supported by the incomes and spending of the people who work in the direct and intermediate jobs add another 2,687,700 jobs, bringing the total jobs associated with motor vehicle manufacturing activities in the United States to 5,600,000 jobs. The ratio of total jobs created to direct employment produces an employment multiplier of 6.6 (5,600,000 ÷ 843,000). The multiplier for motor vehicle manufacturing and assembly (automaker) alone is 7.6 (2,443,000 ÷ 322,000). There are more than six additional jobs in the U.S. economy for every job in automobile manufacturing operations.

The direct employees of automakers include researchers, engineers, managers and administrative support, as well as workers on the assembly lines. Because the actual manufacturing of parts and assembly of vehicles draws on a deep supply chain for components and materials, manufacturing jobs have a high downstream (intermediate and spin-off) employment multiplier. When considering only assembly line employment, the jobs multiplier for automaker vehicle manufacturing activities is approximately 11.[57] That is, for every job on an assembly line, 10 additional jobs are created or supported in the economy.

Compensation in the private sector associated with the total jobs (direct plus intermediate plus spin-off) amounts to $375.3 billion. Estimated personal taxes to be paid, resulting from employment in automotive manufacturing operations, are nearly $45 billion.

To put the compensation and employment numbers in context, the direct, intermediate, and spin-off jobs associated with vehicle and parts manufacturing account for nearly three percent of employment in the entire U.S. economy and two percent of total U.S. compensation.

Table 2.2 offers a more detailed look at the intermediate and spin-off employment associated with vehicle and parts manufacturing. In the intermediate employment category, there are 2,069,300 jobs spread across numerous manufacturing and non-manufacturing industries. As mentioned earlier, the intermediate category captures the employment necessary to satisfy manufacturers' demands for the materials and services needed to design, produce and sell motor vehicles. This can be broadly considered the automotive supplier network. This supply network consists of the Tier 1 suppliers who supply parts and services directly to vehicle assemblers along with the lower-tier suppliers who supply the basic materials and services to

[57] Not shown in Table 2.1. Vehicle assembly operations and employment are a subset (and comprise approximately 70 percent) of the 322,000 total jobs at automakers.

the Tier 1 group. Some of these companies supply basic commodities and can be several steps removed from the vehicle design and manufacturing process and serve multiple industries.

Table 2.2: Intermediate and Spin-off Employment Contribution of Motor Vehicle and Parts Manufacturer-related Operations in the U.S.

Economic Impact	Intermediate	Spin-off
Manufacturing	597,000	150,600
Durable Goods Manufacturing	492,000	83,200
Non-durable Goods Manufacturing	105,000	67,400
Non-Manufacturing	1,472,300	2,537,100
Administration and Services	345,000	97,000
Finance and Insurance	118,300	254,300
Management of Companies	45,000	93,000
Professional and Technical Services	237,300	160,400
Retail Trade	77,000	369,000
Transportation and Warehousing	51,700	162,200
Wholesale Trade	238,000	106,500
Other Services	286,000	919,700
Other Non-Manufacturing	74,000	375,000
Total	**2,069,300**	**2,687,700**

Source: Center for Automotive Research, 2014

At an automotive manufacturing facility, primary assemblers require plastic and metal parts, electronic components, and other materials to produce vehicles; it is these intermediate demands, satisfied by a vast group of specialized manufacturers, that form the basis of U.S. intermediate employment contributions. As shown in Table 2.2, CAR finds nearly 600,000 intermediate jobs in the manufacturing sector, primarily in the industries necessary to produce automobiles—parts manufacturing, primary metal manufacturing, fabricated metal products manufacturing, and plastics and rubber products manufacturing. Employees of these suppliers are manufacturing the parts and components necessary to produce the services and material inputs at assembly operations and are in addition to the 322,000 people directly employed by the automakers and the 521,000 people employed in Tier 1 parts manufacturers, aftermarket firms, and export parts suppliers.

The bulk of employment in the intermediate category is in the non-manufacturing sector, totaling nearly 1,500,000 jobs. Industries within this category are not normally thought to be associated with automobile manufacturing in such high numbers. However, as a result of the separation of the complete vehicle design and parts manufacturing processes (from the

automobile manufacturing company to the supplier sector), many more distinct industries have become major suppliers to the automobile industry. Industries of note in the non-manufacturing category are professional and technical services employing 237,300, administration and services, 345,000 jobs, wholesale trade, 238,000 jobs, and finance and insurance, 118,300 jobs.

Table 2.2 also shows there are 2,687,700 total spin-off jobs associated with motor vehicle and parts manufacturing operations. These are expenditure-induced jobs, created as a result of spending by the people employed in the direct and intermediate categories. As could be expected, a large portion of the spin-off jobs are in the non-manufacturing sector of retail trade, which employs 369,000 people. When employees use their paychecks to purchase goods (for example: electronics equipment, clothing, food, and even new automobiles), employment is created to supply their demands.

Automobile Dealerships

Auto assembly operations and motor vehicle parts manufacturing operations are business operations often clustered together within certain areas in manufacturing-oriented regions of the country. Auto dealerships, on the other hand, are found in nearly every community across the country–in rural and urban areas alike. Just as the manufacturing segment of the motor vehicle industry has suffered in the recent economic downturn, the retail and service segment of the industry has also incurred heavy losses. If the amount of column space in news media is considered a measure of issues of importance, the economic and cultural effect of the downturn on auto dealerships did not go unnoticed anywhere. The omnipresence of auto dealerships in communities across the U.S. allow for a deep connection between their business operations and civic events. "If there were a competitive event to measure the philanthropy of businesses in America, the local car dealer would always take the top prize. If you go to a Little League or youth hockey game or any other locally organized sporting event, the sponsors always seem to be local auto dealers."[58]

Employment and income estimates are derived from analyses using the REMI model mentioned earlier. The employment and compensation data used to perform the research was provided by the National Automobile Dealers Association (NADA); the intermediate and spin-off effects were generated by the model. The remaining data on the U.S. economy and the automotive industry was collected by CAR from a wide variety of publicly available sources, which are listed in the references.

While total employment at U.S. auto dealerships is slightly over one million people, the direct employment and resulting downstream jobs estimates are for new vehicle sales and service

[58] Crain, Keith. (2009). "Closing Dealerships? Be Careful". Automotive News. September 7, 2009. <http://www.autonews.com/article/20090907/RETAIL/309079865/closing-dealerships?-be-careful>.

only. Focusing on the sales and service of new vehicles only (and not used) more accurately reflects the footprint of new motor vehicle sales. Complete U.S. automotive dealership employment for new vehicle sales and service totaled 710,000 employees. As can be seen in Table 2.3, there are 246,700 intermediate jobs that support direct employment in the industry. The spin-off jobs associated with spending from the people who work in the direct and intermediate jobs add another 693,300 jobs, bringing the total jobs associated with new motor vehicle retail operations in the United States to 1,650,000 jobs. The ratio of total jobs created to direct employment produces an employment multiplier for motor vehicle retail operations; this number is 2.3. This multiplier of 2.3 means there is slightly more than one additional job in the U.S. economy for every job in automobile dealership operations.

Compensation in the private sector associated with total jobs (direct plus intermediate plus spin-off) amounts to $116 billion. Estimated personal taxes to be paid resulting from employment in automotive manufacturing operations are nearly $20 billion.

Table 2.3: Total Contribution of New Motor Vehicle Dealership Operations to the Economy in the United States

Economic Contribution	
Employment	
Direct	710,000
Intermediate	246,700
Total (Direct + Intermediate)	956,700
Spin-off	693,300
Total (Direct + Intermediate + Spin-off)	1,650,000
Multiplier: (Direct + Intermediate + Spin-off)/Direct	2.3
Compensation ($billions nominal)	116.000
Less: transfer payments & social insurance contributions	-15.890
Less: personal income taxes	-19.440
Equals private disposable personal income ($billions nominal)	80.670
Contribution as % of total private economy	
Employment	0.9
Compensation	0.6

Source: Center for Automotive Research, 2014

The direct, intermediate, and spin-off jobs associated with U.S. auto dealerships account for nearly one percent of employment in the entire U.S. economy and nearly one percent of total U.S. compensation. Table 2.4 provides a more detailed look at the intermediate and spin-off employment associated with dealership operations. In the intermediate employment category, there are 246,700 jobs spread across numerous industries.

Table 2.4: Intermediate and Spin-off Employment Contribution of New Motor Vehicle Dealership Operations in the U.S.

Economic Impact	Intermediate	Spin-Off	Total
Office Administrative & Business Support Services	41,544	9,028	50,572
Facilities Support Services	18,351	4,997	23,348
Professional & Tech Services	42,710	45,227	87,937
Accounting, Tax Preparation, Bookkeeping, and Payroll Services	6,387	3,374	9,761
Advertising and Related Services	4,320	2,468	6,788
Architectural, Engineering, and Related Services	6,612	3,954	10,566
Computer Systems Design and Related Services	3,285	4,954	8,239
Legal Services	4,804	3,671	8,475
Management of Companies and Enterprises	3,282	3,335	6,617
Management, Scientific, and Technical Consulting Services	8,122	16,141	24,263
Scientific research and development services	4,542	6,128	10,670
Specialized design services	1,356	1,202	2,559
Finance, Insurance	35,791	55,120	90,911
Manufacturing	12,224	40,936	53,160
Metals, Machinery and Fabricated Metal Prod	3,373	6,995	10,368
Motor Vehicles and Related Equip	1,070	5,571	6,641
All Other Durable Goods	2,711	12,813	15,524
Consumer Non-durable Goods	5,070	15,557	20,627
Retail Trade	10,147	184,488	194,634
Transportation & Warehousing	8,838	27,713	36,550
Truck Transportation	2,650	10,575	13,226
Warehousing and Storage	1,582	8,753	10,336
All Other Transportation & Warehousing	4,605	8,384	12,989
Information: Publishing, Broadcasting, Internet	6,360	13,141	19,501
Accommodations & Food Services	16,062	43,976	60,038
Wholesale Trade	15,178	12,613	27,791
All Other Services, including Health Care and Education	28,872	149,159	178,031
Construction and Utilities	9,182	96,991	106,173
Forestry, Fishing and Mining	1,441	9,912	11,353

Source: Center for Automotive Research, 2014

The multiplier effect for new vehicle dealers is much lower than the multiplier associated with manufacturing activities because 90 percent of the industries that comprise the supplier network for vehicle dealers are non-manufacturing industries. In general, manufacturing industries demand the most from underlying intermediate and supplying industries, as

manufactured goods reach deep into the supply chain – all the way to the origin and sourcing of raw materials.

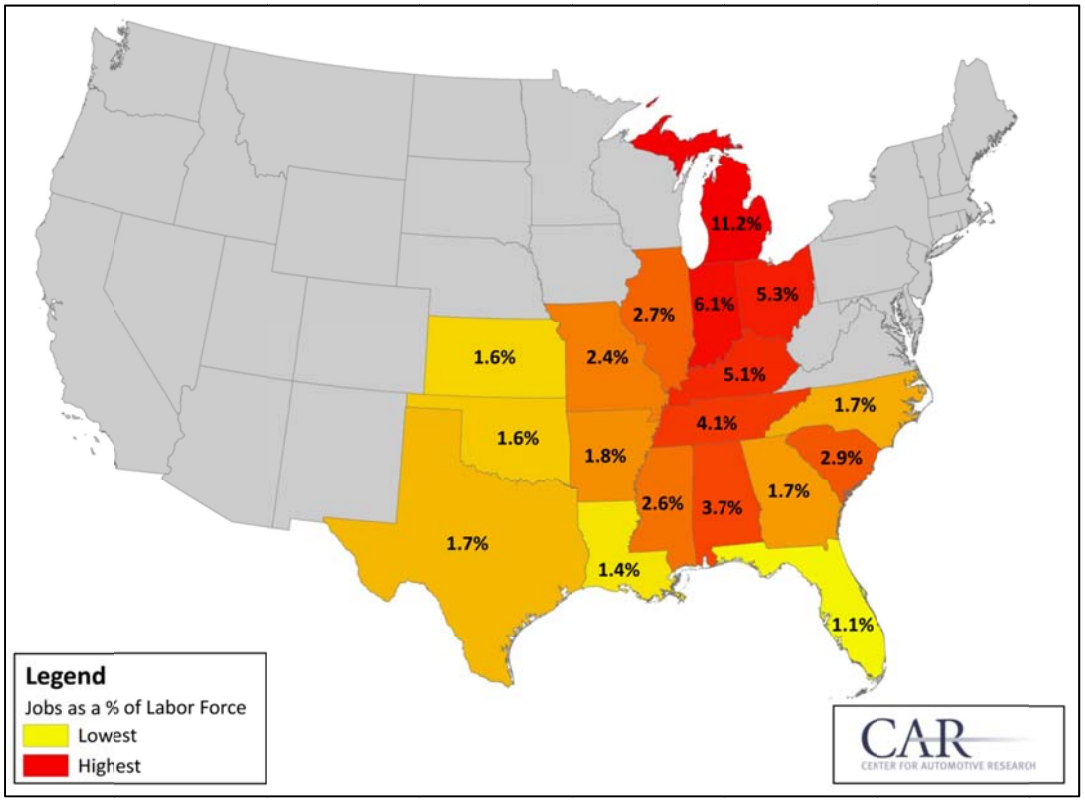
Section III - Estimates of the Economic Contribution of the Motor Vehicle Industry to Individual State Economies

The motor vehicle industry's breadth and depth of operations extends into every state economy in the nation. The industry influences an unusually large number of individual communities because the supplier network spreads across many states. Beyond that, motor vehicle dealerships have a presence in nearly every community in the country. The tables and figures in this section examine the estimated employment and income contributions of the industry to individual state economies.

Even for those states with relatively few direct jobs in the industry, the total number of jobs supported by the industry is significant. In many states, large numbers of jobs are generated due to the state's proximity to manufacturing or technical facilities located in neighboring states. All states see major additional employment contribution from substantial numbers of spin-off jobs resulting from the spending of direct and intermediate employees of the industry.

The automotive industry is a mature industry, with a large agglomeration of assembly and parts manufacturing plants well established from the upper Midwest to the Gulf of Mexico. This concentration can be seen in Figure 3.1, which shows the top states for automotive employment (direct and intermediate jobs from automakers, parts suppliers, and motor vehicle dealerships), as a percentage of state labor force.

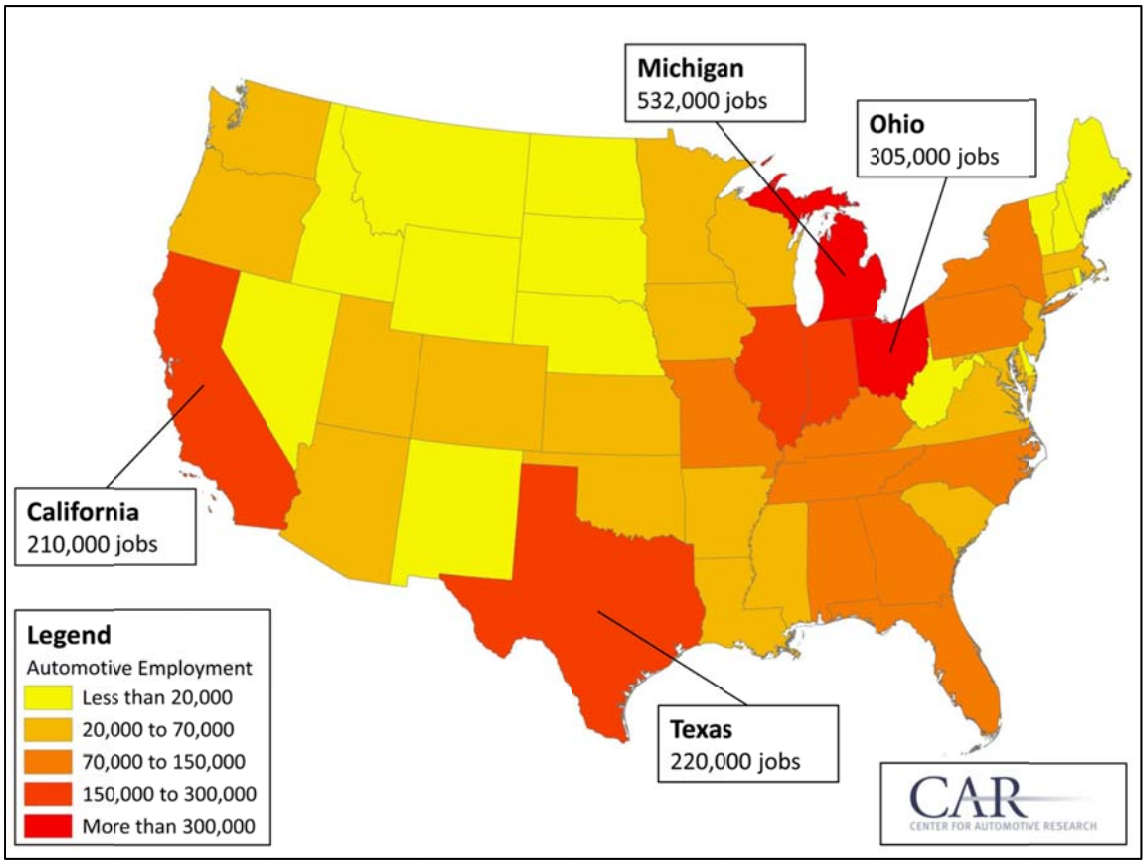
Figure 3.1: Automotive Industry Employment as Percent of State Labor Force



Note: Includes direct and intermediate jobs, but does not include expenditure induced (spin-off) jobs.
Source: Center for Automotive Research, 2014

In terms of sheer number of jobs supported by the industry, Figure 3.2 below displays the direct and intermediate employment contribution in the industry for motor vehicle assemblers, parts suppliers, motor vehicle dealerships, and the suppliers to these operations. This map does not include expenditure-induced (spin-off) employment. As can be seen, the industry provides significant numbers of jobs to every state in the nation. Even among the states in the lowest employment classification in the map (the under 20,000 jobs category), the average number of supported jobs is well over 7,000.

Figure 3.2: Automotive Industry Employment by State



Note: Includes direct and intermediate jobs, but does not include expenditure induced (spin-off) jobs.
Source: Center for Automotive Research, 2014

The automotive industry employment contribution in one state is not attributable only to the investment in that state, but is also supported by automotive industry investments and activities in nearby states as well. As a result, employment multipliers are not calculated for individual states. Employment multipliers apply to the national economy and are not applicable to, nor can be derived from, any one state's economy.

Table 3.1: Automotive Industry Employment Contribution by State

State	Total Industry Employment Contribution	State Labor Force	Auto Contribution as % of Labor Force
Alabama	165,470	2,118,000	7.8%
Alaska	4,790	366,700	1.3%
Arizona	68,210	3,049,900	2.2%
Arkansas	62,110	1,307,400	4.8%
California	381,830	18,757,100	2.0%
Colorado	69,060	2,805,100	2.5%
Connecticut	63,740	1,886,300	3.4%
Delaware	28,220	454,500	6.2%
D.C.	10,540	378,800	2.8%
Florida	242,335	9,659,600	2.5%
Georgia	206,810	4,762,700	4.3%
Hawaii	5,270	667,800	0.8%
Idaho	24,210	774,400	3.1%
Illinois	413,900	6,531,100	6.3%
Indiana	420,570	3,245,900	13.0%
Iowa	79,000	1,711,600	4.6%
Kansas	59,460	1,495,500	4.0%
Kentucky	205,800	1,996,800	10.3%
Louisiana	84,230	2,165,300	3.9%
Maine	19,215	703,800	2.7%
Maryland	82,640	3,100,400	2.7%
Massachusetts	94,270	3,545,800	2.7%
Michigan	943,620	4,737,600	19.9%
Minnesota	110,380	2,988,200	3.7%
Mississippi	73,820	1,250,100	5.9%
Missouri	167,060	3,057,700	5.5%
Montana	9,110	520,200	1.8%
Nebraska	45,720	1,021,400	4.5%
Nevada	24,680	1,368,400	1.8%
New Hampshire	13,990	739,800	1.9%
New Jersey	137,680	4,528,800	3.0%
New Mexico	17,040	922,300	1.8%
New York	288,380	9,539,700	3.0%
North Carolina	197,465	4,646,400	4.2%
North Dakota	31,045	415,500	7.5%
Ohio	629,180	5,737,600	11.0%
Oklahoma	69,400	1,790,200	3.9%
Oregon	46,600	1,957,500	2.4%
Pennsylvania	256,360	6,363,500	4.0%
Rhode Island	4,760	555,400	0.9%
South Carolina	138,800	2,192,200	6.3%
South Dakota	30,840	451,400	6.8%
Tennessee	268,870	3,001,500	9.0%
Texas	460,650	13,039,200	3.5%
Utah	45,495	1,436,300	3.2%
Vermont	8,645	351,000	2.5%
Virginia	152,760	4,263,000	3.6%
Washington	60,530	3,488,500	1.7%
West Virginia	39,160	796,800	4.9%
Wisconsin	182,170	3,098,700	5.9%
Wyoming	4,110	311,300	1.3%
U.S. Total	**7,250,000**	**156,054,700**	**4.6%**

Source: Center for Automotive Research, 2014

Table 3.2: All Jobs for Automakers by State (Direct, Intermediate, and Spin-off)

All Jobs for Motor Vehicle Manufacturers (Automakers)				
State	**Direct**	**Intermediate**	**Expenditure-Induced**	**TOTAL**
Alabama	12,000	22,700	32,000	66,700
Alaska	10	50	100	160
Arizona	800	3,500	7,000	11,300
Arkansas	300	5,000	7,000	12,300
California	13,000	38,000	50,000	101,000
Colorado	600	3,000	9,000	12,600
Connecticut	200	1,000	6,040	7,240
Delaware	200	1,000	8,000	9,200
D.C.	100	1,000	3,500	4,600
Florida	1,100	10,000	32,000	43,100
Georgia	5,800	29,000	45,000	79,800
Hawaii	10	100	300	410
Idaho	10	200	500	710
Illinois	12,500	53,100	94,000	159,600
Indiana	25,500	48,000	73,900	147,400
Iowa	100	2,000	9,100	11,200
Kansas	1,200	2,000	19,060	22,260
Kentucky	18,500	20,000	25,000	63,500
Louisiana	50	5,000	11,000	16,050
Maine	10	250	500	760
Maryland	500	5,800	12,700	19,000
Massachusetts	200	8,200	16,300	24,700
Michigan	124,500	202,000	244,000	570,500
Minnesota	200	8,000	18,000	26,200
Mississippi	8,000	8,000	9,000	25,000
Missouri	10,800	16,000	34,800	61,600
Montana	10	100	400	510
Nebraska	200	3,000	7,700	10,900
Nevada	100	2,600	4,600	7,300
New Hampshire	40	900	2,000	2,940
New Jersey	3,500	9,000	31,000	43,500
New Mexico	10	300	700	1,010
New York	5,700	27,400	35,000	68,100
North Carolina	1,000	16,000	25,000	42,000
North Dakota	10	300	3,700	4,010
Ohio	34,500	100,000	152,400	286,900
Oklahoma	50	3,500	7,000	10,550
Oregon	300	2,200	4,000	6,500
Pennsylvania	600	17,000	25,000	42,600
Rhode Island	10	100	400	510
South Carolina	7,400	10,050	12,000	29,450
South Dakota	10	200	6,000	6,210
Tennessee	17,500	27,900	55,000	100,400
Texas	11,500	58,550	85,000	155,050
Utah	50	2,200	5,000	7,250
Vermont	10	100	200	310
Virginia	700	7,000	22,400	30,100
Washington	200	1,300	4,000	5,500
West Virginia	1,300	7,300	9,000	17,600
Wisconsin	1,100	15,000	50,500	66,600
Wyoming	10	100	200	310
U.S. Total	**322,000**	**805,000**	**1,316,000**	**2,443,000**

Source: Center for Automotive Research, 2014

Table 3.3: All Jobs for Motor Vehicle Dealers by State (Direct, Intermediate, and Spin-off)

All Jobs for Motor Vehicle Dealers				
State	**Direct**	**Intermediate**	**Expenditure-Induced**	**TOTAL**
Alabama	9,900	2,900	11,000	23,800
Alaska	1,700	500	1,600	3,800
Arizona	16,900	6,000	15,100	38,000
Arkansas	5,900	1,600	6,700	14,200
California	77,500	33,200	65,800	176,500
Colorado	11,800	4,800	12,700	29,300
Connecticut	9,300	2,600	8,200	20,100
Delaware	20	10	50	80
D.C.	1,900	500	1,800	4,200
Florida	47,200	17,400	41,300	105,900
Georgia	20,800	7,500	22,000	50,300
Hawaii	1,600	400	1,600	3,600
Idaho	2,800	800	2,700	6,300
Illinois	28,200	11,300	28,500	68,000
Indiana	14,100	4,500	15,800	34,400
Iowa	8,300	2,100	8,500	18,900
Kansas	6,900	1,900	7,200	16,000
Kentucky	8,200	2,300	9,700	20,200
Louisiana	10,700	3,500	12,400	26,600
Maine	6,200	1,700	5,900	13,800
Maryland	15,200	3,900	13,900	33,000
Massachusetts	15,000	5,300	13,300	33,600
Michigan	23,300	8,500	22,500	54,300
Minnesota	12,900	4,800	12,100	29,800
Mississippi	5,200	1,300	6,700	13,200
Missouri	14,400	4,500	14,600	33,500
Montana	2,400	700	2,300	5,400
Nebraska	4,900	1,400	5,100	11,400
Nevada	3,400	900	3,200	7,500
New Hampshire	2,900	800	2,800	6,500
New Jersey	20,600	5,900	20,300	46,800
New Mexico	5,700	1,600	5,400	12,700
New York	32,600	13,900	34,800	81,300
North Carolina	21,500	6,700	21,300	49,500
North Dakota	5,700	1,600	5,400	12,700
Ohio	27,700	9,400	26,800	63,900
Oklahoma	11,200	3,000	10,000	24,200
Oregon	8,400	2,900	7,700	19,000
Pennsylvania	31,200	9,100	28,600	68,900
Rhode Island	1,100	300	1,000	2,400
South Carolina	10,100	2,800	11,400	24,300
South Dakota	2,200	600	2,100	4,900
Tennessee	13,600	4,600	17,300	35,500
Texas	64,300	27,600	65,700	157,600
Utah	5,900	2,600	7,300	15,800
Vermont	3,400	900	3,200	7,500
Virginia	19,600	5,300	18,300	43,200
Washington	14,500	4,700	11,800	31,000
West Virginia	4,100	700	4,100	8,900
Wisconsin	15,700	4,500	14,400	34,600
Wyoming	1,400	400	1,300	3,100
U.S. Total	**710,000**	**246,700**	**693,300**	**1,650,000**

Source: Center for Automotive Research, 2014

SECTION IV - METHODOLOGY OVERVIEW

The estimates in this report of the intermediate and induced employment associated with direct employment with vehicle assemblers (automakers) and dealerships are produced using a dynamic, inter-industry model developed by Regional Economic Models, Inc. (REMI). A total footprint of the industry, including all vehicle and component manufacturing, as well as new vehicle dealership employment, was also calculated to arrive at the total industry employment contribution of 7.25 million jobs. The REMI model is designed for industry- and region-specific contribution analysis. The major interactions between primary data input and model structure are described below.

The Macroeconomic Model

To estimate the total employment and compensation provided by parts suppliers, motor vehicle assemblers and new vehicle dealership operations, the research team at CAR used a 51-region, 169 industry sector model developed by REMI to capture effects in all fifty U.S. state economies, the District of Columbia and the U.S. national economy. The model provides a baseline forecast of regional and national economies. Various economic scenarios are then input into the model and simulations based on the new data are calculated by the model Changes from the baseline are measured using results from these simulations. Underlying demographic and industry-specific information for every region are contained in the baseline forecast.

Trade flows, migration patterns and commuter flows connect each state economy, allowing for dynamic multi-regional analysis. Simulation results can be interpreted as the new economic equilibrium (given a change to the baseline) and are the product of multiple structural equation iterations across the state economies. A simulation begins with the user inputting a direct change to the baseline economy. Once this change is entered into the model, new vectors of transactions between businesses are calculated along with consumer purchases of goods and services. These vectors may change as estimated household income increases or decreases under the new scenario being modeled. The model reports the economic changes from the baseline in a number of variables, with the most easily understood being employment.

The dynamic multi-regional character of the REMI model is a defining element not found in other commercial contribution analysis models and enables CAR to produce the results contained in this study. In essence, the model can simulate economic contributions that may occur in any one state resulting from changing the levels of employment in any or all of the other states.

Methods & Assumptions

The general analytical method is to run independent simulations for motor vehicle assemblers, all vehicle and component manufacturing, and new vehicle dealership operations by subtracting the employment of each group from the baseline regional economies at the state level. This counter-factual technique allows for the separation of economic activity – influenced by the operations of assemblers, all vehicle and components manufacturing and dealers – from the aggregate economy, and permits the capture of economic contributions from continued employment in the sectors of interest for any given time period. In general, the difference between the baseline forecast and the simulation represents the economic contribution of assemblers, dealers and the total footprint of the industry.

This study should not be interpreted as representing the economic activity that would be lost if the automotive industry did not operate in the United States. That scenario would generate significant compensating adjustments (over time) in the economy and is not examined in this study. CAR's purpose is to dissect and present the industry's current presence in the domestic economy. This study represents a snapshot of the automotive industry's total employment contribution on the nation's economy.

Consideration was paid to the potential of double-counting activities between supplier, dealership and assembler runs. Within the framework of the REMI model, there is an inter-industry, input-output (I-O) table that calculates demand for intermediate inputs used in the production of a finished good. A more rigorous effort to avoid double-counting was applied to this study versus the 2010 study. In this study, all automaker employees who manufacture parts were not included as direct employees in the assembler simulation. Next, common to both studies, the automaker simulation model was run first, then the calculated demand for parts suppliers associated with automakers were discounted (these are the suppliers who will be included as direct employees of parts manufacturers in the second run). With both types of parts makers (those employed by automakers and those employed by Tier 1 parts suppliers) removed from the assemblers simulation, the CAR research team was able to adjust for systemic double counts and calculate only the net employment effects for the assembler simulation runs.

As a consequence of this up-front effort to avoid double counting between segments of the industry (automakers, parts suppliers and dealerships), the results for each of these segments can be added together to arrive at the total economic contribution of the industry. These results fairly represent the size of the industry and its contribution to the U.S. and individual state economies. All simulation results are relevant to the economic conditions of calendar year 2014.

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APPENDIX A

Contribution of the Automotive Industry to Small Manufacturers in Kentucky

The Center for Automotive Research is performing a study analyzing the state jobs contribution of the automotive industry to small manufacturers in Kentucky. This effort is sponsored by Alliance of Automobile Manufacturers, in cooperation with all of the major automakers. A major part of this effort is a mapping of the supply chain in Kentucky. CAR's research will also feature a case study of small and medium suppliers, beginning with interviews from a voluntary group of key suppliers. These interviews will help paint a picture of how Kentucky-based assembly plants are contributing to the support of suppliers in the state.

Question List

1) What portion of your revenues comes from the automotive industry?

2) What parts does your plant produce which will ultimately make their way to any of the Kentucky-based assembly plants?

3) How many employees work in your plant whose job is related to work on parts that ultimately make their way to Kentucky assembly plants?

4) How many of your Kentucky-based suppliers provide parts used in your products that are delivered to Kentucky-based assembly plants?

5) Were there any tooling purchases from Kentucky companies made specifically for these parts?

6) As a Tier 2 supplier, what is your level of responsibility for engineering and R&D for the parts that ultimately make their way to Kentucky assembly plants?

7) Have you recently begun tracking your supply chain more closely than in the past? Is your firm increasing local sourcing?

8) What are the major issues and challenges you face in your current operations?

9) How have automakers and Tier 1 suppliers engaged with you, and how have they assisted you with overcoming challenges?

10) Please describe your interactions with state and local government agencies. What about economic development organizations?