

The Economic Impact of the Motor Vehicle Parts Manufacturing Industry on the United States

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Foreword

There has been an unprecedented growth in both North American vehicle sales and U.S. vehicle production over the past three years since the last MEMA Employment Impact Study was conducted. Back in 2013 (date of the last Employment Impact Study release) it was outlined that there was tremendous rise in both the total number of direct employees active in the U.S. automotive parts industry and their impact on the economy. This positive trend has continued.

The motor vehicle industry, aided by a strengthening economy, relatively low fuel prices and an expansion in employment has driven a strong vehicle market rebound from the worst of the recession of 2009. Since 2012, total vehicle (light, medium and heavy on-road) production in the United States grew almost 17% - a compound annual growth pace of over 5%. In 2015, the motor vehicle supply industry, supporting both light and medium/heavy duty original equipment manufacturers (OEM) and the aftermarket employed over 871,000 people across the country – a rise of 19% since 2012. The average vehicle transaction price in 2015 hovered around \$34,000 – an increase of 10% which accounts for increased vehicle content and supplier value added.

This report was commissioned by the Motor & Equipment Manufacturers Association (MEMA) to provide a comprehensive overview of the economic and employment impact of the motor vehicle parts manufacturing industry. The motor vehicle supply industry was defined as not just those industries supplying parts and materials to light vehicle OEMs, but also those supplying heavy duty OEMs and also those supplying products to the automotive aftermarket. This is a continuation of similar studies that MEMA has previously commissioned and this new scope ensures that the total motor vehicle supply market is captured within the analysis, providing a complete picture of the current industry.

This report examines the composition of those 871,000 direct employees, both from an industry segment standpoint at a national level as well as from a state-by-state distribution. Utilizing internal IHS Markit information, relevant government data, and geographically specific impact models, this report demonstrates that an estimated 4.2 million total jobs are supported by the U.S. motor vehicle supply industry, which includes the indirect and induced impacts of the direct employment.

The significance of this employment impact, as well as the wages generated and economic activity created, are addressed within this report.

Executive Summary

The U.S. motor vehicle parts manufacturing industry, feeding light and heavy-duty original equipment manufacturers (OEM), and the automotive aftermarket, supports jobs in every state in the country and touch nearly every industry.

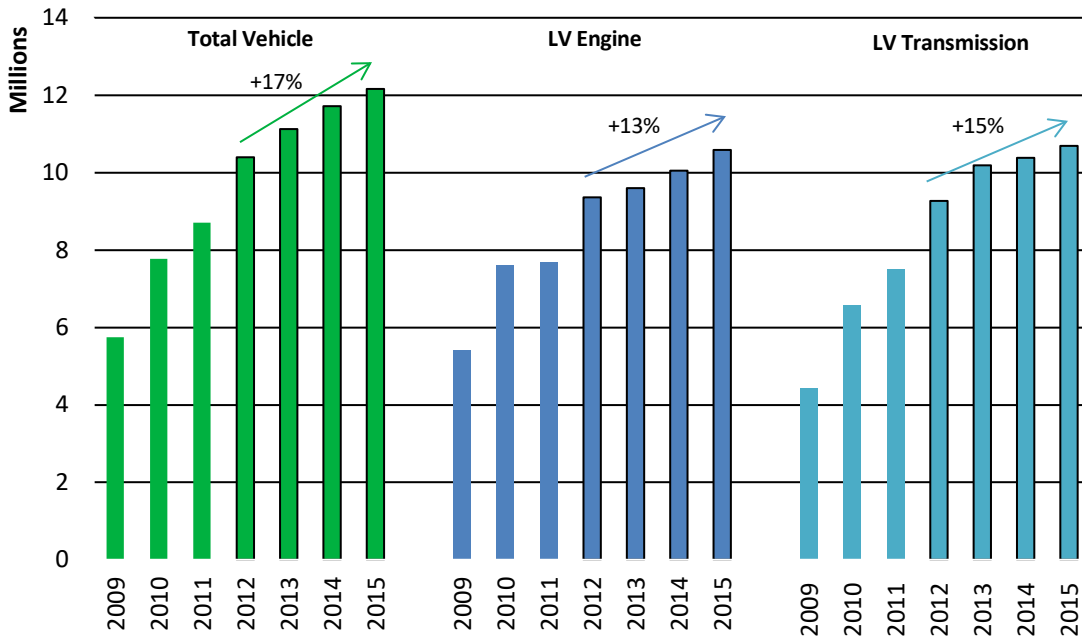
- **Over 871,000 jobs directly supported by the motor vehicle parts manufacturing industry – an increase of 19% from the 2012 study.**
- **Nearly 523,000 jobs directly tied to supplying light vehicle manufacturers.**
- **Over 203,000 jobs directly tied to supplying heavy-duty vehicle manufacturers and the heavy-duty aftermarket.**
- **Nearly 145,000 jobs directly tied to supplying the light vehicle aftermarket.**
- **The top five states for direct employment – MI, OH, IN, TN, KY – make up 47% of total direct employment – down from 49% in 2012.**
- **The 871,000 jobs generates a supply chain effect of nearly 1.49 million indirect jobs.**
- **The direct and indirect employment support an additional 1.90 million employment-induced jobs within the U.S.**
- **The total employment impact of the motor vehicle parts manufacturing industry in the United States is over 4.26 million jobs in 2015 – rising 18% from 3.62 million in 2012.**
- **Over \$270 billion in total employee compensation paid to workers supported by the motor vehicle parts manufacturing industry in 2015– a rise of 22% from \$221 billion in 2012 is 2.8% of total U.S. employee compensation (up 0.2 share points from 2012).**
- **Nearly \$435 billion in economic contribution to the U.S. GDP is generated by the motor vehicle parts manufacturing industry and its supported activity in 2015 – 2.4% of U.S. GDP (up 0.2 share points from 2012).**
- **The 4.26 million total jobs makes up 2.9% of the U.S. employment market (up 0.2 share points from 2012).**

Industry Background

The U.S. manufacturing industry, bolstered by strengthened economy, rising consumption, improved capacity utilization, and continued improvements in worker productivity, has seen its share of employment stabilize at just under 9% in 2015 – level with 9% in 2012 though much lower than the 14% share in 1998. The absolute number of employees involved in manufacturing has grown just 3.3% over the past three years – rising from 11.9 million workers in 2012 to over 12.3 million in 2015. For 2015, this accounts for 8.7% of non-farm payroll versus 8.9% in 2012 as the service side grew faster than manufacturing employment. The most recent peak was 1998 at more than 17 million workers accounting for 13.9% of non-farm payroll. The growth pace of auto parts manufacturing (18% in total) rose faster than all major industry sectors including: natural resources and mining, retail, utilities and non-durable manufacturing.

Within the manufacturing sector, the automotive market has been a significant driver of growth. Combined domestic light and heavy duty vehicle production has been rising steadily since 2012. As shown in Figure 1, light vehicle output rose 17%, medium/heavy vehicle output rose 17%, engine output rose 13% and transmission climbed 15% as suppliers strived to supply these end markets. As several new established or expanded vehicle production facilities were established in the U.S., major component output such as engines and transmissions climbed as well. Incremental light vehicle production capacity was integrated at BMW, Daimler and Toyota. This is reflective of several OEMs choosing to reduce currency and inventory risk through location of output closer to the final consumer in North America.

Figure 1
U.S. Vehicle, LV Engine, and LV Transmission Production



The automotive sector was acutely impacted as the combination of rising unemployment, constrained credit and falling consumer confidence caused light vehicle sales to fall by more than a third from the pre-recession level of 16.6 million units in 2006 to 2010's 10.5 million units. The impact on heavy duty vehicle sales was even more pronounced, as 2009's low-point of 199,000 units was nearly 2/3 that of the 2006 peak of 561,000 units. The trend has solidly reversed since the 2009 recession. By 2015, total U.S. output has risen 56% to 12.1 million units from 2009 – still 700,000 units behind the all-time high in 2000 of 12.8 million units though at an all-time record when total North America is considered (U.S., Canada and Mexico).

As the economy has stabilized post-recession, total light vehicle sales grew briskly through the front half of this decade. In 2015, U.S. light vehicle sales were nearly 17.2 million, while the heavy duty segment moved 450,000 units. As a result, vehicle production has rebounded as well with 2015 combined vehicle production at 12.1 million units.

Total U.S. Motor Vehicle Parts Manufacturing Industry

The U.S. automotive components manufacturing sector has experienced substantive restructuring this decade. The industry is now more efficient in terms of both labor and capital, better utilized, and exhibits improved capability to withstand volume fluctuations for the future. Since 2012, a majority of the additional vehicle production volume generated in the U.S. has been driven by the shift to 3-crew or 3-shift production structures at most Detroit 3 (General Motors, Ford Motor and FCA) facilities. Despite this there has been incremental light vehicle production investment at a number of OEMs – namely Toyota in Kentucky, BMW in South Carolina and Daimler in Alabama. Normalized capacity utilization for light vehicle production facilities rose to 104% in 2015 from an already strong 91% in 2012. The 12.2 million units produced in 2015 by the light and heavy duty OEMs are critically dependent upon the motor vehicle supply industry, which is defined within this study as all those industries supplying parts and materials directly to the OEMs as well as supplying their products to the automotive aftermarket¹.

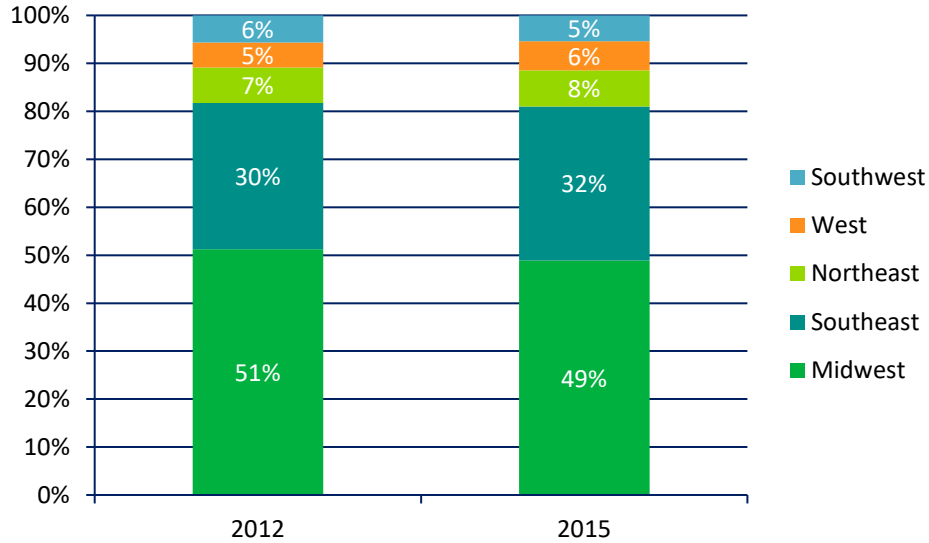
In order to support the 2015 vehicle production, as well as the parts needed within the aftermarket to support the 258 million vehicles on the road (2015), the U.S. motor vehicle supply industry directly employed over 871,000 people, up 18% from 2012.

As shown in Figure 2 below, the 871,000 employees directly employed within the industry are spread across the U.S. geographically².

¹ The spectrum of industries included within this analysis is detailed in Table 6.

² The map of regions to states can be found in Appendix I

Figure 2
Regional Distribution of Total U.S. Direct Employment



Light vehicle and heavy duty vehicle OEM production is continuing to gravitate towards the U.S. Southeast as a share of total U.S. output. Given this ongoing trend, logistics will drive suppliers towards these facilities as well versus supplying out of traditional locations in the Midwest or Ontario. This was the case in 2012 when the last study was established and is extended in this study. For 2015, the trend continues as a rising portion of production is in the U.S. Southeast (32% share) is driving localized supply towards these facilities. Output in the Midwest grew at half the rate, 12% from 2012 to 2015 versus the Southeast rising 24% over the period. Several OEMs started programs in the 2012-15 period to shift their suppliers closer to the final point of assembly to reduce logistics costs – especially for facilities lacking appreciable volume in neighboring counties to justify another supplier plant. Supplier park and colocation initiatives are underway at facilities in Missouri, Tennessee, Texas and a number of locations in the U.S. Southeast. Lastly, as new capacity is opened by non-Detroit 3 players, some newer suppliers are locating in the U.S. – ideally in the Southeast closer to their customers.

Despite the shift, the powerhouse states of Ohio, Michigan and Indiana continue to dominate in several component areas though growth is expected in the Southeast due to shifting/incremental vehicle/engine manufacturing. In 2015, nearly 1/3 of all direct motor vehicle supply employees were located within the Southeast region.

Light and heavy duty vehicles were produced in 17 states in 2015 – a decline of one state (Louisiana) from 2012. The auto part manufacturing industry has a presence in all 50 states, as can be seen in Table 1. At the state level, the top three states of direct employment – Michigan, Ohio and Indiana – comprise 36% of the national total (down from 37% in 2012), while the top 10 states bring that share to just over 64% (was 69% in 2012). In all, nineteen states have direct employment above 10,000 employees.

Table 1
State Distribution of Total U.S. Direct Employment

Total U.S. Direct Employment	
TOTAL	871,831
Michigan	125,909
Ohio	96,238
Indiana	88,306
Tennessee	50,128
Kentucky	47,658
Alabama	41,107
Illinois	38,394
North Carolina	33,825
South Carolina	33,766
Texas	33,132
California	31,190
Pennsylvania	27,920
Georgia	23,836
New York	19,517
Wisconsin	18,200
Missouri	16,301
Iowa	16,114
Virginia	13,277
Arkansas	10,495
Mississippi	9,706
Florida	8,827
Oklahoma	8,676
Nebraska	8,415
Utah	7,884
Minnesota	6,366
Kansas	6,270
Connecticut	4,958
Washington	4,687
Arizona	4,672
Oregon	4,473
West Virginia	4,069
New Jersey	4,028
South Dakota	3,931
Louisiana	3,167
Colorado	3,120
Massachusetts	2,510
North Dakota	1,994
Rhode Island	1,879
Maryland	1,720
New Hampshire	1,389
Vermont	745
Idaho	616
Maine	549
New Mexico	525
Nevada	484
Delaware	400
Montana	269
Wyoming	136
Alaska	30
Hawaii	21
District of Columbia	2

The 871,000 direct employees within the U.S. motor vehicle parts manufacturing industry generate a significant employment impact within their own supply chain to support their activities. This indirect effect supports 1.48 million employees within the U.S. The combined 2.4 million direct and indirect employees create their own economic impact through their everyday purchases within their local economy. This employment induced effect supports an additional 1.91 million employees. The total employment impact from the U.S. motor vehicle supply industry is 4.27 million employees. The industry also generates significant wages and labor income paid to these employees, as well as economic value-added that contributes to the U.S. GDP. A summary of the total economic impacts is shown in Table 2.

Table 2
Summary of Economic Impacts of U.S. Motor Vehicle Parts Manufacturing Industry

2012	Employment	Labor Income (\$M)	Value Added (\$M)
Total Effect	3,621,111	\$220,542	\$354,349
Direct Effect	734,212	\$58,249	\$80,895
Indirect Effect	1,267,005	\$86,076	\$137,133
Induced Effect	1,619,894	\$76,217	\$136,321
2015	Employment	Labor Income (\$M)	Value Added (\$M)
Total Effect	4,264,110	\$270,318	\$435,324
Direct Effect	871,831	\$71,717	\$101,210
Indirect Effect	1,487,125	\$105,281	\$167,204
Induced Effect	1,905,154	\$93,320	\$166,910
CAGR	Employment	Labor Income	Value Added
Total Effect	5.6%	7.0%	7.1%
Direct Effect	5.9%	7.2%	7.8%
Indirect Effect	5.5%	6.9%	6.8%
Induced Effect	5.6%	7.0%	7.0%
Net Growth	Employment	Labor Income	Value Added
Total Effect	17.8%	22.6%	22.9%
Direct Effect	18.7%	23.1%	25.1%
Indirect Effect	17.4%	22.3%	21.9%
Induced Effect	17.6%	22.4%	22.4%

Light Vehicle U.S. Motor Vehicle Parts Manufacturing Industry

The segment of the U.S. motor vehicle parts manufacturing industry that supports the light vehicle OEMs makes up the majority of the industry's direct employment. In 2015, 523,000 people were employed within this segment of the industry, making up 49% of the total industry direct employment. The direct employment within this segment creates an indirect employment effect of nearly 923,000 employees. As a result of the direct and indirect employment, an induced employment impact of 1.61 mil employees is generated. The total employment impact for the segment is 2.61 million jobs, which is 1.8% of U.S. employment. The 2.61 million jobs represent an employment multiplier of 4.5.

Light Vehicle OE grew more than both heavy duty and LV aftermarket as stronger U.S. volume, improved output for exports to Mexico and Canada, shifting of logistics closer to the final assembly point and rising vehicle content from 2012 to 2015 drove a 23% improvement from 2012. In addition to the employment impacts, the wage and economic value created by this segment can be seen in Table 3.

Table 3
Summary of Economic Impacts of U.S. Light Vehicle Parts Mfg. Industry

2012	Employment	Labor Income (\$M)	Value Added (\$M)
Total Effect	2,132,649	\$129,459	\$205,634
Direct Effect	423,897	\$33,478	\$44,436
Indirect Effect	756,582	\$51,195	\$81,096
Induced Effect	951,775	\$44,785	\$80,102
2015	Employment	Labor Income (\$M)	Value Added (\$M)
Total Effect	2,607,504	\$168,126	\$268,366
Direct Effect	523,143	\$43,746	\$59,894
Indirect Effect	922,577	\$66,311	\$104,612
Induced Effect	1,161,784	\$58,068	\$103,860
CAGR	Employment	Labor Income	Value Added
Total Effect	6.9%	9.1%	9.3%
Direct Effect	7.3%	9.3%	10.5%
Indirect Effect	6.8%	9.0%	8.9%
Induced Effect	6.9%	9.0%	9.0%
Net Growth	Employment	Labor Income	Value Added
Total Effect	22.3%	29.9%	30.5%
Direct Effect	23.4%	30.7%	34.8%
Indirect Effect	21.9%	29.5%	29.0%
Induced Effect	22.1%	29.7%	29.7%

Heavy Duty U.S. Motor Vehicle Parts Manufacturing Industry

The segment of the U.S. motor vehicle parts manufacturing industry that supports the heavy duty vehicle OEMs and the associated aftermarket makes up just over 23% of the industry's direct employment. In 2015, that amounted to over 203,000 people employed within this segment of the industry. Of these employees, roughly 12,000 or 6% are employed by remanufacturing operations. Within heavy duty remanufacturing, nearly half of the employment volume is dedicated to Motor Vehicle Transmission and Power Train Parts. The direct employment within this segment creates an indirect employment effect of nearly 304,000 employees. As a result of the direct and indirect employment, an induced employment impact of 400,000 employees is generated. The total employment impact for the segment is 907,000 jobs, which is 0.6% of total U.S. employment. The total employment figure represents an employment multiplier of 4.5.

Heavy duty automotive parts manufacturing employment grew 19% from 2012 to 2015. In addition to the employment impacts, the wage and economic value created by this segment can be seen in Table 4.

Table 4
Summary of Economic Impacts of U.S. Heavy Duty Parts Mfg. Industry

2012	Employment	Labor Income (\$M)	Value Added (\$M)
Total Effect	778,869	\$46,998	\$74,775
Direct Effect	170,623	\$12,914	\$17,520
Indirect Effect	263,322	\$17,858	\$28,233
Induced Effect	344,850	\$16,226	\$29,022
2015	Employment	Labor Income (\$M)	Value Added (\$M)
Total Effect	906,893	\$57,898	\$92,075
Direct Effect	203,458	\$16,005	\$21,766
Indirect Effect	303,700	\$21,915	\$34,574
Induced Effect	399,735	\$19,979	\$35,734
CAGR	Employment	Labor Income	Value Added
Total Effect	5.2%	7.2%	7.2%
Direct Effect	6.0%	7.4%	7.5%
Indirect Effect	4.9%	7.1%	7.0%
Induced Effect	5.0%	7.2%	7.2%
Net Growth	Employment	Labor Income	Value Added
Total Effect	16.4%	23.2%	23.1%
Direct Effect	19.2%	23.9%	24.2%
Indirect Effect	15.3%	22.7%	22.5%
Induced Effect	22.1%	29.7%	29.7%

U.S. Aftermarket Parts Manufacturing Industry

The segment of the U.S. motor vehicle parts manufacturing industry that supports the light vehicle aftermarket makes up 17% of the industry's direct employment. In 2015, this segment produced nearly 145,000 direct jobs. Remanufacturing accounted for over 10,000 of these direct jobs, 7% of segment employment. The direct employment within this segment creates an indirect employment effect of nearly 261,000 employees. As a result of the direct and indirect employment, an induced employment impact of 344,000 employees is generated. The total employment impact for the segment is 750,000 jobs, which is 0.5% of total U.S. employment. The total employment figure represents an employment multiplier of 5.2.

Aftermarket employment grew at a much slower pace than both heavy duty and light vehicle related automotive parts manufacturing employment for several reasons. Due to cost and inventory, aftermarket components can be outsourced to lower cost locations more easily. In addition to the employment impacts, the wage and economic value created by this segment can be seen in Table 5.

Table 5
Summary of Economic Impacts of U.S. Aftermarket Parts Mfg. Industry

2012	Employment	Labor Income (\$M)	Value Added (\$M)
Total Effect	709,592	\$44,086	\$73,940
Direct Effect	139,701	\$11,857	\$18,939
Indirect Effect	247,101	\$17,023	\$27,804
Induced Effect	323,269	\$15,205	\$27,196
2015	Employment	Labor Income (\$M)	Value Added (\$M)
Total Effect	749,713	\$49,787	\$83,729
Direct Effect	145,230	\$13,424	\$21,606
Indirect Effect	260,848	\$19,195	\$31,415
Induced Effect	343,635	\$17,169	\$30,708
CAGR	Employment	Labor Income	Value Added
Total Effect	1.9%	4.1%	4.2%
Direct Effect	1.3%	4.2%	4.5%
Indirect Effect	1.8%	4.1%	4.2%
Induced Effect	2.1%	4.1%	4.1%
Net Growth	Employment	Labor Income	Value Added
Total Effect	5.7%	12.9%	13.2%
Direct Effect	4.0%	13.2%	14.1%
Indirect Effect	5.6%	12.8%	13.0%
Induced Effect	6.3%	12.9%	12.9%

Economic Contribution Assessment

Approach and Methodology

How to Define the Industry

This research effort continues and builds upon previous work done by the Motor & Equipment Manufacturers Association (MEMA) to quantify the size of the motor vehicle parts manufacturing industry and determine its contributions to the overall U.S. economy. MEMA has periodically commissioned studies to determine these results and then utilized those figures to communicate the importance of the industry to a variety of stakeholders.

For the purpose of this study, the overall industrial sphere that was analyzed was expanded from previous efforts to include a more comprehensive view of all the products that go into not only a light vehicle, but also heavy duty vehicles and those products destined directly for the aftermarket. The final definition was set to cover all parts and raw materials shipped directly to either light vehicle or heavy duty OEMs, as well the manufacturers of products made specifically for the aftermarket. This effort resulted in a total direct employment figure for the U.S. motor vehicle parts manufacturing industry. The U.S. total direct employment figure was then split into three distinct categories:

- OE Light Vehicle (LV): Includes all manufacturing of components for the original equipment purposes for light vehicles (typically Class 3 and below in GVWR)
- Heavy Duty: Includes both original equipment and aftermarket components and accessories manufacturing for on-highway medium and heavy trucks in the Class 4 sector and higher in GVWR)
- Aftermarket (AF): Includes all components and accessories focused on the light vehicle (Class 3 and below in GVWR) sector including dealer service parts.

Given the determination of the components, accessories and some light equipment to be included in the analysis, the associated NAICS (North American Industry Classification System) codes were determined for inclusion in the study. These codes are found in various levels of detail – from four digit codes to the more specific five and six digits codes – the appropriate detail was determined and included for consideration in the analysis.

The foundation of the industry analysis, as was the case in previous studies, is the NAICS code 3363 – Motor vehicle parts manufacturing sector. This was the only industry sector, either at the four digit level or the more specific five and six digit levels where all U.S. employment was considered part of the motor vehicle supply industry. This provided a foundation of 2015 employment of over 567,000. Beyond that, each additional relevant NAICS code was examined individually to determine not only the share of their total employment relevant to this study, but also how that share should break out from a segment and from a state-by-state standpoint. For 2015, Carbon Fiber and Graphite Product Manufacturing was added to the relevant NAICS codes to reflect changes in automotive body material usage.

For each major NAICS code, major U.S. manufacturers were determined for better understanding of the composition of their footprint from a sector and geographic

consideration. Depending upon the position of the sector participant, an analysis of the exposure to LV, LV AF or HD was determined and when required, the geographic bias (state exposure) as an input to the final analysis was determined.

In addition, several adjoining associations were contacted for their analysis and expert view of specific sectors. This included steel, rubber and aluminum as primary inputs into various manufacturing activities by original equipment manufacturers (OEMs) or end markets such as light and heavy vehicle aftermarket.

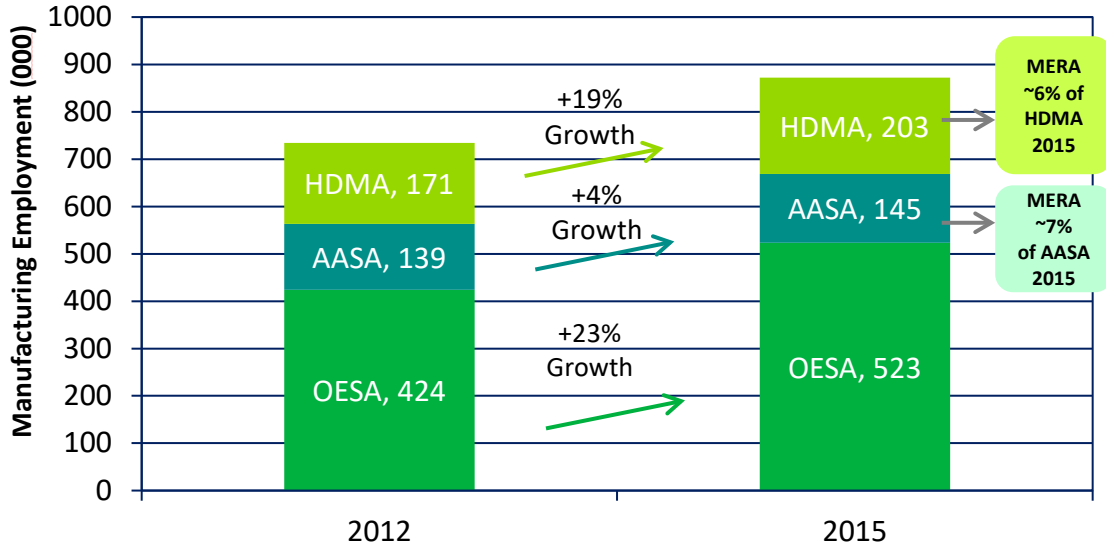
The primary source of the sector level employment data, both for the United States and at the state level, was internal IHS Markit databanks detailing industry/geography relationships. This data was supported by relevant government data from the BLS and Census.

Table 6 highlights the industry level contribution to the total U.S. motor vehicle parts manufacturing market, aggregated to the four digit NAICS level. Figure 3 shows the resulting direct employment shares by industry segment.

Table 6
Industry Contributions to the U.S. Motor Vehicle Parts Manufacturing

NAICS	Industry Description	Direct Employment
Total Direct Employment		871,831
3363	Motor Vehicle Parts Manufacturing	567,794
3362	Motor Vehicle Body and Trailer Manufacturing	94,314
3261	Plastics Product Manufacturing	58,284
3262	Rubber Product Manufacturing	54,251
3255	Paint, Coating, and Adhesive Manufacturing	14,300
3311	Iron and Steel Mills and Ferroalloy Manufacturing	12,531
3241	Petroleum and Coal Products Manufacturing	10,236
3313	Alumina and Aluminum Production and Processing	7,881
3359	Other Electrical Equipment and Component Mfg.	6,888
3336	Engine, Turbine, and Power Transmission Equip. Mfg.	6,721
3325	Hardware Manufacturing	5,977
3326	Spring and Wire Product Manufacturing	5,409
3351	Electric Lighting Equipment Manufacturing	5,341
3345	Navigational, Measuring, and Control Instruments Mfg.	4,984
3333	Commercial and Service Industry Machinery Mfg.	3,709
3259	Other Chemical Product and Preparation Mfg.	3,119
3256	Soap, Cleaning Compound, and Toilet Prep. Mfg.	2,832
3327	Machine Shops; Turned Product; Screw, Nut, and Bolt Mfg.	1,815
3339	Other General Purpose Machinery Manufacturing	1,243
3322	Cutlery and Handtool Manufacturing	1,157
3329	Other Fabricated Metal Product Manufacturing	1,116
3334	HVAC and Comm. Refrigeration Equipment Mfg.	842
3231	Printing and Related Support Activities	692
3161	Leather and hide tanning and finishing	395

Figure 3
Segment Shares of the Direct Employment of the Total U.S. Motor Vehicle Supply Industry



How to Define the Economic Contribution

The objective of measuring the economic contribution is to fully “size” the industry’s economic influence by capturing all of the supply-chain and income effects associated with the U.S. motor vehicle parts manufacturing industry. The results of the direct employment that has been determined to exist within this industry were integrated into a modeling system to capture the comprehensive contribution of this industry to the U.S. economy.

The steps used to derive the economic contribution of any industry can be summarized as follows:

- Any level of industry activity, in this case within those industries that supply the light and heavy duty OE market as well as the aftermarket, represented by direct employment, results in direct benefits to the economy.
- This employment also results in indirect effects on final demand. In theory, an increase of output within the motor vehicle supply industry, with all else constant, would lead to more employment and output among supplier industries, such as raw materials, transportation and professional services. This is the type of impact seen within in the supply chain, resulting from the change in the target industries, in this case motor vehicle production or the aftermarket.

The industries that make up the motor vehicle parts manufacturing industry use many different types of products and services from various industrial sectors of the economy. As a result, a change in parts output would result in both a direct contribution (through production) and an indirect contribution (via supply-chain dynamics) across a broad spectrum of sectors. The contribution of these supplier industries has implications for each supplier industry’s own supply chains, magnifying the indirect contribution.

As explained below, the net effects on the U.S. economy and its industrial sectors, due to these contributions, are divided into three stages: the **direct** contribution, the **indirect** contribution and the **induced** economic contribution.

For each stage in the analysis, the economic contribution is quantified in terms of employment, value added contribution to GDP, and labor income.

- The **direct contribution** is the effect of the core industry's output, employment, and income. For example, the motor vehicle parts manufacturing industry's direct contributions are generated by the production of its products to downstream elements – either OEMs or the aftermarket. Investments in these activities result in a direct contribution to production output, the number of workers employed by the industry and how much those workers are paid and otherwise compensated.
- Any changes in the purchasing patterns or activities by the motor vehicle parts manufacturing industry initiate the **indirect contributions** to all of the supplier industries that support the industry. Changes in demand from the direct industries lead to corresponding changes in output, employment, and income throughout their supply chains and inter-industry linkages. The affected supplier activities span the majority of industries in the U.S. economy. These operations extend beyond the acquisition of intermediate goods and includes operational aspects such as accounting and legal spending, real estate management, etc.
- Finally, workers and their families in both the direct and indirect industries spend their income on food, housing, leisure, autos, household appliances, furniture, clothing, and other consumer items. The additional output, employment, and income effects that result from their consumer spending activities are categorized as the **induced economic contribution**.

Modeling the Economic Contribution

As discussed previously within this section of this report, a significant effort went into first defining the industry, and then into determining just what the direct employment within those component industries was attributable to the U.S. motor vehicle parts manufacturing sector. The result of that effort was an estimate for 2012 direct employment within the industry that was built up from 57 separate six digit NAICS industries.

- The IMPLAN model³ was utilized to evaluate changes, within the context of a comprehensive, linked industrial structure of an economy. The NAICS codes were mapped to their corresponding IMPLAN sector codes and the direct employment level by sector served as inputs to the IMPLAN model.

³ See Appendix III for more details on the IMPLAN model

- The U.S. IMPLAN model was utilized to separately analyze the light vehicle, heavy duty and aftermarket segments of the motor vehicle supply industry. The sum of these impacts was then utilized to quantify the total impact of the entire industry.
- Specific state IMPLAN models were used to separately analyze each state's economic impact from their own direct employment.

The IMPLAN model was used to quantify the direct and indirect contributions of the motor vehicle parts manufacturing industry. When combined, the direct and indirect contributions represent all of the production, marketing, and sales activities required to bring primary products to the end-users, either the vehicle manufacturers or the aftermarket consumers. IMPLAN's input-output framework allows one to enter direct employment, by industry, in order to analyze and quantify direct and indirect contributions. The sum of all contributions relative to the total size of the economy provides initial benchmark estimates to evaluate the importance of a given industry.

The induced economic contributions represent the changes in consumer spending when their incomes are altered. The broad range of consumer spending means that induced contributions tend to be dynamic and reactive to shifts in consumer sentiment and employment outlooks. The composition of induced effects therefore tend to mirror the overall makeup of the consumer expenditures for the region.

Industry Economic Impact

Total U.S. Motor Vehicle Parts Manufacturing Industry

As described previously in the report, the industry definition exercise determined that the U.S. motor vehicle parts manufacturing industry is made up of over 871,000 direct employees, spanning 24 industry sectors and touching all 50 states. The industry impact from the great recession and the following market rebound has resulted in a market sector that has undergone substantive restructuring over the past five years. The outcome from that restructuring is an industry that is now more efficient, better utilized and better prepared for those kinds of dramatic volume fluctuations should they reoccur.

The sector specific direct employment levels were input into an IMPLAN model of the entire United States, and the results of the model show that the indirect employment effect of the industry is 1.49 million employees. So for every direct job, 1.71 indirect jobs are created. Therefore, nearly 2.36 million employees are involved in either manufacturing of parts for the motor vehicle industry or are part of the supply chain for that industry. As a result of the wages paid to those direct and indirect jobs, an employment induced effect of 1.91 million jobs is generated by the industry. The induced multiplier for the industry is 2.2. The total employment impact from the U.S. motor vehicle supply market is 4.26 million employees. That means the industry makes up 2.9% of the 142 million non-farm employees within the U.S. For the total industry, the employment multiplier is 4.89.

The 4.26 million total employees supported by the industry generate over \$270 billion in wages and income. That figure is 2.8% of all employee compensation paid in the country in 2015. The industry also generates nearly \$435 billion in GDP contribution, which is 2.4% of the 2015 total U.S. nominal GDP. These figures are detailed in Tables 7 and 8 below.

Table 7
Summary of Economic Impacts of U.S. Motor Vehicle Parts Manufacturing Industry

	Employment	Labor Income	Value Added
Total Effect	4,264,110	\$270,318,004,196	\$435,324,475,257
Direct Effect	871,831	\$71,716,814,804	\$101,210,065,314
Indirect Effect	1,487,125	\$105,281,422,265	\$167,204,260,949
Induced Effect	1,905,154	\$93,319,767,127	\$166,910,148,994

Table 8
Summary of Economic Impacts of U.S. Motor Vehicle Parts Manufacturing Industry in 2015

Employment Contribution of Motor Vehicle Parts Manufacturing Industry to the Economy in the United States	
Employment	
Direct	871,831
Indirect	1,487,125
Expenditure-induced	1,905,154
Total (direct + indirect + expenditure-induced)	4,264,110
Multiplier	4.89
Industry Contribution as % of total 2015 U.S. economy	
Labor Force	2.9%
Employee Compensation	2.8%
U.S. Nominal GDP Contribution	2.4%

The distribution of the total employment of the motor vehicle parts manufacturing across major industry sectors is shown in Figure 4 and Table 9. While the manufacturing sector is obviously the largest segment, nearly two thirds of all employment came from outside this core industry. The information and professional services sector is one industry that derives significant employment benefits from the motor vehicle parts manufacturing industry, receiving 24% of the total employment contribution. The wholesale and retail trade sector is home to roughly 12% of the total employment contribution, as is the leisure and other services sector. Finance, insurance, real estate, and leasing accounts for 9% of the total employment, while the remaining jobs are dispersed across transportation and utilities, natural resources, construction, and government.

Figure 4
Total Employment Contribution of MV Parts Manufacturing Industry

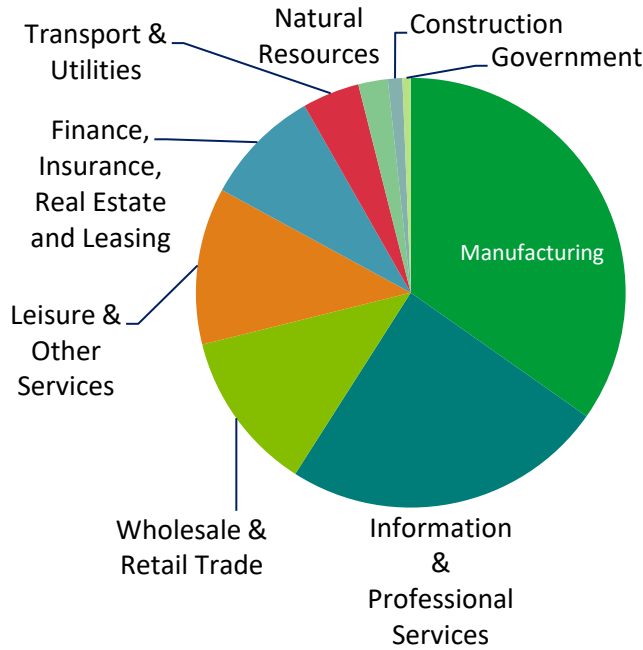


Table 9
Total Employment Contribution of Motor Vehicle Parts Manufacturing Industry

Major Sector Employment		
TOTAL EMPLOYMENT	4,264,110	100.0%
Manufacturing	1,481,713	34.7%
Information & Professional Services	1,035,488	24.3%
Wholesale & Retail Trade	515,307	12.1%
Leisure & Other Services	503,642	11.8%
Finance, Insurance, Real Estate and Leasing	377,114	8.8%
Transportation & Utilities	183,224	4.3%
Natural Resources	94,733	2.2%
Construction	46,298	1.1%
Government	26,590	0.6%

The manufacturing sector makes up the largest share of the total employment impact, and over half of that volume is from the industry’s direct employment. The remaining sectors all generate their employment without directly serving the end markets, and therefore nearly 2.8 million jobs are supported by the industry that are from companies not typically associated with motor vehicle parts manufacturing. Table 10

provides a detailed picture of these benefits seen in those other industries, highlighting the indirect and expenditure-induced employment allocation across industries. Looking specifically at the indirect and induced employment impacts, there is a much larger share of employment within the non-manufacturing industries. This highlights the importance of the industry to not just major manufacturing industries, but also a wide spectrum of non-manufacturing industries that may not typically interact with the motor vehicle industry.

Table 10
Indirect and Expenditure-Induced Industry Employment Contribution
for the Total Motor Vehicle Parts Manufacturing Industry

	Indirect	Induced
TOTAL U.S. EMPLOYMENT	1,487,125	1,905,154
Manufacturing	522,164	87,901
Information & Professional Services	403,898	631,407
Wholesale & Retail Trade	158,977	356,330
Transportation & Utilities	114,815	68,409
Finance, Insurance, Real Estate and Leasing	104,643	272,472
Leisure & Other Services	98,392	405,251
Natural Resources	45,144	49,589
Construction	29,932	16,366
Government	9,162	17,428

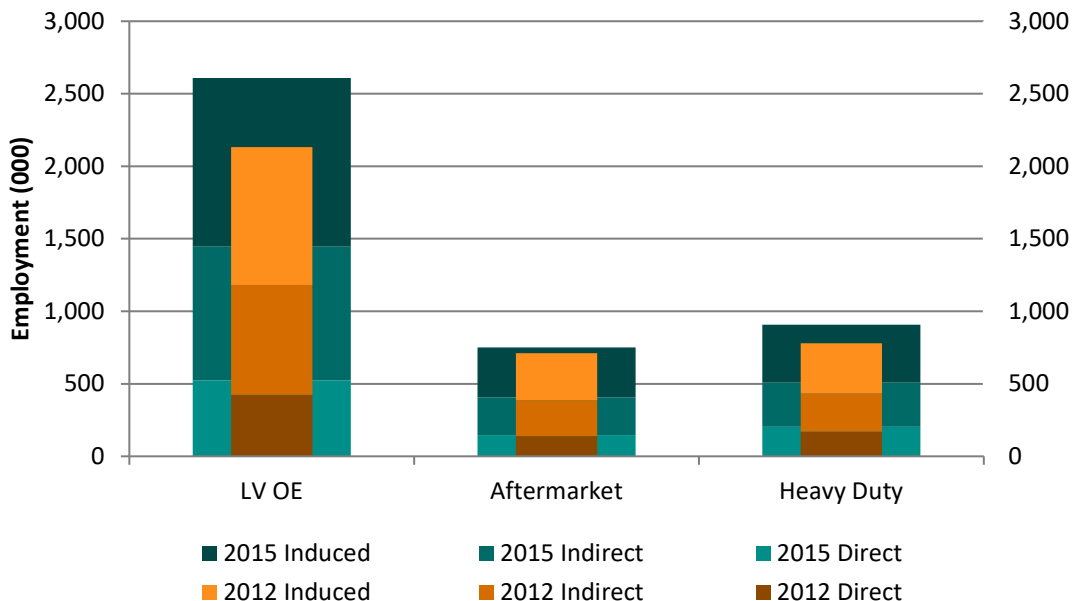
A detailed look at the indirect employment impact shown in table 11 shows that approximately 65% of the total indirect employment is in non-manufacturing industries. Within that remaining 35% of indirect employment that is within the manufacturing sector, the fabricated metal product and primary metal manufacturing industries are the largest beneficiaries of indirect employment for the manufacturing sector, accounting for 17% of the total indirect employment and almost half of the total manufacturing indirect employment.

Table 11
Segment Breakdown of Indirect Employment Contribution
for the Motor Vehicle Parts Manufacturing Industry

	Indirect	Indirect share
TOTAL U.S. EMPLOYMENT	1,487,125	100%
Non-Manufacturing	967,961	64.9%
Other Manufacturing	51,830	3.5%
Fabricated Metal Product Manufacturing	157,356	10.6%
Primary Metal Manufacturing	96,098	6.5%
Transportation Equipment Manufacturing	70,666	4.8%
Plastics and Rubber Products Manufacturing	41,265	2.8%
Computer and Electronic Product Manufacturing	30,178	2.0%
Chemical Manufacturing	28,695	1.9%
Machinery Manufacturing	24,593	1.7%
Wood Product Manufacturing	11,304	0.8%
Electrical Equip, Appliance, & Component Mfg	10,180	0.7%

A similar analysis was done for each of the three industry segments – Light Vehicle Original Equipment Parts, Heavy Duty Original Equipment and Aftermarket Parts, and Light Vehicle Aftermarket Parts. The highlights of the direct employment and the total economic impact of these three industry segments was detailed previously in Tables 3, 4 and 5 respectively. The changes in employment growth are summarized in Figure 5.

Figure 5
Employment Impacts by Industry Segment, 2012 and 2015



State Level Impact Results

Previously this report highlighted the state and regional direct employment figures for the industry and how they changed from 2012 to 2015. Similar to what was done on an industry segment level, an economic impact analysis was done as the state level.

For a variety of reasons, many motor vehicle parts suppliers will locate themselves near assembly facilities, but the motor vehicle parts supply industry is a very diverse compilation of manufacturing industries and therefore shows a much broader geographical footprint than the light and heavy duty OEMs. Light and heavy duty vehicles were produced in 17 states in 2015 – a decline of one state (Louisiana) from 2012, but the supply industry has a presence in all 50 states, as was highlighted previously in Table 1 and has been restated below in Table 12.

Table 12
State Distribution of Total U.S. Direct Employment

Total U.S. Direct Employment			
TOTAL		871,831	
Michigan	125,909	Connecticut	4,958
Ohio	96,238	Washington	4,687
Indiana	88,306	Arizona	4,672
Tennessee	50,128	Oregon	4,473
Kentucky	47,658	West Virginia	4,069
Alabama	41,107	New Jersey	4,028
Illinois	38,394	South Dakota	3,931
North Carolina	33,825	Louisiana	3,167
South Carolina	33,766	Colorado	3,120
Texas	33,132	Massachusetts	2,510
California	31,190	North Dakota	1,994
Pennsylvania	27,920	Rhode Island	1,879
Georgia	23,836	Maryland	1,720
New York	19,517	New Hampshire	1,389
Wisconsin	18,200	Vermont	745
Missouri	16,301	Idaho	616
Iowa	16,114	Maine	549
Virginia	13,277	New Mexico	525
Arkansas	10,495	Nevada	484
Mississippi	9,706	Delaware	400
Florida	8,827	Montana	269
Oklahoma	8,676	Wyoming	136
Nebraska	8,415	Alaska	30
Utah	7,884	Hawaii	21
Minnesota	6,366	District of Columbia	2
Kansas	6,270		

At the state level, the top ten states of direct employment make up just over 67% of the national total. Three states – Michigan, Ohio and Indiana – have direct employment levels above 88,000 while nineteen states have direct employment above 10,000.

Table 13 expands the state level results to include the downstream employment impacts for each state.

Table 13
State Employment Impacts

	Direct	Indirect	Induced	Total
United States	871,831	1,487,125	1,905,154	4,264,110
Michigan	125,909	234,734	339,662	700,305
Ohio	96,238	199,649	253,659	549,546
Indiana	88,306	134,794	172,626	395,725
Tennessee	50,128	75,853	99,476	225,457
California	31,190	87,621	87,582	206,393
Illinois	38,394	70,667	94,563	203,624
Texas	33,132	79,831	87,722	200,685
Kentucky	47,658	62,733	74,376	184,767
Alabama	41,107	60,269	63,439	164,815
North Carolina	33,825	58,422	72,348	164,594
South Carolina	33,766	49,921	64,642	148,329
Pennsylvania	27,920	47,775	62,602	138,297
Georgia	23,836	39,414	55,165	118,415
Tennessee	50,128	75,853	99,476	225,457
Wisconsin	18,200	31,145	40,960	90,305
New York	19,517	30,773	36,867	87,157
Missouri	16,301	23,840	34,623	74,764
Iowa	16,114	17,699	24,965	58,778

	Direct	Indirect	Induced	Total
Virginia	13,277	17,505	21,675	52,457
Florida	8,827	16,182	22,083	47,092
Utah	7,884	14,921	18,016	40,820
Arkansas	10,495	12,831	15,088	38,414
Oklahoma	8,676	11,847	15,270	35,793
Mississippi	9,706	11,044	12,937	33,687
Nebraska	8,415	10,884	13,639	32,938
Minnesota	6,366	9,916	15,433	31,715
Oregon	4,473	9,165	10,990	24,627
Arizona	4,672	7,386	10,537	22,595
Kansas	6,270	6,487	9,621	22,378
New Jersey	4,028	6,252	10,897	21,177
Connecticut	4,958	6,851	9,122	20,931
Washington	4,687	7,688	8,549	20,924
Louisiana	3,167	5,116	6,589	14,871
West Virginia	4,069	4,132	6,421	14,622
Colorado	3,120	4,653	6,884	14,657
South Dakota	3,931	3,923	4,653	12,507
Massachusetts	2,510	3,682	5,748	11,940
Maryland	1,720	2,281	3,505	7,506
Rhode Island	1,879	1,866	2,795	6,540
New Hampshire	1,389	1,694	2,486	5,568
North Dakota	1,994	1,700	1,810	5,504

	Direct	Indirect	Induced	Total
Vermont	745	768	866	2,378
Idaho	616	560	812	1,988
Maine	549	581	754	1,884
New Mexico	525	525	727	1,776
Nevada	484	619	698	1,801
Delaware	400	532	841	1,773
Montana	269	292	335	896
Wyoming	136	83	80	299
Hawaii	21	16	14	51
Alaska	30	5	4	39

Table 13 differs from Table 12 in that it is sorted by Total employment contribution as opposed to by direct employment contribution. The top 10 states in total employment contribution are shown below in Table 14.

Table 14
State Rankings by Employment Contribution

	Direct Rank	Total Rank
Michigan	1	1
Ohio	2	2
Indiana	3	3
Tennessee	4	4
California	11	5
Illinois	7	6
Texas	10	7
Kentucky	5	8
Alabama	6	9
North Carolina	8	10

The biggest changes can be seen California and Texas, which are 11th and 10th largest respectively for direct employment but move up to the 5th and 7th ranked spots when including the indirect and induced employment. California and Texas provide the 4th and 5th largest indirect contributions, which in turn boosts their induced employment effect. While both of these states are very large, they do have significant manufacturing operations that are utilized across the country for downstream parts supply and therefore make the motor vehicle parts supply industry much more relevant to those states than their direct employment might imply.

Michigan, Ohio and Indiana are the three largest states for direct and total employment, a ranking that is unchanged from 2012. Combined, these three states added nearly 40,000 direct employees from 2012 to 2015, which is nearly 30% of the 137,000 increase in direct industry employment during this time. As was discussed previously in the report, this growth occurred during a time in which overall manufacturing employment was growing very slowly. Table 15 compares the increase in direct industry employment within these three states to that of overall manufacturing employment within the state.

Table 15
Employment Growth, 2012 to 2015

	Direct Industry Employment Growth	Total Mfg. Employment Growth
Michigan	23,285	57,517
Ohio	6,815	31,208
Indiana	8,655	37,033

For both Ohio and Indiana, direct employment within the motor vehicle parts supply industry generated nearly a quarter of all manufacturing employment growth seen within those states from 2012 to 2015, highlighting just how critical the industry has been to the rebound in manufacturing employment seen in those states, which grew 4.8% and 7.7% respectively. The impact is even more significant within Michigan, where the 23,285 additional employees supported by the industry makes up 40% of the total manufacturing growth, providing significant fuel to the 10.9% overall growth in manufacturing employment seen within the state from 2012 to 2015.

Appendix I: State Regional Mapping

Midwest	Southeast	Northeast	West	Southwest
IA	AL	CT	AK	AZ
IL	AR	DC	CA	NM
IN	FL	DE	CO	OK
KS	GA	MA	HI	TX
MI	KY	MD	ID	
MN	LA	ME	MT	
MO	MS	NH	NV	
ND	NC	NJ	OR	
NE	SC	NY	UT	
OH	TN	PA	WA	
SD	VA	RI	WY	
WI	WV	VT		

Appendix III: The IMPLAN Model

IMPLAN, short for “**I**mpact Analysis for **P**lanning,” is a widely used commercially available model for input/output analysis. Minnesota IMPLAN Group, Inc., is responsible for the production of the IMPLAN data, model, and software. Using classic input/output analysis in combination with region-specific social accounting matrices and multiplier models, IMPLAN provides a highly accurate and adaptable model for its users. The IMPLAN database contains country, state, zip code, and federal economic statistics, which are specialized by region. IMPLAN accounts closely follow the accounting conventions used in the “Input-Output Study of the U.S. Economy” by the BEA and the rectangular format recommended by the United Nations. The IMPLAN system was designed to serve three functions:

- 1) Data retrieval,
- 2) Data reduction, model development, and
- 3) Impact analysis

Comprehensive and detailed data coverage of the entire United States by geography, and the ability to incorporate user-supplied data at each stage of the model-building process, provides a high degree of flexibility both in terms of geographic coverage and model formulation. There are two components to the IMPLAN system, the software and databases. The databases provide all information to create regional IMPLAN models. The software performs the calculations and provides an interface for the user to make final-demand changes.

The IMPLAN system consists of two major parts:

- 1) A national-level technology matrix and
- 2) Estimates of sectoral activity for final demand, final payments, industry output, and employment for each detailed geography in the United States along with the aggregate region.

Input-output accounting describes commodity flows from producers to intermediate and final consumers. The total industry purchases of commodities, services, employment compensation, value added, and imports are equal to the value of the commodities produced.

Purchases for final use (final demand) drive the model. Industries produce goods and services for final demand and purchase goods and services from other producers. These other producers, in turn, purchase goods and services. This buying of goods and services (indirect purchases) continues until leakages from the region (imports and value added) stop the cycle.

These indirect and induced effects (the effects of household spending) can be mathematically derived. The derivation is called the Leontief inverse. The resulting sets of multipliers describe the change of output for each and every regional industry caused by a one dollar change in final demand for any given industry.

Creating regional input-output models requires a tremendous amount of data. The costs of surveying industries within each region to derive a list of commodity purchases production functions) are prohibitive. IMPLAN was developed as a cost-effective means to develop regional input-output models.

IMPLAN easily allows the user to do the following:

- Develop his/her own multiplier tables;
- Develop a complete set of SAM (Social Accounting Matrix) accounts;
- Change any component of the system, production functions, trade flows, or database;
- Generate type I, II, or any true SAM multiplier internalizing household, government, and/or investment activities
- Create custom impact analysis by entering final-demand changes;
- Obtain any report in the system to examine the model's assumptions and calculations.

There are two components to the IMPLAN system, the software and databases. The databases provide all information to create regional IMPLAN models. The software performs the calculations and provides an interface for the user to make final-demand changes.

IMPLAN Software

Minnesota IMPLAN Group developed the current version of IMPLAN Professional® version 3.0 in 2009. It is a Windows-based software package that performs the calculations necessary to create the predictive model. The software reads the database, creates the complete set of social accounting matrices (SAM), the I/O accounts, and integrates all user-defined inputs to produce an alternative scenario.

The IMPLAN Input/Output System derives the predictive multipliers. The software also enables the user to make changes to the data, the trade flows, or technology. It also enables the user to make final-demand changes, which results in the impact assessment.

Features of IMPLAN Professional® include:

- 1) Windows file and printer management;
- 2) Economic database editor;
- 3) Complete Social Accounting Matrix structure;
- 4) A choice of trade-flow assumptions: Supply-Demand Pooling; Regional Purchase Coefficients; Location
- 5) quotients;
- 6) Production function editor, i.e., the tools and opportunity necessary to modify the "absorption"
- 7) and "byproducts" matrices;
- 8) Libraries for production functions and impact analysis expenditures;
- 9) Flexible model aggregation tools;
- 10) Report generator; many preset reports for all stages of model building and analysis;
- 11) Export feature to many of the major PC file formats;
- 12) Flexible assumptions for induced effects;
- 13) Type SAM – true SAM multipliers which allow internalizing any number of institutions;
 - a. Type II - Based on PCE and SAM based local income relationship;

- b. Type II - Based on user-specified disposable income rate;
 - c. Type III (CPMM) - Traditional Forest Service employment based multipliers;
- 14) Menu structure for easy impact analysis;
 - 15) Event-based impact databases;
 - 16) Built-in and editable transaction margins;
 - 17) Built-in and editable deflators;
 - 18) Technical support by MIG, Inc.;
 - 19) Data in Access Database format.

Database

Each database has information for these components for all 440 industrial sectors in the IMPLAN model. This 440-sector scheme was revised in 2007 and was originally the basis for the Bureau of Economic Analysis's Benchmark Input-Output Study. This scheme is nearly 6 digit NAICS for manufacturing, and more aggregate for service sectors. By necessity IMPLAN's sectoring is very similar. However, in some cases, 6 digit NAICS code data has been aggregated for certain IMPLAN sectors. A full NAICS to IMPLAN mapping document can be downloaded from www.implan.com.

Employment is total wage and salary and self-employed jobs in a region. In the 1985 database, employment was measured as full-time equivalent jobs. This meant that total employment in a region would generally be below most published estimates because these are generally full-time and parttime. In the 1990 and subsequent databases, employment includes both full-time and part-time workers. Employment in the 1990 and subsequent databases are measured in total jobs.

There are four sub-components for value added:

- 1) Employee Compensation;
- 2) Proprietary Income;
- 3) Other Property Type Income;
- 4) Indirect Business Taxes;

Employee compensation is wage and salary payments as well as benefits, including health and life insurance, retirement payments, and any other non-cash compensation. This provides a measure of income to workers who are paid by employers.

Proprietary income consists of payments received by self-employed individuals as income. This would be recorded on Federal Tax Form 1040C. This includes income received by private business owners, doctors, lawyers, and so forth. Any income a person receives for payment of self-employed work is counted here.

Other property-type income consists of payments from rents royalties and dividends. This includes payments to individuals in the form of rents received on property, royalties from contract, and dividends paid by corporations. This also includes corporate profits earned by corporations.

Indirect business taxes consist primarily of excise and sales taxes paid by individuals to businesses. These taxes are collected during the normal operation of these businesses but do not include taxes on profit or income. Goods and services purchased for their ultimate use by an end user are called final demands. For a region, this would

include exports as that is a final use for that product. In an input-output framework, final demands are allocated to producing industries with margins allocated to the service sectors (transportation, wholesale and retail trade, insurance) associated with providing that good to the final user.

Thus, final demands are in producer prices. There are 13 subcomponents for final demands:

- 1) Personal Consumption Expenditures (PCE)—nine income levels;
- 2) Federal Government Military Purchases;
- 3) Federal Government Nonmilitary Purchases;
- 4) Federal Government Capital Formation Purchases;
- 5) State and Local Government Non-Education Purchases;
- 6) State and Local Government Education Purchases;
- 7) State and Local Government Capital Formation Purchases;
- 8) Inventory Purchases;
- 9) Capital Formation;
- 10) Foreign Exports;
- 11) State and Local Government Sales;
- 12) Federal Government Sales;
- 13) Inventory Sales.

All final demands in the original data are on a commodity basis. The distinction between industries and commodities is as follows from the 1972 I-O Definitions and Conventions Manual:

- An input-output industry is a grouping of establishments, as classified by Standard Industrial Classification (SIC)⁴;
- An input-output commodity consists of the characteristic products of the corresponding I-O industry wherever made. There are several industries that have no commodities. This is a result of departures from the strict SIC of industries. Also, some commodities have no associated industry. An example of this is noncomparable imports.

PCE consists of payments by individuals/households to industries for goods and services used for personal consumption. Individuals tend to buy little directly from industries other than retail trade. In an input-output table, though, purchases made by individuals for final consumption are shown as payments made directly to the industry producing the good. PCE is the largest component of final demand.

⁴ The IMPLAN sector scheme is now currently based on NAICS definitions and is revised as necessary after each 5-year Economic Census is released.

Federal government purchases are divided between military and nonmilitary uses and capital formation. Federal military purchases are those made to support the national defense. Goods range from food for troops to missile launchers. Nonmilitary purchases are made to supply all other government functions. Payments made to other governmental units are transfers and are not included in federal government purchases.

State and local government purchases are divided between public education and non-education and capital formation. Public education purchases are for elementary, high school, and higher education. Non-education purchases are for all other government activities. These include state government operations, operations including police protection and sanitation. Private-sector education purchases are not counted here. Private education purchases show up in IMPLAN sectors 495 and 496.

Inventory purchases are made when industries do not sell all output created in one year. This is generally the case. Each year, a portion of output goes to inventory. Inventory sales occur when industries sell more than they produce and need to deplete inventory. Inventory purchases and sales generally involve goods-producing industries (e.g., agriculture, mining, and manufacturing).

Capital formation is private expenditures made to obtain capital equipment. The dollar values in the IMPLAN database are expenditures made to an industrial sector producing the capital equipment. The values are not expenditures by the industrial sector.

Foreign exports are demands made to industries for goods for export beyond national borders. These represent goods and services demanded by foreign parties. Domestic exports are calculated during the IMPLAN model creation and are not part of the database.

The national transactions matrix is based on the most current BEA National Benchmark Input-Output Model. It is re-sectored to IMPLAN industrial sectoring. We use our IMPLAN data for the current year to update the most recent National Benchmark study.

IMPLAN Multipliers

The notion of a multiplier rests upon the difference between the initial effect of a change in final demand and the total effects of that change. Total effects can be calculated either as direct and indirect effects, or as direct, indirect, and induced effects. Direct effects are production changes associated with the immediate effects or final-demand changes. Indirect effects are production changes in backward-linked industries caused by the changing input needs of directly affected industries (for example, additional purchases to produce additional output). Induced effects are the changes in regional household spending patterns caused by changes in household income generated from the direct and indirect effects.

Five different sets of multipliers are estimated by IMPLAN corresponding to five measures of regional economic activity: total industry output, personal income, total income, value added, and employment. For each set of multipliers, four types of multipliers are generated, Type I, Type II, Type SAM, and Type III.

Type I Multiplier

A Type I multiplier is the direct effect, produced by a change in final demand, plus the indirect effect divided by the direct effect. Increased demands are assumed to lead to increased employment and population with the average income level remaining constant. The Leontief inverse (Type I multipliers matrix) is derived by inverting the direct coefficients matrix. The result is a matrix of total requirement coefficients, the amount each industry must produce for the purchasing industry to deliver one dollar's worth of output to final demand.

Type II Multipliers

Type II multipliers incorporate "induced" effects resulting from the household expenditures from new labor income. The linear relationship between labor income and household expenditure can be customized in the IMPLAN Professional® software: 1. The default relationship is PCE and total household expenditures. Each dollar of workplace-based income is spent based on the SAM relationship generated by IMPLAN. 2. The second possibility is a RIMS II style of Type II multiplier, where PCE is adjusted to represent only the spending of the disposable income portion of labor income. In this way, there is a direct one-to-one relationship to labor income and PCE. Then, a ratio which the user can specify is applied to convert total income to disposable income before the rounds of induced effects are calculated.

Type SAM

Type SAM multipliers are the direct, indirect, and induced effects where the induced effect is based on information in the social account matrix. This relationship accounts for social security and income tax leakage, institution savings, and commuting. It also accounts for inter-institutional transfers. This multiplier is flexible in that you can include any institutions you want. In other words, if you want to create a model closed to households and state and local government, you can. If you select this option, an additional dialog box will be displayed allowing you to select the institutions you want to include.

Output Multipliers

This report shows the total industry output multipliers and per-capita personal consumption expenditures. Output multipliers can be used to gauge the interdependence of sectors; the larger the output multiplier, the greater the interdependence of the sector on the rest of the regional economy. A Type I entry represents the value of production (from direct and indirect effects) required from all sectors by a particular sector to deliver one dollar's worth of output. Type II, SAM, and III adds in the induced requirements.

Example: If a Type I multiplier for the dairy farm industry is 1.0943, for each dollar of output produced by the dairy farm sector, 0.0943 dollars' worth of indirect output is generated in other local industries. If the Type SAM Dairy Farm multiplier is 1.3140, 0.3140 dollars of indirect and induced output is generated in other local industries. The induced output would be 1.3140 minus 1.0943 or 0.2197 dollars for each dollar of output produced by the dairy farm sector.

Labor Income Multipliers

The labor income multiplier report shows the direct, indirect, and induced employee compensation plus proprietor income effects generated per dollar of output. The Type I personal income multiplier is the direct and indirect employee compensation plus proprietor income divided by the direct income. The Type II, Type SAM, and Type III multiplier adds the induced effects component.

Example: If the Type I multiplier for the dairy farm sector is 1.4761 and the Type SAM multiplier is 2.7067, then for each dollar of direct income generated by this industry, 0.4761 dollars of indirect and 1.2306 dollars of induced income are generated.

Employee Compensation Multipliers

Employee compensation represents all payroll costs of wage and salary workers. The Type I, Type SAM, Type II, or Type III total income multipliers are listed in this report along with the direct, indirect, and induced total income effects generated from the production of one dollar's output.

Proprietor Income Multiplier

Proprietor income is the income earned by the owners of a private—non-incorporated business—i.e., the self-employed. The Type I, Type SAM, Type II, or Type III total income multipliers are listed in this report along with the direct, indirect, and induced total income effects generated from the production of one dollar's output.

Other Property-Type Income

Other property-type income represents corporate income, rental income, and interest. The Type I and Type II/Type SAM/Type III total income multipliers are listed in this report along with the direct, indirect, and induced total income effects generated from the production of one dollar's output.

Value-Added Multipliers

Type I and Type II/Type SAM/Type III value-added multipliers are listed in this report along with the direct, indirect, and induced value-added effects generated from the production of one dollar of output. Value-added includes employee compensation, proprietary income, other property-type income, and indirect business taxes.

Employment Multipliers

Type I and Type II/Type SAM/Type III employment multipliers are listed in this report along with the direct, indirect, and induced employment effects from the production of one million dollars of output. Employment is in terms of full-time and part-time jobs.

Example: if a dairy farm Type I employment multiplier is 1.1158, for each job created directly by the dairy farm industry, 0.1158 jobs are created indirectly.



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