TENNESSEE'S AUTOMOTIVE CLUSTER





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Tennessee's Automotive Cluster

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Cluster Strategy

Over the last 35 years, Tennessee's automotive cluster has developed into one of the nation's strongest industry clusters. The opening of the Nissan plant in Smyrna in 1983 put Tennessee on the map and paved the way for significant growth in automotive industries across the state. The Nissan plant was the third foreign-owned automotive production plant in the U.S. and one of the earliest investments by Japanese vehicle makers in foreign markets.¹ The arrival of Nissan was quickly followed by the opening of General Motors' Saturn plant in Spring Hill in 1985, which created thousands of jobs and signaled a shift towards the Southeast region for domestic auto production.² Automakers were beginning to take notice of Tennessee's unique advantages for automotive manufacturing, like transportation access, a trained work force, amenable tax policy, and incentives.

Prior to 1980, Tennessee had 49 automotive suppliers.³ By 1998, the number of suppliers had increased to 500.⁴ Today, Tennessee is home to nearly 900 automotive suppliers and three major assembly plants (Nissan in Smyrna, General Motors in Spring Hill, and Volkswagen in Chattanooga). Nissan's Smyrna location is the most productive automotive plant in North America. In 2017, the plant produced more than 628,000 automobiles. Tennessee's auto plants produced 1,005,198 vehicles overall, an 18.1% increase from 2016 to 2017.⁵ *Business Facilities* magazine has ranked Tennessee the number one state for automotive manufacturing strength for five of the last eight years, including four consecutive years from 2009-2013.⁶ Moreover, the Southeast region has 15 automotive assembly plants, and Tennessee is within a day's drive of another nine plants.⁷ Completion of the Toyota-Mazda plant in Huntsville, which is expected to employ 4,000 workers, will create new revenue opportunities for automotive suppliers in Tennessee.⁸

The story of Tennessee's automotive cluster underscores the importance of cluster strategy. The growth of the automotive cluster has benefited all Tennesseans. Companies have grown revenue through superior supplier networks and an improved labor force. Workers have gained new employment opportunities and enjoyed long-term wage growth and a higher quality of life. Tennessee's automotive labor force, highly experienced and constantly growing due to the education pipeline, is an asset over which companies compete. History has shown that companies within a cluster offer competitive wages and supplemental benefits to their workers. Volunteer Engineering, a metal stamping company in Coffee County, recently increased benefit packages and implemented a four-day work week to attract and retain top talent.⁹

¹ Murray, M., & Mayes, D. (1999). *The location decisions of automotive suppliers in Tennessee and the Southeast*. http://cber.haslam.utk.edu/pubs/mnm083.pdf

² Rosenfeld, S., Liston, C., Kingslow, M., & Forman, E. (2000). Clusters in rural areas: Auto supply chains in Tennessee and houseboat manufacturers in Kentucky. *TVA Rural Studies Working Paper*.

³ Perucci, R. (1994). Japanese Auto Transplants in the Heartland: Corporatism and Community.

⁴ Murray, M., & Mayes, D. (1999). *The location decisions of automotive suppliers in Tennessee and the Southeast*. http://cber.haslam.utk.edu/pubs/mnm083.pdf

⁵ Automotive News. (2018). North America car and light-truck production by plant, December & YTD.

⁶ TNECD. (2018). *Automotive*. https://www.tnecd.com/industries/automotive/

⁷ The regional assemblers are the Ford Motor Company (KY); General Motors (KY; TN), Toyota (MS; KY), Honda (AL), Nissan (TN; MS), Volvo (SC), Kia (GA), Daimler AG (AL; SC), BMW (SC), Hino (WV), and Volkswagen (TN). Plants within an eight-hour drive are General Motors (IN; OH; MO), Toyota (IN), Chrysler (OH), Honda (OH; OH; IN), and Subaru (IN).

⁸ Reuters. (Jan. 10, 2018). *Toyota, Mazda announce \$1.6 billion plant for Huntsville, Alabama*. https://www.reuters.com/article/ususa-alabama-plant/toyota-mazda-announce-1-6-billion-plant-for-huntsville-alabama-idUSKBN1EZ2NE

⁹ Rosenfeld, S., Liston, C., Kingslow, M., & Forman, E. (2000). Clusters in rural areas: Auto supply chains in Tennessee and houseboat manufacturers in Kentucky. *TVA Rural Studies Working Paper*.

Automotive Cluster

The state of Tennessee benefits from cluster strategy as well. The growth of clusters results in increased tax revenue. In 2017, three of the top taxpayers in Anderson County were automotive parts manufacturers in Clinton.¹⁰ Tennessee's economy has grown stronger and more resilient because of its industry clusters. The co-existence of similar industries with overlapping labor forces acts as an insurance policy for the state economy, preventing over-reliance on any particular company or industry. Researchers have pinpointed Tennessee's automotive cluster as an example of a desirable cluster. This cluster "presents a picture of a diversified manufacturing capacity rather than a region that is heavily dependent on just one component, such as fabrics or plastics."¹¹

Cluster strategy is also a key part of rural development. Wages in rural areas tend to be higher on average for clustered industries than non-clustered industries. ¹² Tennessee is focused on achieving statewide growth and reducing the number of economically distressed counties in the state. Development projects aimed at specific clusters furthers this goal by attracting new investment to distressed and at-risk counties.

Cluster targeting also sidesteps the dilemma faced by economic developers in deciding which areas of the state to target. Cluster growth in one county has far-reaching impacts and spills over into other counties. Numerous case studies have shown that the growth of automotive industries in metropolitan areas leads to economic expansion in non-metro counties as well. Secondary- and tertiary- automotive suppliers to OEMs often locate in nearby rural counties, especially those with exceptional highway access.¹³ Development projects are crucial to the growth of industry clusters in Tennessee. Researchers have shown that states without development projects have failed to attract original equipment manufacturing (OEM) in automotive industries. Governments that implement incentives consistently attract new automotive projects, resulting in substantial revenue and a high return on investment for taxpayers.¹⁴ In the case of competitive projects, incentives can be a make-or-break factor in a foreign manufacturer's location decision.¹⁵

Cluster strategy is as important now for Tennessee than ever before. Empirically, states are most successful in attracting new companies and retaining current businesses when a cluster already exists. ¹⁶ Some critics argue that incentives are ineffectual and a misuse of taxpayer resources. The case against incentives has been disproven for industry clusters. Time and time again, states in the Southeast region have won competitive projects and attracted new companies to the region by targeting the automotive sector.¹⁷ The success of Tennessee in growing the automotive cluster underscores the value of development projects and provides a framework for cluster strategy in the years ahead.

https://mycouriernews.com/articles/2017/04/82/top-ten-taxpayers-in-county-identified

¹⁰ The Courier News. *Top ten taxpayers in county identified*.

¹¹ Rosenfeld, S., Liston, C., Kingslow, M., & Forman, E. (2000). Clusters in rural areas: Auto supply chains in Tennessee and houseboat manufacturers in Kentucky. *TVA Rural Studies Working Paper*.

¹² Gibbs., R, & Bernat, G. (1997). Rural industry clusters raise local earnings. *Rural Development Perspectives*, 12(3), 18-25. ¹³ Rosenfeld, S., Liston, C., Kingslow, M., & Forman, E. (2000). Clusters in rural areas: Auto supply chains in Tennessee and houseboat manufacturers in Kentucky. *TVA Rural Studies Working Paper*.

¹⁴ Hill, K., & Bramst, E. (2003). *The Auto Industry Moving South: An Examination of Trends*. http://www.cargroup.org/wp-content/uploads/2017/02/The-Auto-Industry-Moving-South-An-Examination-of-Trends.pdf

¹⁵ Axarloglou, K. (2007). What Attracts Foreign Direct Investment Inflows in the United States? *International Trade Journal*, 19(3). doi: 10.1080/08853900591007438.

¹⁶ Anderson, D., & Johnson, S. (1992). A linkage approach to industrial development. *Growth and Change*, 23(Summer).

¹⁷ Klier, T. (2000). Does "Just-in-time" mean "Right-next-door"? Evidence from the auto industry on the spatial concentration of supplier networks. *Journal of Regional Analysis & Policy*, 30(1).

Introduction

Tennessee's automotive cluster employs 75,641 Tennesseans, the highest in the Southeast region and fourth highest in the nation. When including industries that primarily serve automotive manufacturers, total employment in Tennessee exceeds 134,000. The counties with the highest employment in this cluster are Rutherford (17,960 jobs), Maury (4,655), Hamilton (4,455), Blount (4,112), and Anderson (4,112). Appendix A provides employment information for each county.



Employers in this cluster added 17,710 new jobs since 2013, a 31% increase in five years. This job growth exceeded expectations by almost 7,000 jobs, demonstrating a strong competitive effect for Tennessee. Today, roughly one out of ten jobs in Tennessee's automotive cluster exists because of Tennessee's exceptional job growth in recent years.¹⁸

Industries in this cluster contribute 2.3% to Tennessee's labor force and 21.0% of manufacturing employment in the state. Some counties' economies are particularly dependent on automotive manufacturing. In Maury County, 73.0% of all manufacturing workers are employed by a company in this cluster.



Automotive Manufacturing as Percentage of Total Manufacturing

Automotive industries contribute 66.3% to Rutherford County's manufacturing workforce. Rutherford ranks fifth among U.S. counties for employment concentration in these industries, and the Nashville-Franklin MSA has the third highest employment of any MSA.

¹⁸ The expected change in Tennessee's industry between 2013 and 2018 was 10,777 net new jobs, 5,697 of which were attributable to industry growth and 5,080 due to overall economic growth. Tennessee's competitive effect (6,933) is 9.2% of total cluster employment.

Other counties with a significant concentration of automotive manufacturing include DeKalb (60.9% of total manufacturing), Warren (55.4%), Blount (51.3%), Franklin (51.3%), and Marshall (49.4%). Marshall and DeKalb Counties rank in the top 25 among U.S. counties for employment concentration. Lewisburg in Marshall County has the fourth highest employment concentration of any MSA. McMinnville in Warren ranks in the top 25 for MSA location quotients.

These industries are significantly more concentrated in Tennessee's rural counties than urban counties. Automotive industries contribute 4.1% of total employment in rural areas, as compared to 1.7% in Tennessee's urban areas. Automotive manufacturing accounts for roughly the same percent of total manufacturing employment in both areas (22.4% in rural and 20.0% in urban).

Business Locations

Tennessee's automotive cluster includes 347 business locations, the second highest number of establishments in the region behind Florida. Automotive businesses in Florida tend to be smallscale operations with an average of 20 workers per location. The average establishment size in Tennessee is 247, the second highest in the nation behind Kentucky (267). The number of establishments in Tennessee involved in the automotive industry among all sectors is approximately 900 locations.

The vast majority of Tennessee businesses in this cluster are motor vehicle parts manufacturing. Motor vehicle assembly and other industries accounts for a much smaller percentage of total business locations.

NAICS	Industry	²⁰⁷⁸ Jobs	SIDOWER ARE (2013,2018)	systems site	Ausiness Locations (2011)	tarning taring				
Rubber Product Manufacturing										
32621	Tire Manufacturing ¹⁹	3,941	18%	25	158	\$294,877,583				
Motor Vehicle Manufacturing										
33611	Automobile and Light Duty Motor Vehicle	20,792	94%	9	2,310	\$2,041,327,643				
33612	Heavy Duty Truck	17	(69%)	3	6	\$1,630,967				
Motor Vehicle Body and Trailer Manufacturing										
33621	Motor Vehicle Body and Trailer	2,212	(71%)	59	37	\$134,000,950				
Motor V	ehicle Parts Manufacturing									
33631	Gasoline Engine and Engine Parts	5,272	25%	39	135	\$342,317,264				
33632	Electrical and Electronic Equipment	6,543	84%	30	218	\$408,226,879				
33633	Steering and Suspension (except Spring)	6,701	51%	19	353	\$388,748,781				
33634	Brake System	1,377	1%	11	125	\$79,287,752				
33635	Transmission and Power Train Parts	2,760	2%	13	212	\$129,865,395				
33636	Seating and Interior Trim	7,802	27%	36	217	\$430,786,728				
33637	Motor Vehicle Metal Stamping	6,455	49%	33	196	\$398,738,245				
33639	Other Motor Vehicle Parts	11,769	25%	70	168	\$731,305,747				

¹⁹ Tire manufacturing is part of the rubber sub-cluster in advanced materials.

Workforce

Industries in the automotive cluster have substantial overlap in occupations. Assemblers and fabricators tend to be found in nearly every type of automotive manufacturing. First-line supervisors are common in this cluster, as are production occupations like machine setters and metal and plastic operators and tenders.

The top occupations required by automotive parts manufacturers are almost identical across these industries, no matter the type of part being produced. The percentage of total industry jobs for which these occupations account is also nearly identical across industries. Motor vehicle manufacturing has a larger variance in occupations, but still demonstrative of the substantial labor overlaps found in industry clusters.

SOC	Occupation	2018	Median	Typical	Significant Concentration within Industry*										
		Jobs	Earnings	Level Req.	33611	33612	33621	33631	33632	33633	33634	33635	33636	33637	33639
Architect	ure and Engineering														
17-2112	Industrial Engineers	5,852	\$39.26	Bachelor's	Х			Х	Х	Х	Х	Х	Х	Х	Х
17-3026	Industrial Engineering Technicians	4,174	\$21.55	Associate's				Х	Х	Х	Х	Х	Х	Х	Х
Installati	on, Maintenance, and Repair														
49-9041	Industrial Machinery Mechanics	9,923	\$22.42	HS or Equiv				Х	Х	Х	Х	Х	Х	Х	Х
Production	on														
51-1011	First-Line Supervisors	18,697	\$25.91	HS or Equiv	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х
51-2028	Electromechanical Assemblers	7,065	\$15.92	HS or Equiv				Х	Х	Х	Х	Х	Х	Х	Х
51-2098	Assemblers and Fabricators	56,516	\$15.24	HS or Equiv	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х
51-4022	Forging Machine	2,742	\$26.01	HS or Equiv	Х										
51-4031	Cutting, Punching, & Press Machine	7,390	\$14.49	HS or Equiv			Х	Х	Х	Х	Х	Х	Х	Х	Х
51-4041	Machinists	7,245	\$19.55	HS or Equiv				Х	Х	Х	Х	Х	Х	Х	Х
51-4081	Multiple Machine Tool Operators	5,695	\$15.15	HS or Equiv		Х		Х	Х	Х	Х	Х	Х	Х	Х
51-4111	Tool and Die Makers	2,830	\$22.13	Certificate				Х	Х	Х	Х	Х	Х	Х	Х
51-4121	Welders, Cutters, and Solderers	9,083	\$17.93	HS or Equiv			Х	Х	Х	Х	Х	Х	Х	Х	Х
51-9061	Inspectors and Testers	14,610	\$16.44	HS or Equiv	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х
51-9198	Helpers—Production Workers	21,627	\$11.93	HS or Equiv			Х	Х	Х	Х	Х	Х	Х	Х	Х
51-9199	Production Workers, All Other	9,790	\$14.80	HS or Equiv	Х		Х	Х	Х	Х	Х	Х	Х	Х	Х
Transpor	tation and Material Moving														
53-7062	Freight, Stock, and Material Movers	92,540	\$13.07	None	Х		Х	Х	Х	Х	Х	Х	Х	Х	Х

*Occupations that account for 1.4% of total jobs within an industry are considered to have a significant concentration.

Average earnings in this cluster are \$73,766, with \$60,030 in wages and salaries and an additional \$13,736 in supplements. Tennessee ranks seventh in the nation and second in the region behind Kentucky for average wages. When adjusting for cost-of-living differences between the states, average wages in Tennessee's automotive cluster exceed the regional and national averages for wages in this cluster.

Average wages differ across industries. Automobile and light duty motor vehicle manufacturing has the highest average wages among Tennessee's automotive cluster (\$98,034),

followed by motor vehicle transmission and power train parts manufacturing (\$85,329) and motor vehicle gasoline engine and engine parts manufacturing (\$77,964). The variance in average wages is attributable to several factors. Each industry has a unique set of costs, based on materials used, the amount of company resources devoted to R&D, and so on. Total revenue also impacts the compensation of workers. External factors, like offshoring and automation, influences wage growth. Industries that produce easily transportable products have a higher incentive to outsource production, as do industries focused on export markets rather than nearby automotive assembling facilities. Offshoring can produce wage stagnation. The trend towards automation also suppresses wage growth by making human labor less valuable to manufacturers.

Positive wage growth is correlated with an increase in a labor pool's value. Companies competing for a highly-qualified group of workers within a region offer higher wages to secure key talent. The importance of workforce quality underscores the need for cluster strategy. Tennessee's automotive labor force, which is highly experienced and constantly growing due to a well-developed educational pipeline, is an asset over which companies will compete. Cluster strength results in wage growth across industries by raising the value of Tennessee workers relative to alternative sources of labor. Moreover, cluster strategy tightens the network of suppliers, reducing production costs and boosting revenue for companies.

Strengths of Tennessee

The influx of foreign direct investment (FDI) into Tennessee's automotive cluster can be attributed to several key strengths of doing business in the state. These strengths can be broken down into three main categories.²⁰

Infrastructure Assets	Low cost land Affordable utility prices Transportation (road, rail, air, ports) Proximity to largest customer bases
Workforce Capabilities	High-quality labor Low unionization rates Educational pipeline
Economic Development	Job training Incentive opportunities

Tennessee offers an attractive array of sites from which manufacturers can choose for their new facilities. The availability of low-priced land, coupled with affordable utility prices, enable manufacturers to construct a new facility at a lower cost in Tennessee than repurposing an older manufacturing facility elsewhere in the United States. Moreover, Tennessee is located in the heart of the nation's most populous region, providing the ideal customer base for foreign manufacturers. Manufacturers can efficiently transport their product to these markets using Tennessee's extensive transportation infrastructure. Proximity to the I-65/I-75 corridor has been shown to be particularly important in location decisions for automotive assembly facilities, even more important than

²⁰ Underwood, R. (2012). Automotive foreign direct investment in the United States: Economic and market consequences of globalization. *Business Horizons*, 55(5), 463-474.

proximity to automotive suppliers.²¹ The former Vice President of Nissan, who was involved in the location decision for the Smyrna facility, reflected afterwards that "the overriding consideration in the company's site decision was centrality to markets, and everything else was of secondary importance."²²

Another characteristic of Tennessee that has attracted FDI is the local workforce. The cost of labor in Tennessee is 11.7% lower than the national average for automotive manufacturing occupations. These occupations have grown 11.1% since 2013, as compared to only 8.7% nationally. Manufacturers have a large and talented labor pool from which to draw. Currently, 16% of unemployed workers in the state have previous experience in manufacturing.

Economic development programs, of which TNECD has played a major role, have been instrumental in attracting automotive FDI to Tennessee. Researchers have concluded that governmental programs have been the driving force behind growing FDI in Tennessee and other states in the region:

The Southeastern focus of global automakers is largely a result of dedicated pro-business strategies by government and economic development officials to enhance and leverage existing infrastructure and workforce resources, providing an attractive location for foreign manufacturers to better their competitive position in the world's largest consumer market.

In addition to tax and financial incentives, job training programs play a key role in Tennessee's automotive cluster strategy. Southeastern states like Tennessee have devoted, on average, 18% of state funding for economic development incentive packages for job training. State governments in the Midwest region allot on average less than 3% of total funding for job subsidization.²³ Tennessee's job training strategy has included an effort to create partnerships between post-secondary institutions and manufacturers. These partnerships, like TCAT Murfreesboro's Nissan Training Center in Smyrna, create a direct educational pipeline for the automotive cluster. TCATs also offer training programs in fields directly related to automotive occupations, like automotive technology, precision metals, and computer-numerically controlled machines. Each year, Tennessee's post-secondary institutions produce a high number of graduates with the skills and education necessary to pursue a career in automotive manufacturing. In 2017, Tennessee institutions awarded 36,184 degrees and certificates in 309 programs of study related to careers in the automotive cluster.

The cluster is by itself a major selling point for Tennessee in attracting new automotive companies to the region. Nissan's decision to relocate its headquarters from Gardena, California to Nashville is a perfect demonstration of the power of the cluster. Companies relocate to Tennessee or expand existing operations to achieve greater supply chain efficiency, labor force pooling, and innovation spillovers between businesses within the cluster. Foreign manufacturers are interested in regional clusters because of their rich network of suppliers and interrelated industries.²⁴

²¹ Murray, M., & Mayes, D. (1999). *The location decisions of automotive suppliers in Tennessee and the Southeast*. http://cber.haslam.utk.edu/pubs/mnm083.pdf

²² Rosenfeld, S., Liston, C., Kingslow, M., & Forman, E. (2000). Clusters in rural areas: Auto supply chains in Tennessee and houseboat manufacturers in Kentucky. *TVA Rural Studies Working Paper*.

²³ Hill, K., & Bramst, E. (2003). *The Auto Industry Moving South: An Examination of Trends*. http://www.cargroup.org/wp-content/uploads/2017/02/The-Auto-Industry-Moving-South-An-Examination-of-Trends.pdf

²⁴ Ellison, G., Glaser, E., & Kerr, W. (2007). What Causes Industry Agglomeration? Evidence from Coagglomeration Patterns. *NBER Working Paper*, No. 13068. doi: 10.3386/w13068.

Automotive Assembly Manufacturing

This industry includes automobile manufacturing (NAICS 336111) and light truck and utility vehicle manufacturing (NAICS 336112). Businesses in this industry manufacture complete vehicles or chassis only. Tennessee has eight automobile manufacturers, which employ 20,787 workers. (Tennessee only has one light truck manufacturer, with less than 10 total employees.)

Tennessee is home to three major automotive assembly plants: Nissan North America in Smyrna (Rutherford), General Motors in Spring Hill (Maury), and Volkswagen in Chattanooga (Hamilton). Other major employers in this industry include J&J Auto Racing (Carroll) manufactures race car chassis. Mike Bos Chassis Craft (Sullivan) produces chassis for dragsters and other specialty vehicles. This industry also includes Yates Services LLC, which provides production support to Nissan.



Tennessee ranks first in the nation for employment concentration in automobile manufacturing.²⁵ This industry is 692% more concentrated in Tennessee than the average U.S. state. For employment, Tennessee ranks second in the nation behind Michigan. By 2023, Tennessee is expected to rank first in the nation. This industry has been growing rapidly in Tennessee in recent years. Since 2013, Tennessee businesses added 10,073 net new jobs (a 94% increase).²⁶ Analysts only predicted employment to grow by 1,247 in Tennessee, demonstrating a competitive advantage to doing business in the state. Increased production at Tennessee's major automotive plants was the driving force behind employment growth. Volkswagen added production of the Crossblue (Atlas) SUV to its Chattanooga location, resulting in thousands of new jobs.²⁷ General Motors created hundreds of jobs at the Spring Hill location for production of two new crossover utility vehicle models, beginning in 2014.²⁸ Employment at Nissan Smyrna has doubled since December 2012 due to three new production lines (the Leaf, Rogue, and Infiniti QX60).²⁹ Today, 42.4% of industry employment in Tennessee exists because of Tennessee's unique strengths in this industry.³⁰ Michigan's industry has had a much more negative trajectory. Employment decreased from 34,698 jobs to 13,673 (a 39% decline in only five years).

²⁵ Since Tennessee's light truck and utility vehicle manufacturing industry (NAICS 336112) is too small for reliable data, the remainder of this section focuses on automobile manufacturing (336111).

²⁶ These estimates slightly misrepresent actual employment growth. Reclassification of companies as assembly manufacturers inflated the growth estimates for this NAICS code.

²⁷ Williams, C. (2014). Volkswagen expansion continues win streak for Tennessee.

https://www.tennessean.com/story/money/cars/2014/07/14/volkwagen-expansion-chattanooga-crossblue-suv/12616743/ ²⁸ Williams, C. (2014). *Could Nissan's Smyrna plant become world's largest auto plant?*

https://www.tennessean.com/story/money/cars/2014/06/04/nissans-smyrna-plant-become-worlds-largest/9955033/²⁹ Williams, C. (2014). Cadillac, GM vehicles headed to Spring Hill plant.

https://www.tennessean.com/story/money/cars/2014/07/11/cadillac-gm-vehicles-headed-spring-hill-plant/12537075/

³⁰ Author's calculation using Tennessee's 2018 competitive effect for automobile manufacturing and 2018 employment.

The average establishment size for Tennessee's automobile manufacturers is 2,598 employees per business location, the highest in the nation. Other states in the region have more businesses in this industry than Tennessee but nowhere near the same labor intensity.

In 2017, Tennessee's automobile manufacturers sold \$18.5 billion in product and earned \$2.0 billion. (Light truck and utility vehicle producers in Tennessee completed \$21.7 million in sales. Total earnings were less than \$1.0 million.) Tennessee's automobile manufacturers satisfied 73% of customer demand in the state with only 8% of total sales.

Automotive manufacturing yields indirect benefits for the state economy. Each job created in this industry results in an average of 3.49 additional jobs being created by local companies. Assembly plants attract new suppliers to the area, particularly suppliers that manufacture bulky or dense products that are difficult to transport.³¹

Workforce

Average earnings in Tennessee's automobile manufacturing industry are \$102,691 (\$83,368 in wages and \$19,323 in supplements). When adjusting for cost-of-living differences between the states, Tennessee's wages rank third in the nation behind Texas and Colorado. The most common occupations are assemblers and fabricators (59.4% of total industry), first-line supervisors of production and operating workers (4.5%), forging machine setters, operators, and tenders, metal and plastic (2.5%), industrial engineers (2.0%), and electricians (1.8%). Occupations utilized by this industry increased 12.8% since 2013, as compared to 9.7% growth nationally. These occupations account for 1.37 million jobs in Tennessee's labor force. Automobile manufacturers are an important source of employment for assemblers and fabricators, in particular. Rutherford County, where Nissan and GM are located, has the highest rate of inbound commuters for this occupation of any county in Tennessee. More than 4,000 assemblers and fabricators commute to Rutherford for work.

The majority of occupations require only a high school diploma or equivalent. Industrial engineers and industrial production managers require a bachelor's degree. Specialized occupations, like tool and die makers and industrial engineering technicians, typically require an associate's degree or some other postsecondary award. In 2017, Tennessee's post-secondary institutions produced 31,774 graduates from 249 programs of study related to industry occupations.

Supply Chain

The most common inputs in this industry are motor vehicle metal stamping (34.5% from instate suppliers), motor vehicle seating and interior trim manufacturing (59.7% in-state), motor vehicle gasoline engine and engine parts manufacturing (29.5%), motor vehicle transmission and power train parts manufacturing (17.9%), corporate, subsidiary, and regional managing offices (23.0%), and other motor vehicle parts manufacturing (17.9%).

Automobile wholesalers are the primary buyers of industry products. In 2018, wholesalers are expected to account for roughly one-third of industry revenue.³² Exports are the next largest market for Tennessee's automobile manufacturers. In 2017, Tennessee manufacturers exported \$2.9 billion in automobiles and \$16.8 million in specialty vehicles.³³ Other buyers include auto dealerships and, to a much lesser extent, government agencies.

³¹ Rosenfeld, S., Liston, C., Kingslow, M., & Forman, E. (2000). Clusters in rural areas: Auto supply chains in Tennessee and houseboat manufacturers in Kentucky. *TVA Rural Studies Working Paper*.

³² IBISWorld. (2018). *High-speed collision: Production has slowed in response to depressed vehicle sales.*

³³ Census Bureau. (2018). Tennessee export data for automobiles (HTS 8702-8704) and specialty vehicles (HTS 8705).



Major Automotive Production in Tennessee (2017)

Industry Outlook

Automobile manufacturing enjoyed solid performance in the U.S. in recent years. Factors like economic recovery and declining oil prices created consumer demand for new vehicles and resulted in new revenue for motor vehicle manufacturers.

These trends are likely to reverse in coming years. Rising fuel prices, coupled with declining consumer confidence, will result in fewer automobile purchases. Manufacturers will decrease output in response to underwhelming demand. To control costs, more companies will turn to offshoring and automated production.³⁴

Tennessee's strong competitive effect in this industry may eliminate some of these challenges. Auto makers in Tennessee are maintaining strong output, even as North American production of light vehicles decreased 4.2% overall between 2016 and 2017. GM Spring Hill more than doubled their previous year's output. The plant produced 236,670 vehicles in 2017, as compared to 112,377 in 2016. (This production increase was the largest of any North American assembly plant besides a facility in Toluca, Mexico.) Volkswagen Chattanooga also reported strong numbers. Production increased 50.1% during this time. Nissan Smyrna's output declined 2.7%. The plants with the most substantial decrease in production were located in Midwestern states: Toledo, Ohio (-68.7%), Belvidere, Illinois (-62.8%), and Hamtramck, Michigan (-54.4%).³⁵

³⁴ IBISWorld. (2018). *High-speed collision: Production has slowed in response to depressed vehicle sales.*

³⁵ Automotive News. (2018). North America car and light-truck production by plant, December & YTD.

Heavy Duty Truck Manufacturing

Heavy duty truck manufacturing (NAICS 336120) employs less than 25 workers at three business locations across the state. M3 Fire Apparatus (Lawrence) provides custom-built trucks for the fire and rescue industries. Total earnings in 2017 were \$1.6 million with \$19.3 million in sales (79% of which were in-state). Average wages in Tennessee are \$72,822.



Motor Vehicle Body and Trailer Manufacturing

Businesses in this industry manufacture four types of products: motor vehicle bodies (NAICS 336211), truck trailers (NAICS 336212), motor homes (NAICS 336213), and travel trailers and campers (NAICS 336214). Tennessee's 59 manufacturers employ 2,212 workers. Employment is strongly concentrated in Eastern Tennessee, specifically McMinn, Loudon, and Blount counties. Rutherford County in Middle Tennessee is also an important location for this type of manufacturing.

Tennessee has 19 motor vehicle body manufacturers, which employ 858 workers. These companies produce bodies for automobiles, trucks, buses, and cabs. Industry products are primarily sold to automobile assembly manufacturers. Tennessee's major employers in this industry are Miller Industries (Greene), which manufactures the company's Vulcan line of car carriers. Morgan Olson LLC (Loudon) produces walk-in and cutaway truck bodies made of aluminum and composite materials. Jost International (Greene) manufactures fifth-wheel couplings for trailers. Allvan USA (Rutherford) builds moving van bodies for professional movers.



The truck trailer manufacturing industry increased significantly in Tennessee in recent years. Employment grew from 419 jobs to 736 today (a five-year increase of 76%). This growth rate, the fourth highest in the nation and second highest in the region behind South Carolina, exceeded the national growth rate for this industry (9%). Employment in truck trailer manufacturing is concentrated in Tennessee at roughly the same level as the average state. Tennessee's location quotient is 0.94 for this industry. Tennessee has 12 truck trailer manufacturers, the largest of which is Heil Trailer International (McMinn). This company produces 100 trailers a month, including aluminum tank trailers, stainless steel petroleum tank trailers for commercial and military use, and customized trailers. Great Dane LLC (Scott) produces several lines of trailer flatbeds and drop decks made of steel and aluminum. This Huntsville facility, one of the company's eight productions plants in the U.S. won the Truck Trailer Manufacturing Association's annual award for plant safety in 2014 and 2015 because of no lost-time accidents.³⁶

Travel trailer and camper manufacturing has much more presence in Tennessee than motor home manufacturing, which employs less than 25 workers across the state. Tennessee has 27 travel trailer and camper manufacturers. Employment in this industry grew from 433 jobs in 2013 to 617 today (a 47% increase over five years). Marine Master Trailers (Coffee) offers several products for transporting boats, including painted steel trailers, galvanized trailers, aluminum l-beam trailers, pontoon trailers, and high-end custom boats made from fiberglass. Homesteader Trailer (Claiborne) manufactures trailers for a variety of hauling purposes, including enclosed cargo, motorcycles, automobiles, horses, and earth materials. Boatmate Trailers (Blount) offers several lines of boat trailers as well as custom-built manufacturing.

Tennessee's motor vehicle body and trailer manufacturers earned \$134.0 million in 2017. Motor vehicle body manufacturers generated the largest earnings in this industry (\$50.7 million), followed by truck trailer manufacturers (\$44.4 million) and travel trailer and camper manufacturing (\$38.8 million). Motor home manufacturing accounted for less than 0.1% of total earnings.

Despite higher revenue, Tennessee's motor vehicle body manufacturers had the lowest annual sales in 2017 besides motor home manufacturers. The truck trailing industry sold \$265.5 million in product, with 21% of sales made to customers in Tennessee. Travel trailer and camper manufacturers sold \$262.5 million worth of products. 42% of these sales were made to Tennessee customers. Sales for motor vehicle body manufacturers totaled \$245.9 million, with 47% of total sales going to buyers in Tennessee.

Truck trailers were sold outside the state more than any other industry product, but manufacturers of these trailers captured a lower percentage of customer demand in Tennessee. Only 24% of truck trailers bought by Tennessee customers in 2017 were produced by manufacturers in the state, as compared to 29% in motor vehicle body manufacturing and 34% in travel trailer and camper manufacturing.

In 2017, Tennessee manufacturers exported \$7.3 million in motor vehicle bodies to other countries and \$22.6 million in trailers.³⁷

Workforce

Average wages for this industry in Tennessee are \$60,329, with \$49,555 in current wages and \$10,774 in supplements and benefits. When adjusting for cost-of-living differences between the states, Tennessee's average wages are comparable to the national and regional averages. Wages for travel trailer and camper manufacturers (\$65,972) are higher on average than truck trailer manufacturing (\$63,402) and motor vehicle body manufacturing (\$54,446). Tennessee ranks fourth in the nation for average wages in truck trailer manufacturing. Tennessee's employment in motor home manufacturing is too small to estimate wages.

Like automotive assembly manufacturing, assemblers and fabricators are the most common occupation in this industry. Workers in these positions account for 33.9% of total industry jobs, followed by welders, cutters, solders, and brazers (11.6%), first-line supervisors of production and operating workers (3.6%), laborers and freight, stock, and material movers (2.9%), structural metal

³⁶ Great Dane. (2016). *Great Dane Huntsville facility wins TTMA plant safety contest*. http://news.greatdanetrailers.com/greatdane-huntsville-facility-wins-ttma-plant-safety-contest/

³⁷ Census Bureau. (2018). Tennessee export data for motor vehicle bodies (HTS 8707) and trailers (HTS 8716).

fabricators and fitters (2.3%), and inspectors, testers, sorters, samplers, and weighers (2.0%). These occupations all tend to require a high school diploma or equivalent, with the exception of laborers and freight movers. Short-term on-the-job training is the most common requirement for material moving occupations in this industry.

Staffing patterns do not vary based on the type of industry product being manufactured. These occupations are equally represented in each type of manufacturing operation, with assemblers and fabricators comprising roughly one-third of total labor.

Supply Chain

Manufacturers of these products rely on services from corporate, subsidiary, and regional managing offices (19.5% acquired in-state), motor vehicle body manufacturing (98.6% in-state), heavy duty truck manufacturing (2.2%), motor vehicle metal stamping (25.6%), and miscellaneous motor vehicle parts manufacturing (67.6%). Automobile manufacturers are the primary buyers of motor vehicle bodies and trailers made in Tennessee. Sales to Tennessee-based automakers accounted for 36% of in-state sales and 13% of total sales for this industry.

Industry Outlook

The truck, trailer, and motor home manufacturing has been growing in the U.S., with industry revenue surging over the last few years. Industry operators benefited greatly from trends like increased consumer spending, more domestic trips taken by U.S. residents, and declining oil and gas prices. With more disposable income, consumers were willing to splurge on big-ticket items like motor vehicles, trailers, and RVs. The aging of the U.S. population also resulted in increased demand for industry products. An uptick in new car sales created additional revenue for manufacturers of motor vehicle bodies. The aging of the U.S. population boosted demand for motor homes and RVs. The primary buyers of these vehicles are retired individuals over the age of the 50. The impending retirement of the Baby Boomers will ensure steady demand for these products in coming years. Trailer manufacturers enjoyed greater demand due to increased economic activity. New industrial and commercial activity spurred growth in the freight services industry, a key buyer of trailers.

Industry establishments will face new headwinds in coming years, creating a slight drag on industry growth. Revenue is expected to increase but at a slower rate than in the recent past. Declining consumer confidence will deter some from purchasing new motor vehicles or trailers. Demand for motor vehicle bodies will decrease as a result. The rising price of crude oil will negatively impact manufacturers of travel trailers, campers, and motor homes. Americans will take fewer domestic camping trips as fuel costs increase. Another industry-wide challenge is the possibility of new environmental regulations, like fuel efficiency standards and carbon dioxide emission caps. Implementation of these regulations will negatively impact freight services and domestic travel. However, new fuel standards will create revenue opportunities as manufacturers compete to create lighter-weight and energy efficient vehicles.

Tennessee manufacturers are uniquely positioned to succeed in this industry. Historically, regions with strong freight trucking industries have been the ideal location for truck trailer manufacturing.³⁸ Employment in Tennessee's truck transportation industry ranks third in the nation. Trade routes are another ingredient for success in trailer manufacturing. Tennessee manufacturers benefit from the state's considerable logistics and transportation assets.³⁹ FedEx's hub in Memphis, which handles up to 1.5 million packages every night, is the largest sorting facility in the world and

³⁸ IBISWorld. (Jul. 2018). Long haul: Strong economic conditions will continue to propel the industry.

³⁹ TNECD. (2018). Transportation, distribution, and logistics. www.tnecd.com/industries/transportation-distribution-logistics/

Automotive Cluster

the busiest cargo airport in the Western hemisphere. The Port of Memphis, through which 12 million tons of cargo pass every year, is a key U.S. shipping port. Tennessee also has more miles of I-40 within its boundaries than any other state, as well as immediate access to seven other interstates and the nation's third largest rail center.



Trade dynamics are expected to change over the next few years. An appreciating U.S. dollar will advantage foreign trailer manufacturers at the expense of domestic producers. However, Tennessee manufacturers benefit from new import competition in other industries, so as long as overall trade activity increases.

Motor Vehicle Gasoline Engine and Engine Parts Manufacturing

Businesses in this industry (NAICS 336310) manufacture or rebuild gasoline engines and parts like carburetors, pistons, and piston rings. This industry also includes establishments that manufacture or rebuild engine parts for non-vehicular machinery.

Tennessee businesses currently employ 6,475 workers at 39 locations.⁴⁰ Tennessee ranks third in the nation and first in the region for employment. Employment concentration in this industry is 295% higher than the average U.S. state. Tennessee's location quotient ranks fourth in the nation. Since 2013, Tennessee companies have added 1,056 net new jobs (a growth rate of 25.0%). 713 of these jobs were created for reasons attributable to Tennessee's unique advantages and not overall industry or economic growth. This industry only grew 8.2% nationally during this time and 8.8% in the Southeast region specifically. Today, more than 10.8% of industry employment in Tennessee exists because of the state's competitive effect in this type of manufacturing.



Hamblen County is the primary location for this industry in Tennessee, with more than 1,900 workers employed by Hamblen-based businesses. Morristown is home to MAHLE Engine

⁴⁰ Author adjusted the EMSI 2018.Q3 estimate for NAICS 336310 in Tennessee (5,272 workers) to account for Nissan Decherd. State- and county- rankings were not changed.

Components USA, which produces 13 million passenger car and 2.5 million diesel pistons per year, and OTICS USA, a manufacturer of gasoline engines for major automotive companies.⁴¹ The Morristown location was the first U.S. facility opened by OTICS, headquartered in Japan.⁴²

Gasoline engine manufacturers in Franklin County employ more than 1,200 workers. Nissan's facility in Decherd, which has produced more than 10 million engines since 1997, manufactures a new engine every 19 seconds. Annually, this facility assembles 1.4 million engines for Nissan and Infinite vehicles, including eMotors for the Nissan Leaf.⁴³ (The Decherd plant also produces power train parts. The facility manufactures 1.4 million crankshaft forgings and 456,000 cylinder block castings per year.)

McMinn County is another important location for this industry in Tennessee. Employment in McMinn has doubled since 2013. DENSO Manufacturing in Athens, which produces exhaust gas sensors, fuel injectors, and other gasoline delivery system components, has three production facilities that collectively employ more than 1,400 workers.⁴⁴ In 2018, DENSO announced 320 new jobs in Athens for production of gasoline direct injection systems as well as fuel pump lines.⁴⁵ The DENSO Corporation, headquartered in Japan, had the second highest sales of original equipment parts of any automotive suppliers in the world in 2017.⁴⁶

Other major employers in Tennessee include Ti Group Automotive Systems LLC (Greene), Nemak USA (Dickson), Takahata Precision America (Scott), Federal-Mogul Sevierville (Sevier), and TPR Federal Mogul (Lawrence).

In 2017, Tennessee's gasoline engine manufacturers earned \$342.3 million with \$2.5 billion in total sales (18% of which were in-state). These in-state sales satisfied 38% of demand from Tennessee customers.

Workforce

Average wages in Tennessee for this industry are \$67,779. When adjusting for cost of living differences between states, these wages are slightly higher than median average wages for this industry in the U.S. (\$70,043).

The most common occupation in this industry is assembling and fabricating. These workers account for 22.4% of total industry employment in Tennessee, with median hourly earnings of \$15.24. Other major occupations in this industry, none of which typically require more than a high school diploma and equivalent, include first-line supervisors of production and operating workers (4.3% of industry employment), multiple machine tool setters, operators, and tenders (3.8%), inspectors, testers, sorters, samplers, and weighers (3.5%), cutting, punching, and press machine setters, operators, and tenders (3.5%). Employers tend to require that workers in these occupations have previous experience and short- to medium-term training rather than postsecondary degrees.

In 2017, postsecondary institutions in Tennessee awarded 29,680 degrees and certificates from 224 programs of study related to careers in the automotive cluster.

⁴¹ DENSO Corporation. (2018). *DMAT: About us*. https://www.denso.com/us-ca/en/about-us/company-information/dmat/ ⁴² MAHLE. (2018). *MAHLE Engine Components USA, Inc., Morristown*. https://www.denso.com/us-ca/en/about-us/company-information/dmat/

⁴³ Nissan News. (2018). *Fact sheet: Powertrain Assembly Plant – Decherd, Tennessee*.

⁴⁴ OTICS USA, Inc. (2018). About Us. https://www.denso.com/us-ca/en/about-us/company-information/dmat/

⁴⁵ DENSO. (Feb. 2018). *DENSO expanding operations, creating hundreds of new jobs*. https://www.wate.com/news/localnews/denso-expanding-operations-creating-hundreds-of-new-jobs/998222066

⁴⁶ Automotive News. (Jun. 2018). 2018 Top Suppliers.

Supply Chain

The primary buyers of industry products are automobile manufacturers. Gasoline engine manufacturers sold \$215.9 million in product to Tennessee-based automakers in 2017 (48% of total in-state sales). Other buyers include boat builders, auto dealerships, lawn and garden equipment manufacturers, general freight trucking, and general automotive repair companies.

To produce these products, industry establishments require materials from other engine equipment manufacturers, motor vehicle metal stamping services, machine shops, nonferrous metal die-casting foundries, and fabricated structural metal manufacturing. Business services like corporate, subsidiary, and regional managing offices are also a key part of the supply chain. A low percentage of these inputs are obtained from other Tennessee businesses, ranging from 7.0% for engine equipment to 35.6% of iron purchases.

Exports are also an important source of revenue. In 2017, Tennessee manufacturers exported \$639.3 million in engine parts (the fourth highest export total in the U.S. behind Michigan, Illinois, and Texas) and \$264.1 million in engine pistons (the sixth highest in the nation).⁴⁷

Industry Outlook

Growing automobile sales in recent years led to increased revenue for manufacturers of gasoline engines and engine parts. Engine manufacturers also profited from declining steel prices. These trends are likely to reverse in coming years. Rising fuel prices and declining consumer confidence will result in decreased demand for gasoline engines from domestic automakers. Interest rate hikes will contribute to consumers' reticence to make major purchases. Moreover, consumers are increasingly interested in hybrid and electric vehicles, undercutting demand for gasoline engines. To address this change in consumer preferences, engine manufacturers are focused on creating more energy efficient products.

These challenges will magnify other trends like offshoring and establishment consolidation. Domestic manufacturers that eschew offshoring will look for labor pools with low average wages, resulting in wage stagnation despite a greater emphasis on high-skill occupations needed for product innovation. Increased automation will also lead to declining employment in the US.

Tennessee manufacturers enjoy two key advantages in this industry. Automakers prefer to work with in-region suppliers to reduce costs. Engine manufacturers in Tennessee benefit from the strength of the auto assembly industry in the state. In addition, foreign automakers that import nearly complete automobiles purchase remaining parts from local suppliers. The large customer base in the Southeast region creates opportunities for Tennessee companies.⁴⁸

Motor Vehicle Electric and Electronic Equipment Manufacturing

Businesses in this industry (NAICS 336320) produce a variety of electrical products for vehicular use, including alternators, generators, lighting fixtures, engine coils, control chips, ignition cables, instrument panels, spark plugs, and windshield washer pumps. This industry does not include all automotive parts with electrical components. Products like lamps, batteries, electric motors, and car stereos are classified separately.⁴⁹

⁴⁷ Census Bureau. (2018). Tennessee export data for engine parts (HTS 8409) and compression-ignition internal combustion piston engines (HTS 8408).

⁴⁸ IBISWorld. (2018). Revving up: Improving car sales will support demand, but alternate engines will stifle growth.

⁴⁹ Automotive lamps are included in the appliances and electrical equipment cluster, specifically electric lamp bulb and part manufacturing (NAICS 335110). Automotive batteries are part of the storage battery manufacturing industry (NAICS 335911),

Tennessee's 30 business locations in this industry employ 7,152 workers, more than 10% of total U.S. employment for this industry.⁵⁰ Tennessee ranks first in the region for employment and fourth in the nation behind Michigan, Ohio, and Texas. Industry employment is 397% more concentrated in Tennessee than the average state. Tennessee's location quotient ranks second in the nation behind Michigan.

The average establishment size in Tennessee (218 workers per location) is greater than any other state. Employment is significantly concentrated in Blount County and Rutherford County. DENSO Manufacturing in Maryville (Blount), which employs more than 4,100 workers, is the largest U.S. facility for this industry and DENSO's largest U.S. plant. The Maryville facility creates starters, alternators, instrument clusters, inverters for hybrid vehicles, and other electrical products. DENSO supplies parts made at this facility to major automotive companies, including Nissan, Toyota, Ford, Subrau, Kia, Honda, and Hyundai. Toyota and GM have awarded excellence awards to DENSO for its product quality and customer service.⁵¹ In September 2017, DENSO announced plans to create 1,000 new jobs at the Maryville facility for production of electrification and safety systems.⁵²



Rutherford County is home to Schneider Electric, which employs more than 1,400 workers. This company creates electrical products that increase the time and energy efficiency of automotive assembly production. Other major employers include BBB Industries (White), Federal-Mogul Ignition (White), Moog Automotive (White), Matsuo Industries (Jefferson), and Patrick Industries (Tipton).

Employment grew rapidly in Tennessee in recent years. Since 2013, Tennessee manufacturers added 2,982 new jobs, the highest net job creation in the nation. This five-year growth rate of 84.1% outpaced the national growth rate (17.5%) and the regional growth rate (42.8%). Roughly four out of five of these new jobs were created for reasons unique to Tennessee and not external factors. Today, one-third of industry jobs in Tennessee exist because of exceptional job growth that occurred since 2013.

These businesses earned \$342.3 million in 2017 after completing \$2.5 billion in sales. 18% of these sales (\$448.0 million) were made to other companies in Tennessee. These in-state sales met 38% of demand by Tennessee customers.

Workforce

Average wages for this industry in Tennessee are \$66,213. These wages, the second highest in the region behind Georgia when adjusting for cost-of-living, are comparable to the national and regional averages.

also in the appliances and electrical equipment cluster. Electrical motors are made by the motor and generator manufacturing industry (NAICS 334290). Car stereos are audio and video equipment manufacturing (NAICS 334310). ⁵⁰ Employment data obtained from EMSI was adjusted to reflect DENSO's actual employment in Maryville, which the company discloses on its website. Rankings based on EMSI data were not adjusted.

⁵¹ DENSO Manufacturing. (2018). *About us*. https://www.denso.com/us-ca/en/about-us/company-information/dmtn/ ⁵² Modern Tire Dealer. (Mar. 2018). *Denso is adding 4 production lines in Athens, Tennessee*.

https://www.moderntiredealer.com/news/728713/denso-is-adding-4-production-lines-in-athens-tennessee

This industry's workforce overlaps significantly with occupations in motor vehicle gasoline engine manufacturing. Major occupations in automotive electrical equipment manufacturing are assemblers and fabricators, first-line supervisors of production and operating workers, machine tool setters, operators, and tenders, inspectors, testers, sorters, samplers and weighers, and cutting, punching, and press machine setters. Like gasoline engine manufacturing occupations, most occupations in electrical equipment manufacturing require a high school diploma or equivalent and some on-the-job training. Tennessee has a well-established educational pipeline for the 180 occupations that comprise this industry. In 2017, Tennessee's post-secondary institutions awarded 29,691 degrees and certificates in 225 programs of study related to this industry.

Supply Chain

To create these products, businesses purchase inputs from semiconductor manufacturers, other electronic component manufacturers, plastics product manufacturers, plastics material and resin manufacturing, and other manufacturers of motor vehicle electrical equipment. Of these purchase categories, motor vehicle electrical equipment is the only input primarily acquired from other Tennessee businesses (99.4%). Tennessee companies in this industry rely on in-state businesses for a significant percentage of business services, specifically lessors of nonfinancial tangible assets (56.2%) and corporate, subsidiary, and regional managing offices (17.8%).

Primary buyers of these products are automobile assembly manufacturers, other motor vehicle electrical equipment manufacturers, government agencies, general freight trucking companies, and auto dealerships.

Industry Outlook

Like other automotive companies, electrical equipment manufacturers will contend with declining vehicle sales and rising fuel prices. Domestic producers are uniquely vulnerable to competition from importers due to the lightweight and low-cost nature of these products. Electrical devices, which tend to be small and easily transportable, can be produced with sufficient quality in low-wage areas by unskilled workers.

Automation will have less of an impact on this industry than other automotive parts manufacturing. The intricateness of electrical products makes hand assembly a necessity. To outcompete importers who have the benefit of cheaper labor, Tennessee companies will need to optimize efficiency and capitalize on pre-existing advantages, such as proximity to vehicle manufacturers like Nissan, GM, and Volkswagen. Diversification of customers will be critical. Automotive suppliers learned the hard way during the Great Recession that multi-billion dollar automakers can easily go bankrupt. Auto parts manufacturers that sell most of their product to a single automaker are flirting with disaster.

Fortunately, the importance of this industry will continue to grow as vehicles become more sophisticated. Today's automobiles include features like sensors, cameras, built-in GPS, smartphone connectivity, electronic instrument panels, and other devices produced by this industry. These features, previously found only in luxury vehicles, are now being included in more affordable car models. The advent of connected and autonomous vehicles will create the need for entirely new types of electrical products.⁵³

⁵³ IBISWorld. (September 2018). *Plugged in: Due to recover in the automobile market, industry demand has increased.*

Motor Vehicle Steering and Suspension Components (except Spring) Manufacturing

This industry (NAICS 336330) produces power steering pumps, shock assemblers, and steering components like assemblies, columns, and wheels. Spring and wire components are not included in this industry.

Businesses in Tennessee employ 6,701 workers at 19 locations. Tennessee ranks second in the nation behind Michigan for industry employment. Since 2013, Tennessee companies added 2,253 net new jobs. These gains exceeded expectations. Nationally, employment in this industry grew only 19.7%. The regional growth rate was slightly higher (25.9%) but significantly lower than Tennessee's rate (50.1%). Tennessee added more than 1,300 more jobs than expected. This additional job creation accounts for more than 20% of current industry jobs in the state, demonstrating a strong competitive advantage for Tennessee manufacturers.

Industry employment is 759% more concentrated in Tennessee than the average U.S. state. Tennessee's location quotient ranks second in the nation behind Kentucky. Giles County is the primary location in Tennessee for this industry. Magneti Marelli Suspensions in Pulaski, formerly International Steel Solutions before being acquired by the Italian-based company, produces suspension parts like shock absorbers. Employment in Giles has increased from 457 jobs in 2013 to 1,621 today due to the success of Magneti Marelli and other suspension parts manufacturers. Giles County has the highest employment concentration of any U.S. county for this industry. Warren and Monroe counties have the third and fifth highest employment concentration, respectively.



Businesses in Warren County employ more than 1,500 workers in this industry. Yorozu Automotive in Morristown, the headquarters of Yorozu's U.S. subsidiary, creates stamped steel parts like suspensions and modules. Employment has increased 65% in Warren since 2013. Monroe County is another important location for this industry. JTEKT Automotive Tennessee in Vonore, which manufactures steering systems for Toyota, BMW, Nissan, and other automakers, employs hundreds of workers in Monroe County. JTEKT has two other locations in Tennessee. The Morristown facility produces steering systems and steering pumps. The Telford plant in Washington County manufactures tapered roller bearings.⁵⁴

Other major employers in Tennessee include NSK Steering Systems America (Dyer), Hendrickson Trailer Suspensions (Montgomery), TRW Inc. (Wilson), TRW S&S (Hawkins), Rhythm North America Corp. (White), and Firestone Industrial Products Co. LLC (Dyer). Tennessee has 19 business locations for this industry, with an average of 353 workers per location. The average establishment size in Tennessee is the third highest of any state behind Michigan and Kentucky.

In 2017, Tennessee's steering systems manufacturers earned \$388.7 million and sold \$2.5 billion in product. Only 13% of total sales were made to other businesses in Tennessee, and with

⁵⁴ JTEKT. (2018). About us. https://jtekt-na.com/about-us/

these sales, Tennessee companies met 81% of in-state demand for industry products. Exports of Tennessee-made vehicle parts (including steering wheels, steering columns, and steering boxes) totaled \$1.4 billion in 2017.

Workforce

Average wages for this industry in Tennessee are \$61,473, with \$49,925 in wages and \$11,549 in supplements. Top occupations are identical to gasoline engine manufacturing and motor vehicle electrical equipment manufacturing: assemblers and fabricators, first-line supervisors of production and operating workers, multiple machine tool setters, operators, and tenders, inspectors, testers, sorters, samplers, and weighers, and cutting, punching, and press machine setters, operators, and tenders. These occupations typically require a high school diploma or equivalent and on-the-job training.

Workers in these occupations have grown 11.7% since 2013, higher than the national growth rate for these occupations (8.8%). Currently, Tennessee has 1.51 million workers in these positions. Median hourly earnings for these occupations (\$17.80) are lower than the national median for this industry (\$20.24 per hour). In 2017, Tennessee's post-secondary institutions awarded 30,646 degrees in 248 programs of study related to occupations in steering and suspension components manufacturing. In the long-term, manufacturers in this industry will require more skilled workers. Investments in automation will eliminate the need for human-run inventory systems while increasing the necessity of technically-trained workers for maintaining the new digital system.⁵⁵

Supply Chain

Key inputs include corporate managing offices, iron and steel mills and ferroalloy manufacturing, motor vehicle metal stamping, custom roll forming, machine shops, and iron foundries. Less than a fifth of these purchases are from other businesses in Tennessee, with the exception of iron foundries (30.6% in-state).

The primary buyers of industry products are automobile manufacturers, general automotive repair services, couriers and express delivery services, automotive body, paint, and interior repair and maintenance, and general freight trucking. Sales between steering and suspension component manufacturers also account for a significant percentage of industry revenue.

Industry Outlook

Like other automotive industries, steering and suspension component manufacturing generated strong revenue in recent years due to an increase in new car sales. Automotive assembly manufacturers were in greater demand for industry products, particularly high-end products that increased the safety and efficiency of vehicular use. Sales to automakers accounted for the largest share of revenue in this industry. Revenue from the automotive parts aftermarket also grew during this period. Surprisingly, the average lifespan of the U.S. automobile has been steadily increasing even during periods of heightened car sales. Per capita vehicle ownership is on the rise, while many car owners are putting their money into maintenance for their current vehicle.

Revenue will likely decline in the next few years. New car sales are predicted to decline due to rising fuel costs and consumer uncertainty. Automakers will make fewer purchases of industry products as a result. Manufacturers of steering and suspension parts will attempt to compensate for this loss by leaning into the automotive parts aftermarket. Increasing import competition will also pose a threat to Tennessee companies.

⁵⁵ IBISWorld. (Sep. 2018). Smooth ride: Increasing automobile production and the parts aftermarket have boosted demand.

In the short-term, industry revenue is expected to decline. No market will be big enough to supplant decreased demand from automakers. In the long-term, manufacturers will enjoy substantial revenue opportunities. This industry will have a major impact on the future of the automotive sector. Mass adoption of electric, driverless vehicles will require power steering systems and suspension parts specifically designed for these vehicles. Manufacturers will compete to create the parts used in driverless vehicle models.⁵⁶

Tennessee manufacturers have key advantages in this industry because of their location. Three automotive assembly plants are located in the state, and numerous other facilities are within a day's drive. Moreover, since the Southeast is the most populous region in the nation, manufacturers have access to an enormous customer base for automotive parts. Proximity to these key buyers reduces transportation costs for manufacturers, boosting revenue.

Motor Vehicle Brake System Manufacturing

Businesses in this industry (NAICS 33634) manufacture brake systems and related components, including cylinders, drums, hose assemblies, pads, belts, and calipers.

With 1,377 employees and 11 establishments, Tennessee ranks ninth in the nation for employment in this industry. Employment is 182% more concentrated in Tennessee than the average state. Tennessee also ranks ninth for employment concentration. The Southeast is the primary location for this industry. Six of the top ten states in employment (Kentucky, South Carolina, Georgia, Alabama, North Carolina, and Tennessee) are located in the Southeast region.

This industry has largely stayed the same in the last few years. Tennessee maintained the same number of establishments, and employment grew by less than 25 net new jobs. More than 40% of Tennessee's employment in brake system manufacturing is located in Marshall County. Nichirin Tennessee, which employs hundreds of workers in Lewisburg, produces automotive hoses for brake systems, air conditioning, and power steering. Since 2013, employment in Marshall County has grown by 500 jobs (a 543% increase).



Montgomery County is another important location for brake system manufacturing in Tennessee. Akebono Brake Corporation in Clarksville, which manufactures products like brake calipers and drum brakes, serves major automakers in the area including GM and Nissan. The Clarksville facility is one of several U.S. manufacturing sites for the Japanese-headquartered Akebono Brake Industry Co. (TYO: 7238). Nichirin Tennessee is one of several U.S. facilities owned by its Japanese parent company, Nichirin Co. Ltd. (TYO: 5184). Moog Automotive in Smithville (DeKalb County) is Tennessee's other major employer in this industry.

In 2017, Tennessee's motor vehicle brake systems manufacturers earned \$79.3 million. Total sales were \$484.6 million, 27% of which were sales to other businesses in the state. In-state sales

⁵⁶ IBISWorld. (Sep. 2018). *Smooth ride: Increasing automobile production and the parts aftermarket have boosted demand.*

satisfied only 44% of demand by Tennessee customers, suggesting that the customer bases of Tennessee manufacturers are located primarily in other regions.

Exports to foreign countries are an important source of revenue for Tennessee companies. Tennessee ranked fourth in the nation in 2017 for exports of rubber tubes, pipes, and hoses (including brake hoses). Manufacturers in Tennessee exported \$70.8 million in these products. Tennessee ranked ninth nationally for exports of motor vehicle parts, including brake parts, mounted brake linings, brake drums, and rotors. Total value of these exports in 2017 was \$1.4 billion. (This export category includes many other products besides brakes, including gear boxes, axles, driving shafts, wheels, rims, covers, radiators, mufflers, clutches, and airbags). Exports of friction materials like brake pads totaled \$258,682.⁵⁷

Workforce

Average wages in Tennessee for this industry are \$59,118, with \$48,068 in wages and an additional \$11,050 in supplements. Occupations in this industry are similar to most other automotive parts manufacturing. Assemblers and fabricators are the most important part of this industry (22.4% of industry jobs), followed by first-line supervisors of production and operating workers (4.3%), multiple machine tool setters, operators, and tenders (3.8%), inspectors, testers, sorters, samplers, and weighers (3.6%), and cutting, punching, and press machine setters, operators, and tenders (3.5%).

These occupations have grown 13.0% in Tennessee since 2013, higher than the national growth rate (9.3%). Median hourly earnings (\$17.94) are lower than the national median (\$20.58). Today, Tennessee has 1.14 million workers in these occupations. An educational pipeline exists for these types of manufacturing occupations. In 2017, Tennessee's post-secondary institutions awarded degrees and certificates to 22,333 graduates in 176 programs of study related to occupations in brake manufacturing.

Supply Chain

Brake systems manufacturers rely on a diverse set of inputs. Services from corporate, subsidiary, and regional managing offices accounted for the most significant industry purchases by Tennessee brake manufacturers in 2017. To create industry products, companies rely on iron, steel, and ferroalloy manufacturers. Only 6.1% of these materials are acquired from other Tennessee businesses. Other key purchases include motor vehicle metal stamping (24.6% from in-state suppliers), custom roll forming (15.9% in-state), machine shops (13.6%), and iron foundries (18.9%).

The primary buyer of industry products is the automobile manufacturing industry. Tennessee brake makers like Akebono sell directly to major automakers in the region, including Nissan and GM. The automotive parts aftermarket is the next biggest source of revenue for Tennessee manufacturers. Other buyers include general automotive repair and automotive body, paint, and interior repair and maintenance. Tennessee brake manufacturers also sell directly to transportation and logistics industries. Couriers and express delivery services as well as general freight trucking operators make substantial purchases from brake manufacturers.

Industry Outlook

Revenue for brake system manufacturing has been increasing in the U.S. in recent years due to increased consumer confidence and per capita disposable income. New car sales increased,

⁵⁷ Census Bureau. (2018). Tennessee export data for rubber tubes, pipes, and hoses including brake hoses (HTS 4009), motor vehicle parts and accessories including brake drums (HTS 8708), and friction materials including brake linings and pads.

creating additional demand from automakers for industry products. Many car buyers opted to buy preowned vehicles, boosting revenue for aftermarket brake components. Rising incomes also led to an increase in vehicle usage, creating more demand for brake products from automotive repair companies. Lower gas prices motivated a greater number of car buyers to purchase SUVs and trucks. Brake systems tend to be larger and more intricate for large vehicles.

Many of these trends are likely to slow or reverse in coming years. Interest rate uncertainty will contribute to consumers' trepidation about making big-ticket purchases, like buying a new car. Rising gas prices will lead to a decline in the average miles at which Americans drive per year. Higher gas prices will also motivate new car buyers to purchase smaller, more energy-efficient vehicles. Appreciation of the dollar will reduce the competitiveness of American manufacturers. Labor costs tend to be higher in the U.S. than foreign manufacturing nations. More American companies will decide to offshore production as the threat of import competition grows steeper. Chinese brake manufacturers, which have increased production to accommodate demand from the nation's growing middle class, are capturing a larger share of the U.S. market than ever before.

Quick delivery times are crucial to success for brake manufacturers. Tennessee manufacturers are in close proximity to automotive assembly plants, ensuring an advantage over importers in the Southeast market.⁵⁸ Continued revenue growth will depend on export competitiveness. Per capita vehicle ownership is on the rise in the developing world and in nations with growing middle classes like China and India. Tennessee companies will need to boosts exports to these nations to avoid over-reliance on U.S. automakers.

Motor Vehicle Transmission and Power Train Parts Manufacturing

Manufacturers in this industry (NAICS 336350) manufacture automatic transmission, axle bearings and assemblies, and other power train parts that transfer the drive generated by the engine to the vehicle's axles. Torque converters, which enable the engine to continue running while the car is motionless, are the automatic transmission equivalent of a clutch. Constant-velocity joints, found in front-wheel drive vehicles, allow the transfer of torque from a drive shaft at an angle. Universal joints are also used to transmit torque at an angle from the engine to the axles. These products are what separate today's automatic vehicles from so-called "stick shift" cars, in which drivers must manually shift gears.



Tennessee's 13 power train manufacturers employ 2,960 workers, the sixth highest level of employment in the nation and third highest in the region behind North Carolina and South Carolina.⁵⁹ Tennessee's location quotient for this industry (1.60) demonstrates that employment is

⁵⁸ IBISWorld. (May 2018). Shifting gears: The industry will experience minor revenue losses moving forward.

⁵⁹ Author adjusted the EMSI 2018.Q3 estimate for NAICS 336350 in Tennessee (2,760 workers) to account for Nissan Decherd's power train manufacturing operations. State- and county- rankings were not changed.

concentrated more significantly in Tennessee than the average state. Tennessee ranks seventh in the nation for employment concentration. Employment grew by less than 100 net new jobs since 2013, a five-year growth rate of 2.5%.

Almost one-quarter of Tennessee's employment is located in Anderson County. Samlip (SL) Tennessee in Clinton manufactures gearshifts for automatic, manual, and electric vehicles as well as pedals and parking brake levers. SL Tennessee is the U.S. subsidiary of the SL Corporation (KRW: 005850), an automotive parts maker headquartered in South Korea. Automotive suppliers in Clinton are an essential part of Anderson County's economy. A 2017 property tax report released by the County Mayor showed that SL Tennessee was the top corporate taxpayer in Anderson. Two other automotive manufacturers in Clinton, AISIN Automotive, and Magna East Bend, placed third and fourth on this list. (The Y-12 Security Complex paid the second highest amount of property taxes in Anderson County for the 2016 tax year.)⁶⁰

Knox County is also important for powertrain manufacturing in Tennessee. EXEDY America Corporation, which employs more than 600 workers at its Mascot facility, produces a wide range of powertrain products, including torque converters, dampers, manual transmission clutches, and more. EXEDY America is a subsidiary of the Japanese-based EXEDY Corporation (TYO: 7278). One of EXEDY America's major clients is General Motors, which honored the Mascot location with a GM Supplier Quality Excellence Award in 2018. EXEDY America creates powertrain products for more than just automotive assemblers.⁶¹ The Mascot plant manufactures forklift transmissions for the construction industry and tractor clutches for the agricultural industry.

Other major employers include: Dacco Inc. (Putnam), which produces torque converters and transmission parts; Tuff Torq Corp. (Hamblen), producer of drivetrain components like transaxles for motor vehicles, construction machinery, and other types of power equipment; and Dana Driveshaft Products LLC (Smith), which manufactures aluminum driveshafts. The Dana Corporation (NYSE: DCN) also has locations in Humboldt and Collierville.

Transmission and power train manufacturers in Tennessee earned \$129.9 million in 2017. Total sales for this industry were \$932.0 million. One-third of total sales were made to other businesses in Tennessee, satisfying 25% of customer demand in the state. Exports of power transmission parts are classified under motor vehicle parts and accessories, along with brake systems and suspensions. Exports of motor vehicle parts totaled \$1.4 billion in 2017.⁶²

Workforce

Average wages in this industry are \$48,007, with \$39,060 in wages and \$8,947 in supplements. Top occupations in this industry are assemblers and fabricators (22.4% of total industry), first-line supervisors of production and operating workers (4.3%), multiple machine tool setters, operators, and tenders (3.8%), inspectors, testers, sorters, samplers, and weighers (3.6%), and cutting, punching, and press machine setters, operators, and tenders (3.5%). Production occupations in this industry tend to require short-term or moderate on-the-job training rather than certain educational completions.

⁶⁰ The Courier News. *Top ten taxpayers in county identified*.

https://mycouriernews.com/articles/2017/04/82/top-ten-taxpayers-in-county-identified

⁶¹ EXEDY America Corporation. (Feb. 6, 2018). *EXEDY America received the GM Supplier Quality Excellence Award*. http://eac.exedy.com/page.php?id=10078&version=English

⁶² Census Bureau. (2018). Tennessee export data for transmission shafts, bearing, gears, and other parts (HTS 8483) and motor vehicle parts and accessories including power transmission parts (HTS 8708).

Supply Chain

Production of power train parts requires significant purchases from custom roll forming companies, machine shops, motor vehicle metal stamping, and iron foundries. Roughly 20% of these materials are obtained from other Tennessee companies. Power train manufacturers in Tennessee obtain 25.0% of iron, steel, and ferroalloy supplies from other businesses in the state. In-state suppliers also provide for a significant percentage of all purchases from nonferrous metal diecasting foundries (23.8%) and precision turned product manufacturers (36.2%), but only a small percentage of purchases from aluminum foundries (4.0%). The primary buyer of industry products are automobile manufacturers. In 2017, Tennessee manufacturers sold \$126.7 million in power train parts to automakers in the state. These sales accounted for 41.0% of all in-state sales and 13.6% of total sales.

Industry Outlook

Power train manufacturers, on the heels of a strong five-year performance, are expected to grow revenue for the foreseeable future. This industry benefited from the surge in new car sales in recent years. Vehicle production is predicted to slow in the U.S., but transmission manufacturers will find new revenue opportunities due to a societal-wide push toward energy-efficiency. Consumers are showing greater interest in energy-efficient vehicles for economic and environmental reasons. Transmission systems influence the fuel efficiency of a vehicle more than arguably any other automotive part. Companies will compete to create affordable power train products that optimize efficiency performance. Innovation will also be important in hybrid vehicle markets. In the long-term, widespread adoption of electric vehicles will substantially undercut revenue for transmission manufacturing. Internal combustion engines, found in gasoline-powered vehicles, produce a different amount of torque based on the gear. Electric motors tend to produce the same torque at each speed, minimizing the need for transmission systems.

Importers have proven adept at penetrating U.S. markets in recent years. Import competition has accelerated consolidation among American companies. The remaining industry players, of which Dana Incorporated stands as one of the most successful, maximize their competitiveness through economies of scale. American manufacturers have begun investing more heavily in automation to control costs. Engineers and related occupations are growing in importance, while automation has eliminated some production occupations. Average wages are increasing in this industry due to the changing workforce.⁶³

Transmission manufacturers tend to be located near major automotive assembly plants. The top regions for employment in this industry are the Midwest (Indiana, Michigan, and Ohio, specifically) and the Southeast (North Carolina, South Carolina, and Tennessee).

Motor Vehicle Seating and Interior Trim Manufacturing

Manufacturers in this industry (NAICS 336360) produce motor vehicle seating, including seat frames, covers, and seat belts, as well as interior trim like paneling and headliners. With 6,599 employees and 35 business locations, Tennessee's seating and trim manufacturing industry is one of the strongest in the nation. Tennessee ranks first in the region and fourth in the nation for employment in this industry. Since 2013, employment increased by 1,646 net new jobs (a 26.7% increase). Across the U.S., seating and trim manufacturing experienced explosive growth during this time. Employment has grown 28.1% nationally since 2013.

⁶³ IBISWorld. (Jul. 2018). Shifting gears: As trends in fuel efficiency persist, industry demand will benefit.

Automotive Cluster

Tennessee's employment concentration is 388% higher than the average U.S. state. This location quotient (4.88) is the fifth highest in the nation and third in the region behind Kentucky and Alabama. Nearly 1,000 jobs are located in Marshall County. The Lewisburg area has the highest employment concentration of any MSA in the nation for this industry. Calsonic Kansei North America's Lewisburg plant manufactures plastic components for interiors as well as electronic products like meters, inverters, and dashboard components. Calsonic also has a Shelbyville location, which produces exhaust systems, engine cooling modules, HVAC, and other electronics. The company, which opened in Tennessee in 1983 after the opening of Nissan, has expanded significantly in recent years. Because of this growth, Lewisburg had the third highest employment growth rate of any MSA in the nation during this time. Marshall County currently has the third highest employment concentration among U.S. counties for seating and trim manufacturing. Lewisburg is also home to one of Multimatic's North American facilities, which produces instrumental panels and other interior products.



Manufacturers in Coffee County employ more than 700 workers. M-TEK in Manchester specializes in interior products like door paneling, rear shelving, trunk trim, dashboard insulators, and plastic injection trim. The company is a supplier for Nissan Smyrna and other automotive assembly plants. M-TEK also has a location in Murfreesboro, which in 2015 became the headquarters for the company's North America operations. The Murfreesboro location also houses the company's engineering and R&D departments. M-TEK is a subsidiary of the Kasai Kogyo Corporation (TYO: 7256), based in Japan. Tullahoma-Manchester has the fifth highest employment of any MSA in the nation (2,136 jobs).

Other major employers include Magna Seating Systems (Maury), MIG Athens LLC (McMinn), IAC Dayton LLC (Rhea), Adient, formerly Johnson Controls (Rutherford; Giles), Imasen Bucyrus Technology Inc. (Maury), and National Seating Co. Inc. (Monroe).

In 2017, Tennessee's seating and trim manufacturers earned \$430.8 million after completing \$3.9 billion in total sales. 23% of total sales were made to other businesses in the state. Tennessee manufacturers captured 51% of in-state demand for these products.

Motor vehicle seating is an important export for Tennessee. Seating parts are the second most exported motor vehicle part made by Tennessee automotive manufacturers. Total value of these exports in 2017 (\$59.08 million) was only slightly less than the export value of Tennessee-made rear-view mirrors (\$59.45 million).

Workforce

Average wages for this industry in Tennessee are \$56,687, with \$46,029 in wages and salaries and an additional \$10,658 in supplements. When adjusting for cost-of-living differences between the states, average wages in Tennessee are slightly higher than regional average wages for this type of manufacturing.

The top occupations in this industry are assemblers and fabricators (22.4% of total industry jobs), first-line supervisors of production and operating workers (4.3%), multiple machine tool setters, operators, and tenders (3.8%), inspectors, testers, sorters, samplers, and weighers (3.6%), and cutting, punching, and press machine setters, operators, and tenders (3.5%). Electrical, electronic, and electromechanical assemblers play a small role in this industry (3.3% of total jobs). Each of these occupations tends to require a high school diploma or equivalent for entry-level positions as well as some on-the-job training.

Supply Chain

Sales between seating and trim manufacturers accounts for the most significant percentage of purchases made by Tennessee companies in this industry. Seating and trim manufacturers made 62.1% of these purchases from other businesses in the state. Other key inputs include services from corporate, subsidiary, and regional managing offices (15.6% of which were acquired from in-state businesses), metal crown, closure, and other metal stampings (17.2% in-state), urethane and other foams (23.8%), textile and fabric finishing mills (11.7%), and plastics material and resins (14.4%).

The primary buyer of Tennessee-made seating and trim products are motor vehicle manufacturers. Sales to automakers in Tennessee accounted for 64.7% of in-state sales and 14.7% of all sales made by these businesses in 2017.

Industry Outlook

Revenue for motor vehicle interior manufacturing grew substantially in recent years due to an increase in new automobile sales. Sales of new vehicles are expected to decline, but revenue for interior manufacturers will likely remain strong. Manufacturers of these products are benefitting from the increasing popularity of vehicle types like electric vehicles, SUV, and light trucks. New vehicle lines increase demand for custom-manufactured interior trim. Moreover, fully-stocked interiors are becoming more and more common in new vehicles, increasing demand for products like leather seating, wood grain, and other seat features.

Declining vehicle sales will accelerate consolidation in the industry. Manufacturers are competing for a smaller number of exclusive contracts with major automakers. Large industry players will continue to acquire smaller competitors with innovative product offerings. Wages are likely to stagnate due to increased automation and offshoring.⁶⁴

Motor Vehicle Metal Stamping

Businesses in this industry (NAICS 336370) produce motor vehicle metal stampings such as fenders, tops, body parts, trim, and modeling. Manufacturers of these products utilize methods like cutting, punching, and bending to produce automotive parts made from sheet metal, steel, and other types of metal.

Tennessee has 33 business locations in motor vehicle stamping, which collectively employ 6,455 workers in the state. Tennessee ranks fourth in the nation for employment and second regionally behind Kentucky. Industry employment grew 47% in Tennessee since 2013, greatly exceeding the national growth rate for this industry (22%). Tennessee companies added 2,129 net new jobs in this industry, the third highest job creation in the nation behind Michigan and Ohio. Unlike Michigan, Tennessee's job growth surpassed what could have been reasonably expected by

⁶⁴ IBISWorld. (Oct. 2018). Driving sales: Growth in worldwide manufacturing activity will fuel sales from foreign markets.

the state of the U.S. economy and overall industry growth. Tennessee employers created 1,173 more jobs than predicted, while Michigan underperformed by an even more significant margin (2,725 fewer jobs than predicted). Today, 18.2% of employment in Tennessee is attributable to the exceptional job growth achieved in the last five years.

Tennessee's location quotient for this industry (3.46) is the fourth highest in the nation and second highest in the region besides Kentucky. Tennessee also has the third most industry establishments in the nation and more than any other state in the Southeast region.



Sumner County accounts for the largest percentage of Tennessee's employment in this industry and eight of Tennessee's 33 business locations. Unipres USA Inc. in Portland uses stamping and machining techniques to manufacture press parts for motor vehicle bodies. The company's main products are side members, steering components, housings, dash lowers, and sill inners. Unipres North America, subsidiary of global automotive supplier Unipres Corp (TYO: 5949), is headquartered in White House, Tennessee. Sumner County has the sixth highest employment of any U.S. county for this industry.

Marshall County also has a significant amount of employment in motor vehicle metal stamping. Walker Die Casting Inc. in Lewisburg specializes in power train components like housings for transmissions, bells, converters, and oil, air, and water pumps as well as oil pans, brackets, transfer cases, and adapter plates.

Other major employers include Toyota Boshoku Tennessee (Madison), which supplies stamped and welded parts for more than 50 vehicle lines at several major assembly plants. More than 250 workers are employed at this facility, and in late 2017 the company announced plans to create 139 new jobs at the Jackson facility.⁶⁵ This facility is one of 18 North American locations for the Japanese parent company (TYO: 3116).

Eagle Bend Manufacturing (Anderson) manufactures body assemblies and structures like frames and other metal stampings. Eagle Bend is a subsidiary of Magna International, the world's third largest automotive parts supplier.⁶⁶ More than 700 Tennesseans work at Eagle Bend. In 2017, the company purchased a \$20 million press unit from the Hyundai Wia Corp. The 3,000 ton unit traveled all the way from South Korea to the Clinch River in Clinton, Tennessee by way of a barge.⁶⁷

Gestamp Chattanooga LLC, which employs hundreds of workers in Hamilton County, produces stampings like motor vehicle body paneling. Southtec LLC (Wilson) also employs hundreds of Tennesseans. Southtec manufactures products like oil pans and engine mounting brackets. E&E Manufacturing of Tennessee (McMinn) specializes in stamped and welded components for the automotive market.

⁶⁵ Business Facilities. (2017). *Toyota Boshoku Tennessee, LLC Expanding In Tennessee*

⁶⁶ Automotive News. (Jun. 2018). 2018 Top Suppliers.

⁶⁷ Gaines, J. (2017). Barge delivers metal press to Eagle Bend Manufacturing.

https://www.knoxnews.com/story/money/business/2017/03/13/barge-delivers-metal-press-eagle-bend-manufacturing/99124574/

In 2017, Tennessee's motor vehicle metal stamping industry earned \$398.7 million and sold \$2.7 billion in product. 21% of these sales were made to in-state customers, satisfying 31% of demand in Tennessee for motor vehicle metal stampings.

Workforce

Average earnings for this Tennessee industry were \$64,850 in 2017 (\$52,753 in wages and salaries and \$12,097 in supplements). Top occupations in this industry were identical to those found in Tennessee's seating and trim manufacturing industry: assemblers and fabricators; first-line supervisors of production workers; multiple machine tool setters, operators, and tenders; inspectors, testers, sorters, samplers, and weighers; and cutting, punching, and press machine setters, operators, and tenders.

Supply Chain

Key inputs for this industry were services from corporate, subsidiary, and regional managing offices (17.7% of which were acquired in-state), iron, steel, and ferroalloy products (15.7% in-state), machine shop services (16.9%), miscellaneous plastic products (17.8%), iron, steel pipe, and tube products made from purchased steel (7.8%). Wholesale trade agents and brokers were also a key upstream industry. Manufacturers in Tennessee utilized in-state wholesalers for 62.6% of these purchases. Tennessee companies benefit

Automobile manufacturers are the primary buyers of motor vehicle metal stampings. Transactions with Tennessee-based automakers accounted for 59% of in-state sales and 12% of total sales for businesses in this industry.

Industry Outlook

Revenue for motor vehicle metal stamping grew tremendously in recent years due to an increase in car sales. Declining consumer confidence will lead to fewer new car sales in coming years, negatively impacting revenue for motor vehicle metal stamping. Rising gas prices will lead many consumers to consider smaller, fuel-efficient vehicles instead of SUVs or light trucks. Smaller vehicles require fewer stamped components, which will also hurt industry revenue. Regulations concerning fuel efficiency will re-enforce the trend toward lighter vehicles. To meet efficiency standards, vehicles need to be lighter and involve less overall bodywork. Motor vehicle stamping manufacturers are increasingly utilizing aluminum and alloys instead of steel. The prices of advanced materials like carbon fiber continue to fall, making these products a viable substitute for traditional materials.

Industry demand is expected to fall due to a slowdown in new car sales. Establishments will consolidate further due to reduced demand. Improved production efficiency will allow the major industry players to continue growing revenue. Manufacturing operations are becoming more and more automated.

Due to the large size and weight of metal components, domestic producers have a built-in advantage over importers in this industry. Manufacturers of metal stampings rely greatly on local suppliers for production materials. Tennessee manufacturers benefit from proximity to automotive assemblers and a strong regional market for metal wholesaling.⁶⁸ Tennessee has 168 metal service centers, which employ 2,633 workers across the state. Metal wholesalers in Tennessee earned more than \$200 million in 2017.

⁶⁸ IBISWorld. (Aug. 2018). *Pedal to the metal: Stronger car sales and more efficient operations will foster revenue growth.*

Other Motor Vehicle Parts Manufacturing

Businesses in this industry (NAICS 336390) manufacture motor vehicle parts and accessories not included in other cluster industries. This industry also includes establishments primarily engaged in rebuilding motor vehicle parts and accessories. Major products include air bag assemblies, catalytic converters, engine exhausts, mufflers, radiators, air-conditioners, air filters, compressors, and wheels.

Tennessee has 70 business locations in this industry, which employ 11,769 workers. Tennessee ranks fourth in the nation and first in the Southeast region for industry employment as well as total establishments. Since 2013, employers in Tennessee added 2,346 new jobs. This fiveyear growth rate of 25% outpaced the national rate of growth (14%). Nearly half of this job creation was attributable to reasons unique to Tennessee's competitive strength in this industry. Tennessee added more jobs in this industry between 2013 and 2018 than any state besides Michigan.

Employment in this industry is 267% more concentrated in Tennessee than the average state. Tennessee ranks fourth in the nation and second in the region behind Georgia for employment concentration.

Nearly 2,000 jobs are located in Bedford County. Calsonic Kansei in Shelbyville produces car air-conditioner systems, heat exchangers, exhaust systems, and electro-mechanical parts. Anderson County has more than 1,700 jobs and two business locations, the largest of which is AISIN Automotive Casting TN Inc. in Clinton. This company specializes in automotive parts like water pumps, oil pumps, timing chain cases, and pistons.

DeKalb County is home to more than 1,100 industry jobs. DeKalb's employment concentration is the fourth highest of any U.S. county for this industry. Tenneco Automotive Operating Inc. in Smithville creates exhaust system products like manifolds, mufflers, and tail pipes. In October 2018, Tenneco (NYSE: TEN) acquired power train and engine manufacturer Federal-Mogul, which has locations in Sevierville and Lawrenceburg.

Other major employers include DURA Automotive Systems (Lawrence), which creates glass products for motor vehicles. FICOSA North America (Putnam) manufactures rear-view mirrors for trucks, vans, and automobiles. Cummins Filtration (Putnam) produces automotive filtration products used in fuel systems, anti-lock braking, power steering, and transmissions. The headquarters for Cummins Filtration, which employs 6,000 workers at 23 locations, is located in Nashville, Tennessee. ABC Technologies, Inc. (Sumner) manufactures blow-molded plastic products at its Gallatin plant.

Tennessee also has several major companies that serve the automotive market but are not classified within an automotive industry. MAHLE Filter North America (Rutherford) manufactures aluminum and steel pistons as well as air induction systems, air cleaners, air ducts, carbon canisters, thermoplastic cylinder head covers, and fuel and oil filters. More than 400 workers are employed at this Murfreesboro facility. Mahle GmbH, the German parent company, is the fifteenth largest automotive supplier in the world.⁶⁹

Tennessee has several glass companies that fall within the automotive cluster. Magneti Mareli's automotive lighting plant in Pulaski (Giles County) produces headlamps and rear lights for automotive assemblers like Chrysler, Mercedes, and GM. Carlex Glass America (Davidson; Monroe) manufactures glass products at its Nashville and Vonore facilities. The company is headquartered in Nashville and has a distribution center in Lebanon. AGC Glass North America (Hawkins) has the highest market share for laminated and tempered glass in the automotive glazing market.

⁶⁹ Automotive News. (Jun. 2018). 2018 Top Suppliers.

Tennessee has several rubber product manufacturers specializing in the automotive industry, including Saargummi Tennessee LLC (Giles), Tepro Inc. (Knox), and Hutchinson Sealing Systems Inc. (Hawkins). Eaton Aeroquip (Dyer) produces hoses with automotive, industrial, and aerospace applications. Tennessee is home to several major tire manufacturers as well, including Bridgestone Americas (Rutherford; Morrison), Carlstar Group (Anderson), Hankook Tire Corporation (Montgomery), Specialty Tires of America (Unicoi), and Mitchell Industrial Tire Company (Hamilton). Bridgestone Americas is headquartered in Nashville.

Adient (Henderson) uses automated welding, assembly, and fabrication to create seating mechanisms, wirings, rods, and other components. Alcoa Inc. (Blount) supplies aluminum sheeting to automotive companies like Ford. SumiRiko Tennessee Inc. (Greene; Claiborne) manufactures rubber hoses, anti-vibration components, and engine mounts. Taiho Manufacturing of Tennessee LLC (Smith) manufactures plastic products like seals and gaskets for the automotive sector. Toyota has recognized the Taiho Gordonsville plant as one of its top suppliers.⁷⁰ Kawasaki Tennessee Inc. (Hamblen), manufacturer of aluminum and machined automotive parts, has also received a Toyota supplier award.⁷¹ HP Pelzer (McMinn) creates interior automotive products like insulators and molded carpets. Kauffman Engineering (Cumberland) produces wire harness and cable assemblies for a number of markets, including automotive. Waupaca Foundry's Etowah plant (McMinn County) produces brake calipers and other components for light vehicle and commercial vehicle assemblers.



In 2017, this Tennessee industry earned \$731.3 million after completing \$5.2 billion in sales. Tennessee manufacturers captured the majority of in-state demand (76%) with only 20% of total sales. The other 80% of sales were transacted with customers outside Tennessee.

Workforce

Average earnings for this industry in Tennessee are \$63,469, with \$51,642 in wages and salaries and an additional \$11,827 in supplements. When adjusting for cost-of-living differences between the states, Tennessee's average wages are nearly equal to the regional and national averages for this industry. The labor force in this industry is identical in composition to Tennessee's other motor vehicle parts industries. Assemblers and fabricators were the most common occupation, followed by first-line supervisors, machine operators, and inspectors. High school diploma or equivalency tended to be required for most entry-level positions in these occupations.

https://corporatenews.pressroom.toyota.com/releases/toyota+suppliers+2016+awards.htm ⁷¹ Citizen Tribune. (2017). *Kawasaki Tennessee, Inc. receives Supplier Award from Toyota*.

https://www.citizentribune.com/news/business/kawasaki-tennessee-inc-receives-supplier-award-from-toyota/article_a9c46802-1cc2-11e7-a38f-034f78d16434.html

⁷⁰ Toyota. (2016). *Toyota Suppliers Recognized for Superior Performance At Annual Event*.

Supply Chain

Manufacturers in this industry utilize a wide range of inputs, due to the diversity of products made by these establishments. The most common inputs are services from corporate, subsidiary, and regional managing offices (16.8% of which were acquired from other Tennessee companies), motor vehicle metal stampings (29.0% in-state), sales between motor vehicle parts manufacturers (98.7% in-state), iron, steel, and ferroalloy products (12.9%), machine shop services (15.7%), miscellaneous plastic products (18.1%), and plastics material and resins (14.8%).

Like other motor vehicle part manufacturers, businesses in this industry made the largest percentage of its sales to automotive assemblers. Sales to Tennessee automotive manufacturers accounted for 30% of in-state transactions and 6% of total sales transactions.

Industry Outlook

Profits have soared recently due to strong demand in the U.S. for new vehicles. Sales of new vehicles are expected to decline through at least 2023, but positive momentum will allow automotive parts manufacturers to sustain revenue growth. Surging demand for industry products in the past few years led to increased production capacity at manufacturing plants. To accommodate demand, manufacturers found ways to improve efficiency and increase automation. Rising profits enabled companies to invest greater resources in research and development. New R&D programs reinforced revenue growth by spurring product innovation. For many types of automotive parts, the trend in innovation has been towards high-tech products that easily interface with motor vehicle electrical systems. Improved product portfolios will be the saving grace for manufacturers during the current lull in demand.

Recent trends have impacted automotive part companies differently based on the type of product being manufactured. Importers have been the most competitive in markets for light-weight, low-cost products like air filters, which can be made by low-skilled labor forces. Manufacturers of technology-intensive products are less impacted by import competition. Unfortunately, proximity to automotive assembler remains a key ingredient to success across automotive parts manufacturing industries. The decision of automakers to offshore production creates strong pressure on parts manufacturers to follow suit. The future of automotive parts manufacturing hinges greatly on the success of domestic motor vehicle production. American-owned automakers will likely continue offshoring production to Mexico and other nations with low-cost labor. However, recent expansions in the U.S. market by foreign-based automotive companies point toward a strong future for automotive parts manufacturers in Tennessee.⁷²

⁷² IBISWorld. (Aug. 2018). *High gear: Industry operators will benefit from an improving economic climate.*

Export Markets

In 2017, Tennessee companies exported \$5.85 billion in motor vehicles and motor vehicle parts and accessories. Exports of these products have increased 28.0% in the last five years. Major markets for these Tennessee-made products were Canada (\$3.26 billion), Mexico (\$708.69 million), Japan (\$376.14 million), China (\$336.26 million), and South Korea (\$200.40 million).



Exports by Industry

The motor vehicle manufacturing industry (NAICS 3362) accounted for the most significant percentage of export revenue for Tennessee's automotive cluster. Exports of Tennessee-made motor vehicles totaled \$2.90 billion in 2017. Major markets for these products were Canada (\$1.87 billion), China (\$208.63 million), Mexico (\$145.64 million), South Korea (\$141.19 million), and Australia (\$136.16 million). The Canadian market generated nearly three times more revenue than the entire market in Asia. Revenue from motor vehicle exports has increased 83.4% since 2013.

Motor vehicle parts manufacturing (NAICS 3363) contributed slightly less to total exports. The value of these exports in 2017 was \$2.71 billion. The most profitable export markets for Tennessee manufacturers were Canada (\$1.28 billion), Mexico (\$487.63 million), Japan (\$368.76 million), China (\$126.81 million), and South Korea (\$54.36 million).

Exports of motor vehicle bodies and trailers (NAICS 3362) in 2017 amounted to \$233.50 million. Major markets were Canada (\$113.91 million), Mexico (\$75.43 million), Russia (\$5.07 million), South Korea (\$4.88 million), and Japan (\$4.73 million). Exports to Canada generated more revenue

than Asian and European markets combined. Exports to Mexico also exceeded the value of exports to Asia and Europe.

Tennessee manufacturers performed very well in export markets relative to other U.S. manufacturers. Tennessee ranked in the top ten among U.S. states for exports of motor vehicles, motor vehicle parts, and motor vehicle bodies and trailers. Tennessee ranked first in the Southeast region for exports of motor vehicle parts, specifically.

Exports by Commodity

Rear-view mirrors were the top export of motor vehicle body parts in 2017 (\$59.45 million), followed by seating parts (\$59.08 million), airbags (\$49.55 million), mountings (\$34.79 million), and safety glass including windshields (\$33.57 million).

The top exports of chassis and power train parts were steering wheels, columns, and boxes (\$260.93 million), suspension shock absorbers (\$114.78 million), gas apparatuses including catalytic converters (\$113.59 million), brakes (\$94.88 million), and driving axles (\$71.81 million).

For electrical components, storage batteries had the highest export value for Tennessee manufacturers in 2017 (\$103.39 million), followed engine generators (\$93.48 million), compressors including compressors for vehicular use (\$73.69 million), lighting equipment (\$71.14 million), and airbag components (\$49.55 million).

Tennessee manufacturers sold \$309.66 million of engine parts in foreign markets and \$242.25 million in ignition engines. A more detailed look at Tennessee's automotive exports is included in Appendix B of this paper.

Recent Projects

The Haslam Administration has been instrumental in the continued growth of the automotive cluster in Tennessee. Since 2011, the Department of Economic and Community Development has received 319 project commitments to create 47,075 jobs. Total capital investment exceeds \$10.6 billion.

63.1% of jobs created through these projects qualify as high-quality jobs, with wages above the county median wage. The automotive cluster has the third highest percentage of high-quality job creation of any Tennessee cluster besides energy technology and business services.

Company	New Job Commitments	Capital Investment (\$)	County	Date
GM Spring Hill Manufacturing	2,350	\$244,000,000	Maury	11/21/2011
Volkswagen Group of the Americas	2,000	\$600,000,000	Hamilton	7/14/2014
Hankook Tire Co., Ltd	1,800	\$800,000,000	Montgomery	10/14/2013
GM Spring Hill Manufacturing	1,431	\$1,020,000,000	Maury	4/27/2016
Nissan North America, Inc.	1,400	\$0	Rutherford	10/19/2012
Denso Manufacturing Tennessee, Inc.	1,000	\$1,000,000,000	Blount	10/6/2017
SL Tennessee, LLC	1,000	\$80,500,000	Anderson	7/25/2014
Volkswagen Group of the Americas	1,000	\$0	Hamilton	3/1/2012
Nissan North America, Inc.	1,000	\$160,000,000	Rutherford	3/17/2015
Nissan North America, Inc.	900	\$0	Rutherford	6/27/2013

	2018 Employment by Industry (NAICS)											
County	32621	33611	33612	33621	33631	33632	33633	33634	33635	33636	33637	33639
Anderson	840			42		<10		<10	653		37	1,743
Bedford				69			48					1.947
Benton							_					1-
Bledsoe				<10								
Blount	80			33	<10	3.651			46		<10	<10
Bradlev	34				<10	6	52		_		-	-
Campbell	_			19	<10	_	_					<10
Cannon										57		
Carroll		222										
Carter												67
Cheatham												•.
Chester												<10
Claiborne				69		<10						
Clay				0.5						<10		
Cocke												<10
Coffee				20	<10					713	25	599
Crockett				<10	10					715	23	333
Cumberland				36								<10
Davidson	37		14	12	66	<10	<10	<10	16	99	<10	73
Decatur	57			29	00	10	10	10	10	55	10	<10
DeKalb				25				14		2		119
Dickson					422					171	499	115
Dver				<10	122		565		<10	.,.	155	57
Eavette				10			303		10			24
Fentress												
Franklin				43					<10	1 424		
Gibson					<10	<10		23	12	165	<10	<10
Giles						12	163			349		<10
Grainger				49								
Greene				143	422						<10	<10
Grundy										136		
Hamblen					1,977				369	17		63
Hamilton	187	272		1	17	24		36	<10	339	388	572
Hancock	_			16								-
Hardeman						2			57			
Hardin				<10								<10
Hawkins				<10			475					315
Haywood				<10	<10						<10	<10
Henderson					<10					94		
Henry					<10		<10	<10			<10	15
Hickman					<10							
Houston											2	
Humphreys												<10
Jackson				<10								19
Jefferson						76						
Johnson												
Knox	28			50	11	<10			616	32	21	414
Lake												

Appendix A: Industry Employment by County

Automotive Cluster

						2018 Em by Indust	ploymen ry (NAIC	t S)				
County	32621	33611	33612	33621	33631	33632	33633	33634	33635	33636	33637	33639
Lauderdale					<10							31
Lawrence			<10		73							368
Lewis				<10								
Lincoln										172		
Loudon				21								34
Macon												<10
Madison					45	<10					416	295
Marion												
Marshall				16				592		99	627	<10
Maury	28	3,763		22	<10	<10				198	<10	640
McMinn	26			332	1,313	<10		3		665	351	<10
McNairy												<10
Meigs												
Monroe				14			164			436		<10
Montgomery	496				<10	<10	494	55			<10	<10
Moore				<10	<10	<10					<10	<10
Morgan												
Obion	<10											
Overton					<10							15
Perry												
Pickett												
Polk												
Putnam					12	73			418		133	872
Rhea	14									655	<10	
Roane											3	
Robertson				<10	2	162	<10				458	194
Rutherford	983	13,893		252	19	1,456	<10		<10	424	625	37
Scott				229	142	<10	177				<10	<10
Sequatchie					<10							<10
Sevier				50	197							
Shelby				24	5	53	<10	<10	93	96	<10	79
Smith					28				28			278
Stewart						129						
Sullivan		28		<10	<10	<10				<10		55
Sumner				39	<10	140			12	<10	1,757	549
Tipton	<10			<10	<10	33					<10	11
Trousdale												
Unicoi	288											
Union												
Van Buren												
Warren	87			14	<10		1,531			<10	16	
Washington				<10	<10	<10		48			<10	<10
Wayne												28
Weakley					<10	<10					<10	<10
White				13		412	269			47		
Williamson				<10	<10	23				45.	<10	135
Wilson Total	30 3,941	2,792	<25	19 2,212	<10 5,272	<10 6,543	393 671	1,377	276	154 782	60 6,455	<10 11,769

Appendix B: Exports by Commodity

Commodity	HTS Code	2017 Export Value (\$)		
Bodies and Parts		value (+)		
Safety Glass (including Windshields)	7007	33.574.075		
Rear-View Mirrors	70091	59,449,033		
Locks	83012	240.655		
Mountings	83023	34.788.803		
Motor Vehicle Bodies	87071	1.012.000		
Motor Vehicle Bodies (Public Transport)	87079	6.270.704		
Bumpers	87081	15,580,200		
Seat Belts	870821	390.816		
Airbags	870895	49.547.329		
Seating	94012	6.716.331		
Seating Parts	94019	59.084.048		
Chassis and Drivetrain Parts				
	400912	4,749,598		
	400922	217.197		
Brake Hoses	400932	13,992,851		
	400942	2,548,193		
	681381	209,608		
Brake Linings & Pads	681389	9.639		
Lugnuts	731816	22.042.929		
Leaf Springs	732010	1.447.374		
Helical Springs	732020	5,944,172		
Gas Filter/Purifier Apparatuses (including Catalytic Converters)	842139	113,593,370		
Ball Bearings	848210	39,995,892		
Tapered Bearings	848220	41,809,965		
Needled Roller Bearings	848240	2.049.439		
Brakes	870830	94,875,496		
Gear Boxes	870840	68,568,500		
Drive Axles	870850	71.807.343		
Wheels	870870	31,274,883		
Suspension Shock Absorbers	870880	114.775.433		
Radiators	870891	21.385.554		
Mufflers and Exhaust Pines	870892	11.927.287		
Clutches	870893	38,187,953		
Steering Wheel Columns and Boxes	870894	260.933.297		
Camping Trailers	871611	45,385		
Unloading Trailers	871620	104.763		
Tanker Trailers	871631	3,242,763		
Transportation Trailers	871639	8,287,586		
	871640	609 238		
Vehicles Not Mechanically Propelled NESOI	871680	2 608 723		
Trailers and Other Motor Vehicle Parts	871690	7 741 245		
Electrical and Electric Components	0/1050	,,, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
Compressors (including for Motor Vehicles)	841430	73 687 036		
Eans (including for Motor Vehicles)	841459	23 166 587		
Automotive Air Conditioners	841520	151 679		
Air Conditioners (not including Refrigerators)	841583	724 326		
	850710	1 306 733		
Nickel-Iron Storage Batteries	850740	2 722		
Storage Battery Parts	850790	103 391 371		
Spark Plugs	851110	12,158,640		

Engine Magnets	851120	6,228
Ignition Coils	851130	20,238,456
Starter Motors	851140	33,949,703
Engine Generators NESOI	851150	93,484,215
Voltage Regulators	851180	3,170,670
Generator Parts and Parts NESOI	851190	19,635,722
Lighting Equipment	851220	71,144,381
Signaling Equipment	851230	4,222,451
Windshield Wipers	851240	100,522
Lighting Equipment Parts	851290	15,248,026
Radio Telephones	851712	504,396,715
Other Transmission Apparatus	852560	23,681,185
Radiobroadcast Receivers, Battery Type NESOI	852719	11,272
Radiobroadcast Receivers for Motor Vehicles	852721	12,692,139
Radiobroadcast Receivers for Motor Vehicles NESOI	852729	83,047
Beam Lamp Units	853910	2,526,110
Ignition Wiring Sets	854430	11,182,182
Motor Vehicle Airbags	870895	49,547,329
Revolution Counters	902910	118,748
Other Speedometers	902920	40,015,424
Revolution Counters Parts and Accessories	902990	653,700
Instrument Panel Clocks	910400	164,467
Engines and Parts		
Spark Ignition Piston Engines	840732	84,235
Compression Ignition Engines	840820	242,249,281
Engine Parts	840991	309,662,052
Engine Parts NESOI	840999	331,500,965
Fuel Injection Pumps	841330	83,240,759
Fuel Injection Pump Parts	841391	80,032,788
Turbochargers	841459	23,166,587
Turbochargers/Superchargers	841480	130,677,503
Oil or Fuel Filter	842123	45,705,279
Air Filters	842131	26,008,275
Transmission Shafts & Crankshafts	848310	100,916,083
Misc. Parts		
Brake Fluid	381900	2,911,485
Anti-Freeze	382000	1,282,404
Mechanical Articles	401699	12,523,896
Jacks	842549	4,826,187
Lifting Machinery	842691	28,155,151
Winches and Jacks Parts	870891	21,385,554
Parts and Accessories NESOI	870899	358,745,450
Trailer Parts and Accessories NESOI	871690	7,741,245