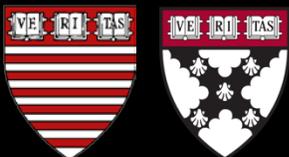


# Ohio

## Automotive Cluster



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## I. Introduction

The Ohio automotive cluster has shrunk substantially in recent decades, but it remains a key industry for the state's economy. It faces significant challenges going forward as it is caught between being highly-skilled and knowledge-driven and being low-cost. If the cluster is to contribute to Ohio's prosperity in the future, it must find a way to innovate in the products it produces, the ways it produces them, or the interactions it has with its customers.

Collaboration between firms is increasingly important to achieving innovation in vertically disintegrated supply chains and Ohio must pursue a strategy to engender such collaboration in the automotive cluster. This report surveys the cluster and provides initial recommendations to accomplish such a goal.

## II. Competitive Landscape

### 1. United States

#### 1.1. Economic Background

With a GDP of \$18.56 trillion<sup>1</sup> in 2016, the United States is the world's largest economy<sup>2</sup>, and the third largest in terms of population, home to 326.6 million people<sup>3</sup>. Its GDP per capita in 2015 on a PPP basis was \$56,115, ranked at the fifth place among other OECD countries behind Luxembourg, Ireland, Switzerland and Norway.

The U.S has benefited from the legacy of abundant natural resources, greatly developed infrastructure as well as well-educated and productive workforce. The free-market environment and functional legal and financial systems have attracted both physical and

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<sup>1</sup> Bureau of Economic Analysis. News Release.

[https://bea.gov/newsreleases/national/gdp/2017/pdf/gdp1q17\\_adv.pdf](https://bea.gov/newsreleases/national/gdp/2017/pdf/gdp1q17_adv.pdf)

<sup>2</sup> World Bank. Gross Domestic Product Ranking. <http://databank.worldbank.org/data/download/GDP.pdf>

<sup>3</sup> United States Census Bureau. US and World Population Clock. <https://www.census.gov/popclock/>

human capital to the country. The general population as well as diversity of immigrants have brought about entrepreneurial spirits that foster innovation as well as research and development.

In recent years, the dynamism of the US economy has been driven by a highly-developed and technologically-advanced segment services sector. It accounts for over almost 80 % of the total GDP<sup>4</sup>, mainly dominated by companies in areas such as technology, healthcare, financial services and retail. The manufacturing sector represents about 11.7 % of the total output in 2016<sup>5</sup> and the US has been a leader in high-valued industries such as telecommunications, automobiles, aerospace and chemicals. The agricultural sector contributes less than 2 % of the total output<sup>6</sup>. Nevertheless, the vast arable land, advanced farming technology and the government subsidies have made the US a net food exporter and the world's leading food exporter<sup>7</sup>.

Recent decades have also seen the U.S. run a growing trade deficit (figure 1). Its top trading partners include the European Union, China, Canada and Mexico<sup>8</sup>. In 2014, the U.S. main exports are capital goods such as industrial machines, and electronic hardware, accounting for 25% of the total export (excluding automobiles)<sup>9</sup>, while for imports, electronics make up the largest import category, followed by oil<sup>10</sup>.

In the last decade, the U.S. economy was marred by the Global Financial Crisis, which began in 2007 with the collapse of the U.S. housing market. The years since the Great Recession

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<sup>4</sup> The World Factbook. <https://www.cia.gov/library/publications/the-world-factbook/fields/2012.html>

<sup>5</sup> Bureau of Economic Analysis. Value Added by Industry as a %age of Gross Domestic Product. [https://www.bea.gov/industry/gdpbyind\\_data.htm](https://www.bea.gov/industry/gdpbyind_data.htm)

<sup>6</sup> Idem.

<sup>7</sup> US Economic Outlook, Focus Economics

<sup>8</sup> US Census Bureau. US Top Trading Partners. <https://www.census.gov/foreign-trade/statistics/highlights/top/top1312yr.html>

<sup>9</sup> "The Atlas of Economic Complexity," Center for International Development at Harvard University, <http://www.atlas.cid.harvard.edu>

<sup>10</sup> Idem.

have been marked by an uneven recovery. GDP grew by more than 20% from 2010 to 2015<sup>11</sup> and unemployment fell to 4.5% in March 2017<sup>12</sup>, but the U.S economy still faces variety of challenges. These include wage and productivity stagnation, rising income inequality, large current account and government deficits, and policy uncertainty under the Trump administration.

### *1.2. Macroeconomic Competitiveness*

**Fiscal Policy** - The U.S government has run a fiscal budget deficit continuously for several decades, except for a few years around the turn of the century (1998-2001)<sup>13</sup>. Government debt ballooned in the years after the Global Financial Crisis as a result of counter-cyclical fiscal policy and falling tax revenues. The total public debt to GDP at the end of 2016 was 105.9 %<sup>14</sup>.

Around 60 % of the government expenditure is allocated to mandatory spending through the entitlement programs such as Social Security and Medicare. The rest is allocated to discretionary spending such as public services, and military and defense. About 56 % of the government revenue is from the income tax on individuals with additional 6 % coming from businesses and corporates. Another 34 % of the collections came from payroll and Social Security taxes.

**Monetary Policy** - The Federal Reserve employs the dual mandate of promoting price stability and full employment. The Federal Open Market Committee (FOMC) is the Fed's monetary policymaking body and meets about eight times a year to discuss the U.S. economy's outlook and different policy options. Before the Global Financial Crisis during 2007-2008, the Fed used the federal fund rate as the key monetary instrument to influence the short-term market rates

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<sup>11</sup> <http://www.tradingeconomics.com/united-states/gdp>

<sup>12</sup> Bureau of Labor Statistics News Release: The Employment Situation. April 7 2017. <https://www.bls.gov/news.release/pdf/empst.pdf>

<sup>13</sup> Congressional Budget Office: Budget and Economic Outlook. <https://www.cbo.gov/publication/52370>

<sup>14</sup> Debt and Deficit Facts. [http://www.usgovernmentspending.com/debt\\_deficit\\_brief.php](http://www.usgovernmentspending.com/debt_deficit_brief.php)

and the economy. In the years since the crisis, the interest rates were reduced to near the zero lower bound. In response, the Fed resorted to the unconventional policy of “quantitative easing”, which involved large purchases of financial assets starting in December 2012.

The Fed ended quantitative easing on October 29, 2014<sup>15</sup> and has signaled that it will follow a path of raising policy rates in the coming years. This is a response to signs of an improving U.S. economy. Not only has unemployment dropped below pre-crisis levels<sup>16</sup> and the inflation rate gradually increased, but the economy has shown resilience despite the volatilities in the global financial markets, a strengthening US dollar, and subdued global demand.

### *1.3. U.S. Diamond Analysis*

According to the 2016-2017 Global Competitiveness Index (GCI) by the World Economic Forum, the US is ranked at the third place out of 140 countries, trailing behind only Switzerland and Singapore. The assessment suggests that the US’s position is driven mainly by innovation, business sophistication, market size, financial market development, labor market efficiency, and higher education and training. Yet the country is underperforming on specific sub-metrics such as Institutions (ranked 27<sup>th</sup>) and Health and primary education (ranked 39<sup>th</sup>)<sup>17</sup>.

**Factor Conditions** - The U.S has a large pool of skilled labor at its disposal. In 2014, the U.S. had approximately 9.1 researchers per 1000 people, ranking at the 13th place among other OECD

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<sup>15</sup> Federal Reserve Issues FOMC statement. <https://www.federalreserve.gov/newsevents/pressreleases/monetary20141029a.htm>

<sup>16</sup> Bureau of Labor Statistics. <https://data.bls.gov/timeseries/LNS14000000>

<sup>17</sup> World Economic Forum Competitiveness Index. <http://reports.weforum.org/global-competitiveness-index/country-profiles/#economy=USA>

countries (the average OECD was 8.04) just the same level as Slovenia, but considerably below Korea (13.4)<sup>18</sup>. In terms of the gross domestic spending on research and development (R&D), it ranked at the tenth place at 2.79% of the total GDP (the average OECD was 2.40%). 17 out of the 20 best universities in the world are the U.S universities (QS World University Rankings 2016-2017).

In terms of innovation, the U.S had about 89.4 patents registered per 100,00 people, the third place among the OECD countries after South Korea and Japan (Figure 2). The U.S also has the most sophisticated and developed financial markets and infrastructure in the world, which helps intermediating funds for businesses and innovation development. In 2015, there were 800 venture capital (VC) firms and 1,200 VC funds raising over \$28 billion. Not surprisingly, the venture capital ecosystem revolves around the world's renowned Silicon Valley, the hi-tech cluster situated in San Francisco, California (National Venture Capital Association 2016).

Despite strengths in innovation, productivity is largely stagnant (Figure 3). The U.S. has fallen behind in education, threatening its historic competitive advantage. Additionally, the aging of the U.S. population means that the labor force is shrinking and dependency rate is rising, adding future fiscal constraints and reducing future growth prospects. If the U.S. can maintain its historical strength in attracting immigrants, it may be able to blunt these impacts, but recent political trends, highlighted by the election of President Donald J. Trump cloud this possibility.

**Demand Conditions:** The U.S is home to over 300 million people with high GDP per capita, which generates strong domestic demand. Household consumption comprises 69% of the total

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<sup>18</sup> OECD Data. Researchers. <https://data.oecd.org/rd/researchers.htm>

GDP<sup>19</sup>. In terms of buyer sophistication, the U.S was ranked at 10th according to GCI index 2016.

In recent years, the U.S. has experienced rising income inequality and stagnant wages. Since 1999, median real household income has declined. The stagnating income and lower job prospects have disproportionately affected the low and middle-income segments, exacerbating the inequality<sup>20</sup>. According to the IMF report on the U.S economic outlook July 2016, the middle-income segment has seen its incomes fall since 2000 lowering aggregate consumption. Moreover, the rapid rise in medical and pension costs for the aging population means that Americans would have lower disposable income in the future.

**1.3.c. Supporting and Related Industries** - U.S. business across many clusters are thriving. Large corporations and other firms that can tap highly-skilled workers are doing well. These businesses have regular and easy access to the capital markets, research universities, entrepreneurial context, innovation infrastructure and high quality management. These advanced firms provide a strong breadth and depth of suppliers that are beneficial for different industries. Unfortunately, many smaller businesses and lower-skill workers are unable to share in this prosperity.

**Context for Firm Strategy & Rivalry** - According to the Doing Business Report 2017, the U.S was ranked at 8th place for the overall ease of doing business score, one place behind its ranking in 2016<sup>21</sup>. One of the areas, in which the United States lagged behind the most compared to 2016, is Starting a Business, currently ranked 51<sup>st</sup>, demoted from 45<sup>th</sup> just a year

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<sup>19</sup> Household final consumption expenditure. <http://www.tradingeconomics.com/united-states/household-final-consumption-expenditure-etc-%of-gdp-wb-data.html>

<sup>20</sup> Rivkin, Desai, Raman and Porter, 2016, Problems Unsolved and A Nation Divided, September 2016

<sup>21</sup> Doing Business. <http://www.doingbusiness.org/data/exploreconomies/united-states>

ago<sup>22</sup>. In terms of government effectiveness, the World Governance Indicators place the US in the upper 80<sup>th</sup> %ile of rankings<sup>23</sup>. The ranking takes into accounts of the regulations relating to business activities and the protection of property rights. For the sub-ranking, the country has high scores in the areas of 'Getting Credit' (2nd) and 'Resolving Insolvency' (5th)<sup>24</sup>.

The Executive Opinion Survey 2016 by World Economic Forum (WEF) indicates that tax rates, tax regulations, and inefficient government bureaucracy are the most problematic factors for doing business in the US. Findings from Harvard Business School based on interviews with HBS alumni reveal similar stories. Most alumni agree that the biggest impediment for business development are areas that are heavily influenced by the federal government <sup>25</sup>Increasing political polarization has been a key impediment to policy changes that could improve the U.S business environment such as tax reform, immigration reform, and infrastructure investment. Moreover, the smaller businesses find themselves struggling more to stay competitive and have more pessimistic views over the U.S business environment than larger corporates.

## 2. Ohio

**Ohio automotive industry has been historically strong. However new important sectors like aerospace and hospitals are taking place.** Within the United States, the top three states for establishments related to automotive production, during the 20th century, were Michigan, Indiana, and Ohio. In the latter, a cluster of manufacturers that supplied air-filled tires; engine starters; metal, rubber, and plastic parts formed in the Central and Northwest region of the

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<sup>22</sup> Idem.

<sup>23</sup> World Governance Indicators. <http://info.worldbank.org/governance/wgi/index.aspx#reports>

<sup>24</sup> Idem.

<sup>25</sup> Rivkin, Desai, Raman and Porter, 2016, Problems Unsolved and A Nation Divided, September 2016

State, constituting the automotive cluster Please see figure 5. Other important industries in the State are the chemical sector, coal and mining, iron and steel mills, woods products and food manufacturing. Currently aerospace and medical services have joined into the production space. The financial crisis of 2007 triggered a crisis in the American auto-industry which resulted in large job losses in the sector. (Hill et. al, 2005)

**Ohio is finally emerging from the deep recession but some economic indicators show performance is still behind pre-Lehman crisis levels.** GDP growth has been strong enough, compared to its neighbors Michigan, Indiana and Kentucky and West Virginia, placing it as the 7<sup>th</sup> largest regional economy of the country in 2015. Ohio's total GDP accounted for 3.4% of total U.S. GDP, compared with 3.6% a decade earlier. Ohio's economy grew more slowly than the U.S. as a whole during the ten years ending in 2015 and also grew slower than its neighboring states.

**In terms of per capita personal income, Ohio has experienced a steady increase on its levels but continues to stay below (90 % of) the national average.** Actually, since 1969 personal income has remained below the U.S. average and the gap has widened ever since. (See Figure 6). Ohio's personal income growth was closely synchronized with the U.S. trend until 1999, when the state's trend started to decelerate. (Ohio Legislative Service Commission, 2016)<sup>26</sup>

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<sup>26</sup> Ohio Facts 2016 Report.

**The unemployment rate has steadily decreased to half the levels of the crisis.** In 2016 was around 5 % compared to its peak of 10 % in 2009. In addition, the share of workers working part-time has declined significantly and the labor force participation is at levels consistent with its estimated long-run trend. **Nevertheless, it is important to notice Ohio's labor participation is at all time-low since 1979** (around 62 %). Regions like Appalachia and Eastern Ohio continue to show higher unemployment levels (ranging from 7 to 10 %), mainly because of its poor economic diversification. (Mester, 2016)

**Real wages are recovering but are still below 1979 levels and benefits have concentrated in higher income deciles.** In the period 1979-2015, wage increases are observed to happen after the sixth decile, with a higher concentration on the ninth income decile. The first deciles have only seen their wage reduced, particularly the middle class (Figure 7). This trend has provoked inequality to rise. Actually, **income inequality is very high in Ohio, with levels comparable to South American countries.** In Ohio, the top 1 % earning more than \$752,000 a year while the bottom 99 % combined earn less than 43,000 a year on average. (Hanauer and Granados, 2016) In 2010, the Gini coefficient (a measure of income inequality) for Ohio was 0.452<sup>27</sup> whereas for Venezuela in 2013 was 0.448<sup>28</sup>

**Overall-economic productivity has been lower than national average since 2004 with a consequential lower hourly compensation** which partially might explain why the real wages have not fully recovered. (Hanauer and Granados, 2016) (Figure 8). **Innovation levels are**

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<sup>27</sup> List of Gini coefficient for diverse states from the U.S. in 2010. Available at: [https://en.wikipedia.org/wiki/List\\_of\\_U.S.\\_states\\_by\\_Gini\\_coefficient](https://en.wikipedia.org/wiki/List_of_U.S._states_by_Gini_coefficient)

<sup>28</sup> World Bank Development Indicators.

**below national average and efforts have concentrated on vanguard sectors that require high-skilled workers.** This might explain why workers with less skills and lower income deciles in Ohio have not benefitted from the innovation going on; which rather seems reflected on its declining wage gains. **The Bloomberg 2016 U.S. State Innovation Index ranks Ohio as number 27 out of 50 in terms of innovation.** The Index scored each of the 50 states on a 0-100 scale across six equally weighted metrics: R&D intensity (Ohio scored 25); productivity (Ohio scored 22); high-tech company density (Ohio scored 32); concentration of science, technology, engineering and mathematics (STEM) employment (Ohio scored 20); science and engineering degree holders (Ohio scored 34); and patent activity (Ohio scored 23).<sup>29</sup> Please see Figure 9 for comparison with other states scores.

**Ohio's economy remains with a higher concentration in manufacturing with respect to the national average.** Output of the state's factories accounted for 18 % of Ohio's gross domestic product in 2015, while manufacturing's share of the national economy was 12 % (Ohio Legislative Service Commission, 2016). **Jobs have been shrinking in the Manufacturing and Trade, Transportation and Utilities sectors but still employ important shares of workers:** 12.7 and 18.7 %, respectively. (Hanauer and Granados, 2016). Please see Figure 10 and Figure 11. **The cars and vehicle parts cluster, heavily relies on manufacturing; nevertheless, jobs creation projections in the longer-term do not look promising,** as increasing automation continues to displace workers from the assembly lines or jobs migrate to southern states or to developing countries.

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<sup>29</sup> Report available at: <https://www.bloomberg.com/news/articles/2016-12-22/here-are-the-most-innovative-states-in-america-in-2016>

**A business-friendly environment with no corporate income tax:** Ohio has a generally friendly business climate and in fact its effective business tax rate was the third lowest in the country for 2011. Total employment increased by 1.8% between 2014 and 2015, with more than 50% of all firms having employees of only 0-4 people (Census data).

### **III. Ohio Automotive Cluster Diagnosis**

#### *1. U.S. Automotive History*

The automotive cluster has had profound impact on American society and economy. Ever since Henry Ford's pioneering techniques of mass automobile production in 1913, the automobile industry has produced transformative change not only in terms of the economic production, but also societal and economic impact where the industry have been located. America's auto-industry has its traditional base in the Midwest states of Michigan, Ohio, and Indiana, centered around the Motor City of Detroit. The growth of automakers, especially the "Big Three" of Ford, General Motors (GM) and Chrysler, gave rise to many related small businesses such as auto-part suppliers and machine shops. These small shops were scattered around the small towns of the upper Midwest, particularly in northern Indiana and Ohio. This spread jobs outside central cities and accelerated the process of urbanization in the region.

The automotive cluster has faced major challenges from international competition, technological advancement, and the stagnant economy. The Global Financial Crisis led to the U.S government's bailout of GM and Chrysler to prevent bankruptcies and millions of job loss. Since then, the industry has slowly recovered. Nevertheless, intense competitions to produce cheaper, high quality, and energy-efficient cars has put higher pressure on local firms to be more innovative and competitive.

## *Overview of the Automotive Cluster in Ohio*

Ohio is one of the centers of the U.S automotive industry with 70.5% of North America light vehicle production either in Ohio or within 500 miles of its border<sup>30</sup>. In 2015, 1.6 million light vehicles were assembled and produced in Ohio with Honda as the largest motor vehicle manufacturer. The company is also the highest motor vehicle industry employer in Ohio, employing 12,200 workers, followed by GM with 9,600, Fiat Chrysler with 6,200, and Ford with 5,900<sup>31</sup>. There are five automotive part suppliers listed on Fortune's U.S 1,000 with world headquarters in Ohio: Cooper Tire & Rubber, Dana, Goodyear Tire & Rubber, Parker-Hannifin and Worthington Industries. Twenty-one auto-related firms on Fortune's U.S 1,000 also have industrial plants in Ohio<sup>32</sup>. There are additional 580 establishments that directly or indirectly supply parts for the motor vehicle manufacturers, placing Ohio as the second, behind only Michigan, in terms of the number of active plants.

Ohio has experienced a decline in the overall employment with losses concentrated more heavily on the automotive cluster since 2001. From 2001-2005, Ohio's total employment decreased by 2.4 %. Employment took a nosedive following the Great Recession in 2007-2009. During the period, the total employment declined by 6.8 %, and the automotive cluster employment declined 32.3 % (Figure 12). In 2015, the automotive industry cluster's average annual pay was \$60,840. During this same time period, Ohio's statewide private industry average annual wage was \$46,582<sup>33</sup>

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<sup>30</sup> Columbus Economic Development. 500 Mile Radius from Columbus.  
[https://www.columbus.gov/uploadedfiles/Business\\_Development/500%20Mile%20Radius.pdf](https://www.columbus.gov/uploadedfiles/Business_Development/500%20Mile%20Radius.pdf)

<sup>31</sup> Ohio Development Services Agency. The Ohio Motor Vehicle Report. December 2016.  
<https://development.ohio.gov/files/research/B1002.pdf>

<sup>32</sup> Idem.

<sup>33</sup> Ohio Department of Job and Family Services. 2014-2024 Ohio Employment Projections: Automotive Industry Snapshot.  
<http://ohiolmi.com/proj/projections/JobsOhio/Automotive.pdf>

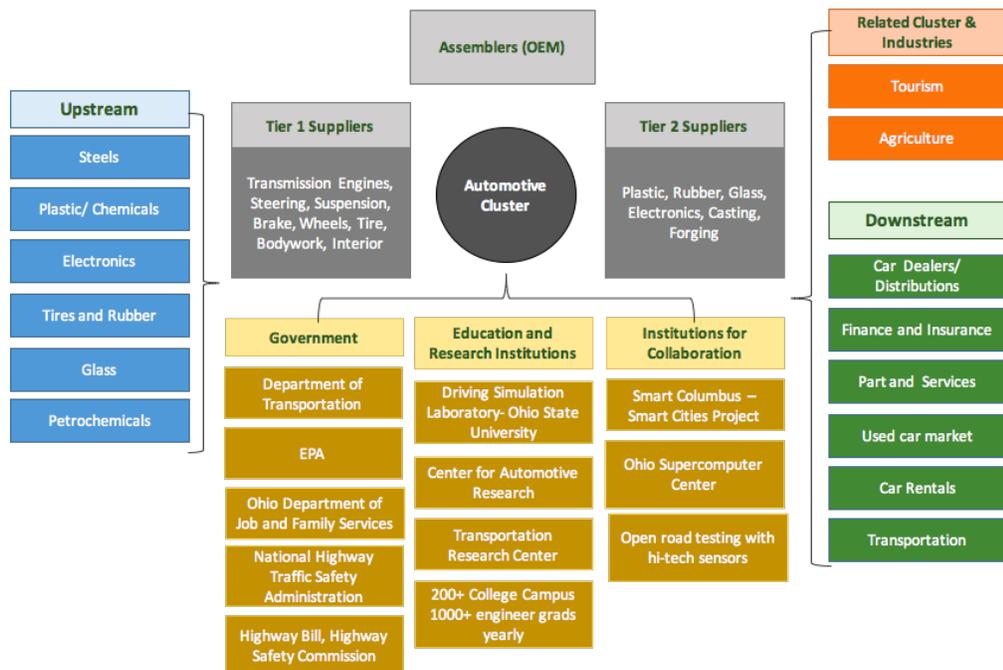
## 2. Cluster Map

The automotive cluster comprises three types of firms:

- 1) **Original Equipment Manufacturer (OEM):** they are motor vehicle manufacturers like Ford, GM and Chrysler that produce the final automobiles in the supply chain
- 2) **Tier 1 suppliers:** the Tier 1 companies supply parts that make up the cars such as engines, turbines, power transmissions, car bodies for OEM.
- 3) **Tier 2 suppliers or below:** these companies supply products or inputs such as plastics, glass, rubber, and electronics to suppliers up the value chain.

Roughly 100 Tier 1 companies operate in Ohio. They employed 66% of Ohio automotive workers (103,750 total) in 2014. The cluster in Ohio extends far beyond this concentration in Tier 1 suppliers and includes firms focused on inputs like rubber to car dealerships to government organizations like the Environmental Protection Agency (EPA).

Automotive Cluster Map



Source: US Cluster Mapping

### *3. Competition and Cooperation from Other States and Countries*

At the regional level, Michigan represents both a competitor and partner for the Ohio automotive cluster. Since 2010, Michigan announced more than \$23 billion in new automotive Original Equipment Manufacturers (OEM) and supplier investments, more than any other state or province in North America. Moreover, in 2014, Michigan's motor automotive GDP was \$36.9 billion while Indiana; Ohio and Texas' combined automotive GDP was \$38.9 billion . Moreover, Michigan is the only state, with more than \$200 thousand FDI, that has managed to increase the foreign direct investment in 4% between 2007 and 2012 despite the financial crisis. While Michigan draws potential capital away from Ohio, the health of the OEMs based in Michigan is critical to the health of the supplier-driven Ohio automotive cluster.

At the international level, the Ohio manufacturing industry has developed a close integration with Mexico for the assembly of high-value inputs which are then exported back to the US. In 2014, Mexico became the 2nd largest export destination for Ohio products related to transportation equipment, machinery, chemicals, plastic and rubber products, and fabricated metal products.

While much is made of the competition from low labor-cost countries like Mexico, more recently automakers have begun reshoring production to the U.S. as cost and production advantages in the U.S. reveal themselves. For example, the Ford's Ohio Assembly and the Cleveland Engine Plant have started to produce medium duty trucks and EcoBoost previously manufactured in Mexico and Spain respectively (AAPC 2016).

## Key Strategic Issues<sup>34</sup>

The Ohio Cluster has lost competitiveness due to a combination of factors including an focus on piece-price reduction strategies and poor collaboration between firms in the supply chain. Since the financial crisis, firms in tier 2 and below have been reluctant to increase investment in equipment or workforce training due to high uncertainty over the expected return and the time it will take for them to reap such benefits. Also, lower tier firms suspect that their customer will switch to another supplier if the same product is offered by a slightly lower cost. As a result, these firms have implemented strong cost-reduction strategies while squeezing value from tiers under them to remain competitive.

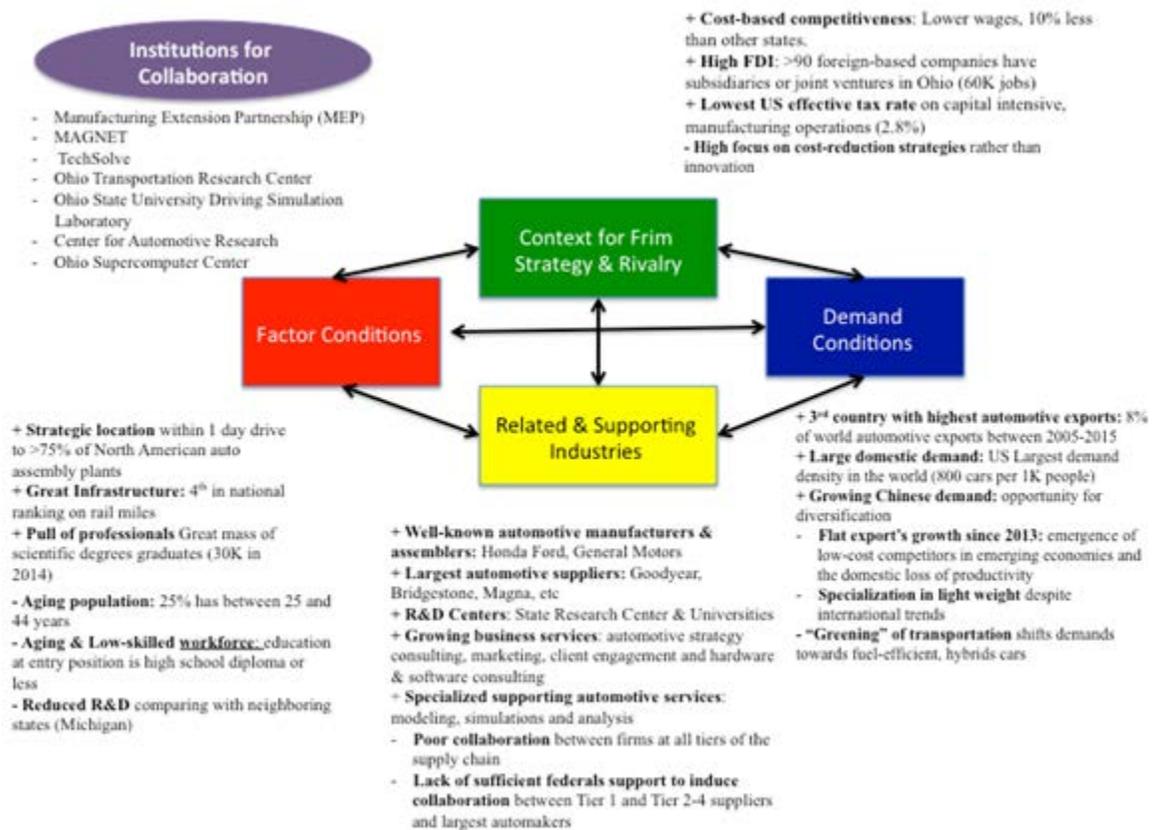
At Tier 1 level, firms express little interest in working collaboratively with their suppliers to reduce cost or add value provided that such engagement would require more time and money than a purely commercial transaction. Tier 1 suppliers also feel pressure to reduce spending due to regular piece-price reduction demands from major automakers facing foreign competition.

### *4. Ohio Automotive Cluster Diamond*

The automotive cluster diamond in Ohio presents strengths and weaknesses on each of the four dimensions. The State possesses strong advantages due to its strategic location and concentrations of firms at all sizes of the supply chain. However the financial crisis, loss of labor productivity, and a strong emphasis on cost-based competition have diverted attention from strategies focused on collaboration, innovation, and productivity gains that would provide a more sustainable economic growth for the cluster.

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<sup>34</sup> These issues have been described by Susan Helper in *The US auto supply chain at a crossroads. The implications of an industry in transformation.* Susan Helper. 2010



**Factor Conditions - The Ohio automotive cluster enjoys a strategic location for the automotive manufacture.** Ohio is within a one-day drive from more than 75% of North American auto assembly parts, Tier 1 and Tier 2 suppliers . The close integration of the automotive supply chain greatly reduces the logistic costs of production.

**Ohio boasts great infrastructure and transportation resources to facilitate open road testing.** Ohio hosts the Transportation Research Center (TRC), which provides enhanced active safety testing and is being utilized by top Original Equipment Manufacturers (OEM), the Traffic Safety Administration (NHTSA), and suppliers. Moreover, the City of Columbus won the U.S. Department of Transportation (DOT) Smart City Challenge and leveraged around \$140 million to develop, deploy, and share knowledge for intelligent transportation.

**Ohio possesses an aging automotive workforce characterized by low productivity.** On average, workers in the automotive industry are older compared to the rest of industries located

in Ohio: 54% are older than 45, compared with 45% in other industries<sup>35</sup>. Ohio's older than average population (Figure 13)<sup>36</sup> creates a challenge for companies in sourcing skilled labor as more experienced engineers and auto industry workers demand higher wages. Since the companies often need to invest in ongoing training for older workers, this further chips away their profit margins.

Moreover, between 2000 and 2014, the State had witnessed a slow growth in labor force productivity of 0.38% despite thousands of jobs lost in the automotive manufacturing industry<sup>37</sup>. Ohio produced more than 30,000 scientific degrees graduates between 2004 and 2014<sup>38</sup>, but the auto industry has not reaped the potential productivity gains from skilled labor supply.

**Ohio has skilled labor and an education system favorable to higher productivity, but the state is in need of further differentiation compared to its other two state competitors.**

Ohio has advanced automotive programs providing a workforce with specialized skills (Figure 14). This was also indicated in a qualitative interview we held with an employee of a local supplier who reported that the company had apprenticeship programs with local universities' engineering programs. However, it looks like that Ohio needs to differentiate itself even further as it is closely matched by neighboring states in educational attainment. 2011-2015 Census data indicates that 89.1% of Ohio's population older than 25 had high school diplomas and 26.1% of the same had a Bachelor degree<sup>39</sup>, compared to Michigan's - 89.6% and 26.9% respectively<sup>40</sup>.

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<sup>35</sup> U.S. Census of Quarterly Workforce Indicators, 2014 Q1

<sup>36</sup> Ohio Department of Job and Family Services. A Workforce Analysis of The Northeast Region (p. 21). [http://ohiolmi.com/wa/2014JobsOhio/Workforce\\_Analysis\\_Northeast\\_Region.pdf](http://ohiolmi.com/wa/2014JobsOhio/Workforce_Analysis_Northeast_Region.pdf)

<sup>37</sup> U.S. Cluster Mapping Project. Institute for Strategy and Competitiveness, Harvard Business School.

<sup>38</sup> U.S. Cluster Mapping Project. Institute for Strategy and Competitiveness, Harvard Business School.

<sup>39</sup> Source: Quick facts- United States Census Bureau. Website: [www.census.gov/quickfacts/table/EDU635215/39](http://www.census.gov/quickfacts/table/EDU635215/39)

<sup>40</sup> US Census Bureau. <https://www.census.gov/quickfacts/table/PST045216/26>

**Ohio invests fewer resources on automotive R&D than other States.** In 2011, Ohio invested \$198 million in Automotive R&D, while Indiana and Michigan spent \$368 million and \$8.9 billions respectively<sup>41</sup>. The state would benefit from greater R&D spending.

**There are also managerial practice deficiencies in auto suppliers.** Qualitative interviews reveal that some smaller businesses have a misconstrued idea of lean practices, associating lean practices more with cost-cutting rather than increased quality (Helper 38). The US Census Management and Organizational Practices Survey for 2015, which aims to get an understanding of the management practices and their links to key economic outcomes, ranks Ohio 27th on its structured management score, ten spots behind Michigan and 16 behind Indiana.

**Demand Conditions** - The US automotive cluster accounted for almost 8% of the world automotive exports between 2005-2015<sup>42</sup>. As the third country with the largest share of automotive exports and the largest demand density at 800 cars per 1,000 people<sup>43</sup>, the United States generally and **Ohio specifically benefits from a strong demand**. However, although the US share of automotive world exports have increased from 7.92% (\$73 billions) to 8.97% (\$126 billions), it has flattened after 2013, probably due to the emergence of low-cost competitors in emerging economies and the domestic loss of productivity. On the domestic side, the Center for Automotive Research projects slow growth in sales in coming years after rebound growth from the Great Recession (Figure 15). Moreover, the Ohio specialization in light-weight trucks might reduce its competitiveness in the midst of the “greening” of transportation that shifts demand

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<sup>41</sup> Accelerating the Growth of the U.S. Automotive Manufacturing Industry at Home, Rather than Abroad. Center for Automotive Research. 2014 (p.48). <http://www.cargroup.org/wp-content/uploads/2017/02/Accelerating-the-Growth-of-the-U.S.-Automotive-Manufacturing-Industry-at-Home-Rather-than-Abroad.pdf>

<sup>42</sup> U.S. Cluster Mapping Project. Institute for Strategy and Competitiveness, Harvard Business School.

<sup>43</sup> U.S. Cluster Mapping Project. Institute for Strategy and Competitiveness, Harvard Business School.

towards fuel-efficient, hybrid cars. These factors combine to weaken the strong demand that Ohio has historically benefited from.

**Related and Supporting Industries - Ohio hosts many of the most well-known automotive manufacturers & assemblers (Honda, Ford, GM) and automotive suppliers (Goodyear, Bridgestone, Magna, ThyssenKrupp).** The cluster concentration and its strategic location allows for easy and fast transportation to other assembly companies (BMW, General Motors, Toyota, Nissan, Daimier, FCA) within 660 miles (1,000 km) away from Ohio cluster. However, after the financial crisis and demand shrinking, most of the remaining automotive suppliers are Tier 2 or Tier 3 with fewer than 250 employees<sup>44</sup>.

**There is a lack of collaboration between firms at all tiers of the supply chain.**

Specially, small shops (tier 2 and 3) face uncertainty about the return on investments and harbor distrust of collaborators and competitors alike. These factors have pushed these firms to generate profits by squeezing margins from lower tiers rather than working with them to eradicate inefficiencies collectively and share cost savings and quality gains (Helper, 2010).

Large auto firms do not have incentives to train their small suppliers as they fear that competitors will reap the benefits of suppliers' training. This reluctance can be better understood if we look at R&D funding structure for the industry. Data from 2007 shows that the automakers themselves are largely funding R&D in the sector, making up 99% of funding, a proportion exceeding that of other sectors (Figure 16). Therefore, it is not surprising that a short-term oriented, profit-maximizing automaker, facing global competition from international firms, will try to squeeze as much value as possible out of suppliers as opposed to opting to

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<sup>44</sup> Based on interview with Susan Helper

invest in the suppliers' training to enhance efficiency and produce trans-tier gains, which is a strategy with longer-term payoffs.

From the perspective of suppliers, the relationship is ridden with mistrust. In a recent survey, 41% of firms reported that they found it likely that their large auto firm customer would switch to another supplier due to a slightly lower cost (Helper p. 50). Furthermore, the burden on the suppliers to add more technology and innovation to the automobile has increased in recent years, transferring the cost of R&D to them and making their margins even thinner. In fact, 28 to 40% of all R&D spending is undertaken by suppliers and suppliers employ 40 percent of engineers and scientists conducting R&D.

**Context for Firm Rivalry and Strategy - Ohio has primarily responded to the high competition in the automotive industry with cost-reduction strategies instead of greater innovation and efficiency gains reforms.** Ohio's employees earn 10% lower wages than the national average for the automotive industry. The state has the lowest US effective tax rate (2.8%) on new capital intensive manufacturing operations and zero taxes on corporate profits inventory, or personal property<sup>45</sup>.

**Ohio receives high amounts of FDI, but it has been shrinking since 2007.** Ohio received more foreign direct investment in 2012 (\$ 200 thousand) than its neighbor states such as Michigan, Virginia, and Indiana.<sup>46</sup> However, after the financial crisis, Ohio's FDI has shrunk almost in 2% while the neighboring states of Michigan and Indiana have experienced an increase of 4%<sup>47</sup>.

**Institutions for Collaboration - The main Institution for Collaboration supporting the cluster is the Manufacturing Extension Partnership (MEP), a federally supported network**

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<sup>45</sup> All roads lead to Ohio. 2017 JobsOhio

<sup>46</sup> U.S. Cluster Mapping Project. Institute for Strategy and Competitiveness, Harvard Business School.

<sup>47</sup> U.S. Cluster Mapping Project. Institute for Strategy and Competitiveness, Harvard Business School.

**of non-profit institutions that provides assistance to small to mid-sized manufacturers.**

MEP provides support for the integrated adoption of multiple complementary policies to improve the performance of Tier 2 to Tier 4 businesses. Organizations like MAGNET and TechSolve in Ohio offer a variety of services including individualized solutions to challenges in operations, employee engagement, sales and marketing, product development, and/or process innovation<sup>48</sup>.

**Moreover, a variety of research centers supports the cluster development.** The Ohio Transportation Research Center, the Ohio State University Driving Simulation Laboratory, the Center for Automotive Research (CAR), and the Ohio Supercomputer Center. Such institutions provide assessments of in-vehicle guidance systems, business services, and hardware as well as consulting in software and specialized expertise in modeling, simulations, and analysis.

**Jobs Ohio is a private non-profit corporation specialized in helping companies find the best place in Ohio to drive job creation and new capital investment in the automotive industry.** SiteOhio, the new program launched by Jobs Ohio, provides a site certification process plus a comprehensive site review to guarantee on-site utilities have adequate capacity and are free from incompatibilities with needed uses, based on constraints from surrounding properties<sup>49</sup>.

#### **IV. Recommendations**

The Ohio automotive faces numerous challenges if it is to improve its competitiveness. To overcome these challenges, it must improve productivity throughout the cluster and foster innovation. Both of these aims are constrained by the fragmentation of the cluster and the lack of collaboration between firms.

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<sup>48</sup> The US auto supply chain at a crossroads. The implications of an industry in transformation. Susan Helper. 2010

<sup>49</sup> JobsOhio website. Accessed on May, 17.

Unfortunately, the state's current development strategy falls short when it comes to addressing these constraints. Most of the state's development efforts focus on low-cost strategies such as reducing tax rates and to a lesser extent on addressing factor conditions by providing key inputs like testing facilities. These strategies target attracting businesses from other states or creating new ones. They fail to recognize the important role of existing small firms and do little to offer them help. Smaller firms in Tier 2 or lower account for 30% of employment, more than the OEMs (Helper, *Industry at Crossroads*, p.4). Tax incentives, support for relocation, and big ticket inputs like testing facilities do little to help such firms. Additionally, the majority of the new state initiatives we reviewed in Ohio had language suggesting targeting new firms and startups, raising questions on whether established small suppliers are benefiting from initiatives such as JobsOhio.

Instead, the Ohio automotive cluster should focus on improving the interactions between different levels of the supply chain so that firms throughout supply chain can contribute to innovation and productivity growth. In order to achieve this goal, members of the Ohio cluster ranging from government agencies to private firms should work together to implement three initial steps:

1. Create institutions for collaboration (IFCs) focused on Tier 2 or lower suppliers
2. Develop specialty IFC-provided consulting in managing relational contracts
3. Establish matching program for start-up entrepreneurs and existing firms

#### *IFCs for Tier 2 or Lower Suppliers*

Small firms in Tier 2 or lower currently have little ability to contribute to innovation in Ohio. They have compartmentalized, short-term managerial practices that respond to the cost-cutting demands of their customers. Customers at Tier 1 or above do not want to invest in the

capacity of individual suppliers because of the risk that the supplier will work with competitors later who will reap the benefit of the initial investment in capacity. This leads to a social underinvestment in the ability of supplier.

IFCs comprised of smaller firms lower on the supply chain could help overcome this collective action problem in two ways. First, member firms could share the cost of accessing programming from entities like MEP and potentially lower the cost to each firm. Second, a group representing similar Tier 2 or below firms would be able to coordinate joint training or upgrading provided by any similarly coordinated group of Tier 1 or higher firms. Creating the opportunity for Tier 1 firms to share the costs of such upgrading and diffusing it among Tier 2 firms would reduce the risk to each individual Tier 1 firm that they would lose out to free riders. Additionally, it would ensure that the training received by Tier 2 or lower firms was applicable not just to a single potential customer making it more attractive for them to make such an investment.

#### *Consulting in Managing Relational Contracts*

Another constraint to collaboration, and the potential innovation and productivity gains it could unleash, is the relative inability of U.S. auto firms to engage in relational contracting. Such contracts require a great deal of trust between parties since exact terms cannot be explicitly specified beforehand or verified afterwards and thus depend on the value of the future relationship between parties. Relational contracts with its suppliers were central to Toyota's rise and General Motor's decline as they enabled Toyota's suppliers to contribute to product innovation to better meet functional requirements instead of simply delivering the contracted part as specified.

Increasing the use of relational contracts within the Ohio supply chain could similarly allow suppliers at all levels to contribute to innovation and productivity gains. Unfortunately, establishing a cooperative equilibrium in which relational contracts are sustainable is not straightforward. The probability that such relationships are maintained can be improved by increasing the value of cooperation. Existing or new IFCs and MEP-backed programs can achieve this by providing consulting services to firms seeking to establish longer-term relational contracts, such as templates for communication and strategies for resolving design and execution disparities. These services can help firms realize the benefits of relational contracts upfront enabling them to maintain such relationships when they might not have otherwise and unleashing the potential of longer-term customer-supplier relationships to improve production techniques and output quality.

#### *Matching Program for Start-Up Entrepreneurs and Existing Firms*

Ohio's current innovation strategy relies on encouraging new firms. This underutilizes the production knowledge and capital of existing firms.<sup>50</sup> Entrepreneurs and researchers at the state's major universities may have innovative ideas, but they often lack expertise in running a manufacturing business. Simply providing capital to such entrepreneurs is a costly way to foster innovation since they must relearn the lessons of existing businesses. Meanwhile, many small firms know how to execute production at scale, but lack innovative ideas.

One of the existing IFCs such as CAR could establish a database to help match existing firms looking to engage with new ideas with entrepreneurs looking to partner with existing firms to get off the ground. CAR could also provide business and legal services to help potential collaborators structure partnership agreements appropriate to each situation. This database

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<sup>50</sup> Interview with Susan Helper.

and complementary services could reduce the search costs for such partnerships and expand the ability of existing firms and new entrepreneurs to collaborate successfully and drive innovation in the Ohio automotive cluster.

### *Conclusion*

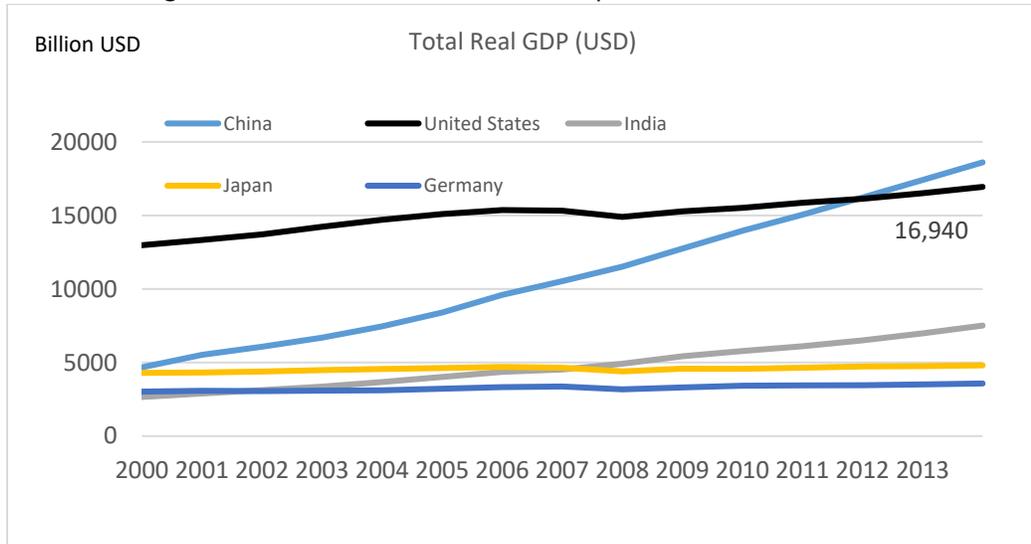
The recommendations above represent a potential set of first step for the Ohio automotive cluster. They are designed to help foster collaboration currently constrained by market failures of one kind or another. Moreover, they will enable actors in the cluster to continue to learn about the barriers to collaboration and revise or expand efforts to encourage the cooperation to revive productivity growth and innovation in Ohio automotive and put it and the state on a more prosperous road forward.

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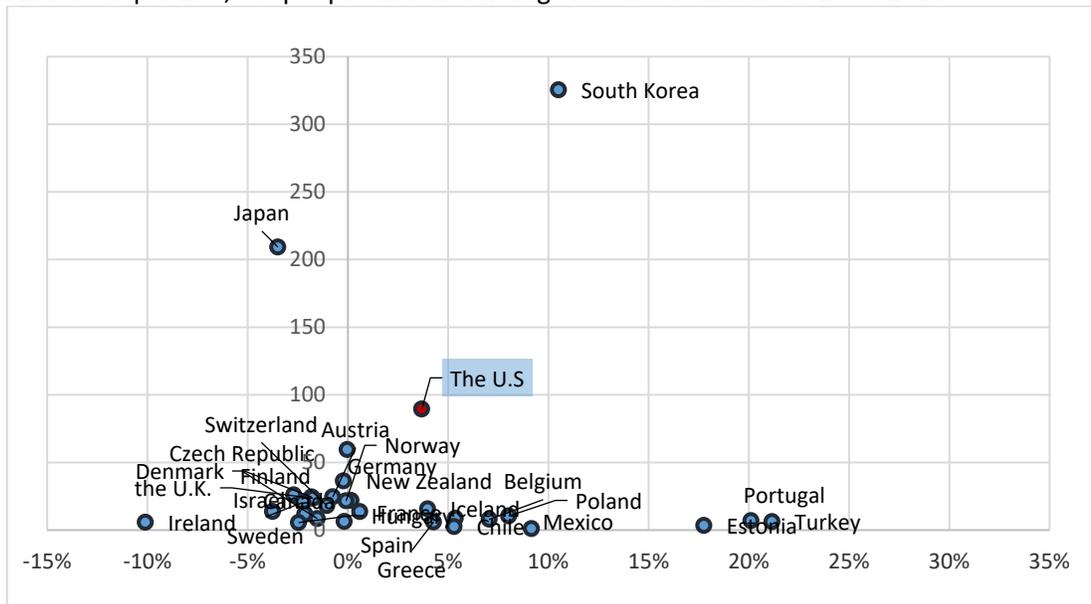
**Appendix:**

**Figure1: The U.S total real GDP in comparison to other countries**



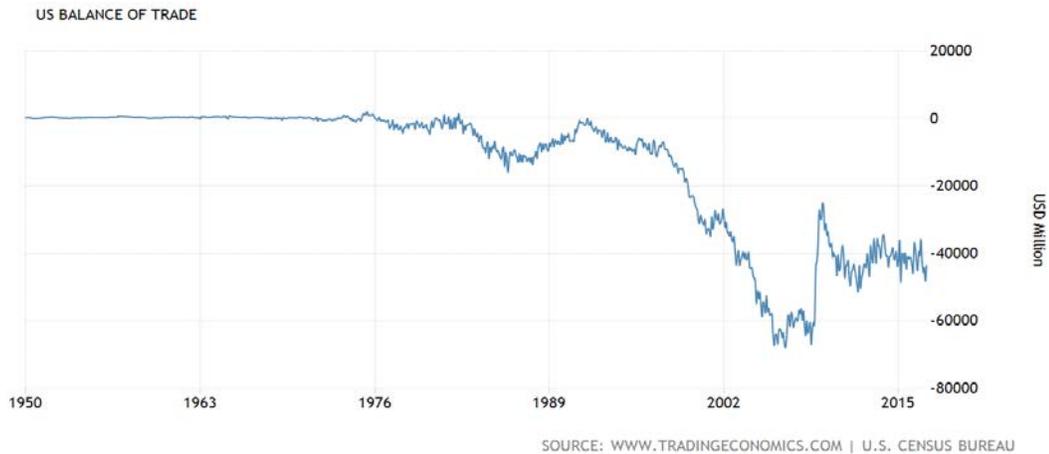
Source: World Bank

**Figure 2: Patent per 100,000 people and the Average Patent Growth from 2006-2014**



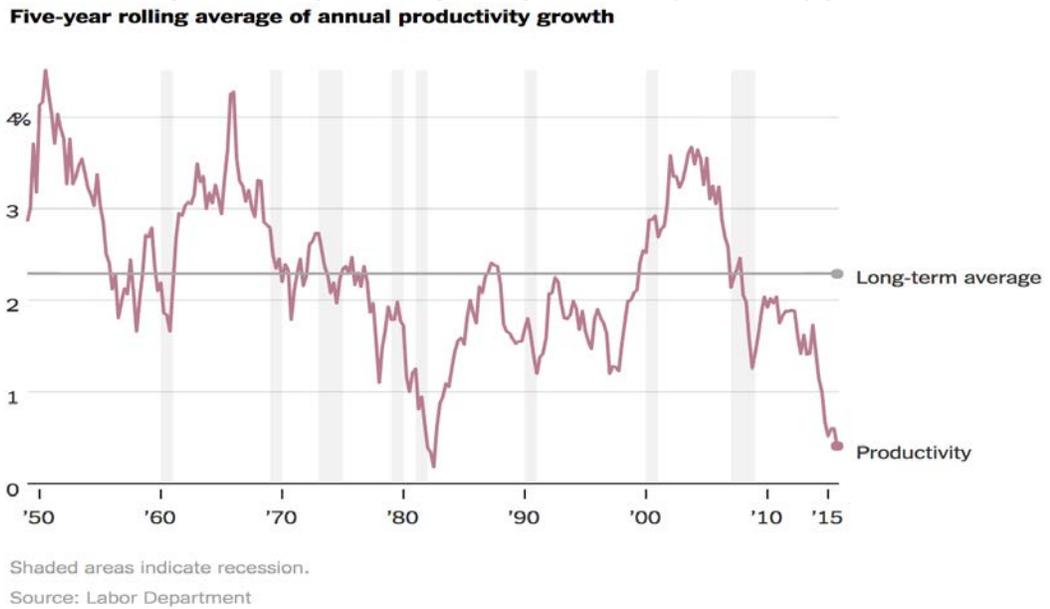
Source: World Bank, OECD and the author's calculations

Figure 3: Increasing US Trade Deficit:



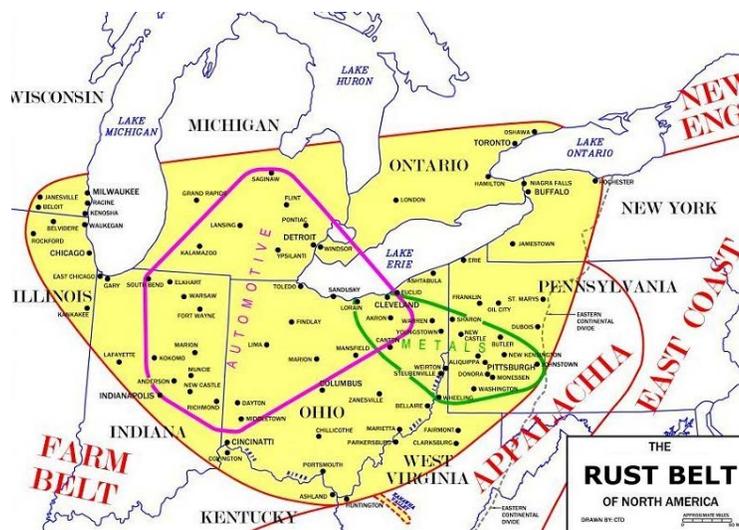
Source: Trading Economics <http://www.tradingeconomics.com/united-states/balance-of-trade> Accessed May 3 2017.

Figure 4: Five-year rolling average of annual productivity growth



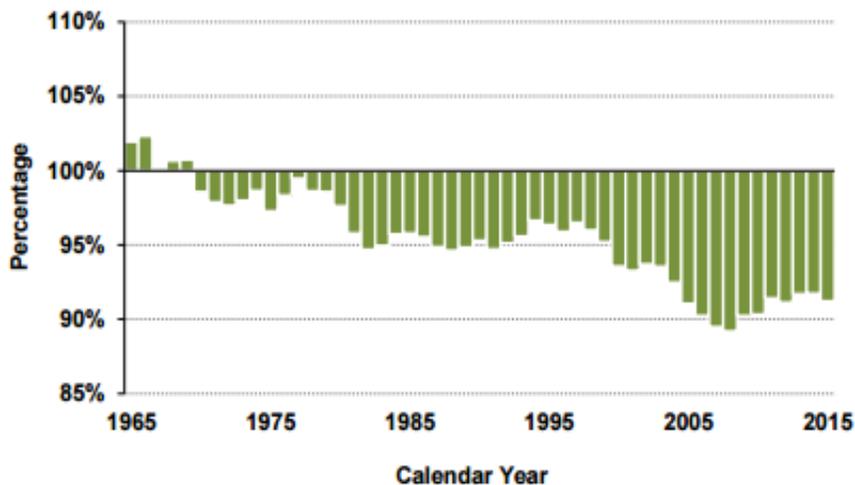
Source: Irwin, Neil. Why is Productivity So Weak? Three Theories. New York Times <https://www.nytimes.com/2016/04/29/upshot/why-is-productivity-so-weak-three-theories.html>

Figure 5: Automotive Cluster concentrated on Columbus-Dayton-Toledo area



Source: Blog on Coalfields of the Appalachians<sup>51</sup>

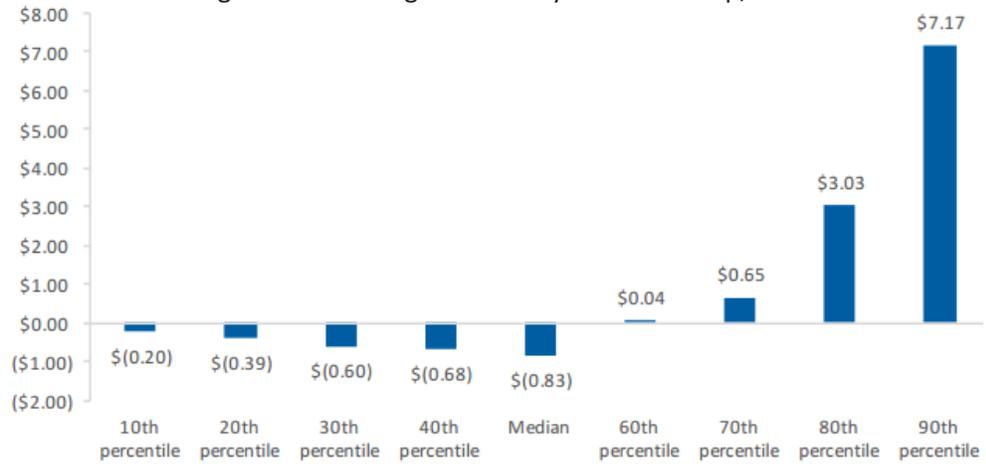
Figure 6: Ohio's per capita income as a %age of U.S. average.



Source: U.S. Bureau of Economic Analysis

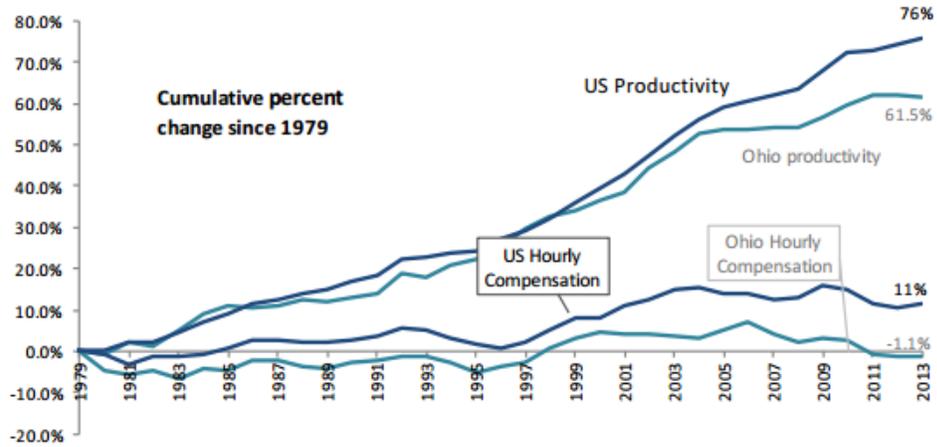
<sup>51</sup> Available at <http://www.coalcampusa.com/rustbelt/rustbelt.htm>

Figure 7. Real Wage Growth by Income Group, 1979-2015.



Source: Hanauer and Granados (2016). Wages adjusted by CPI in 2015 dollars.

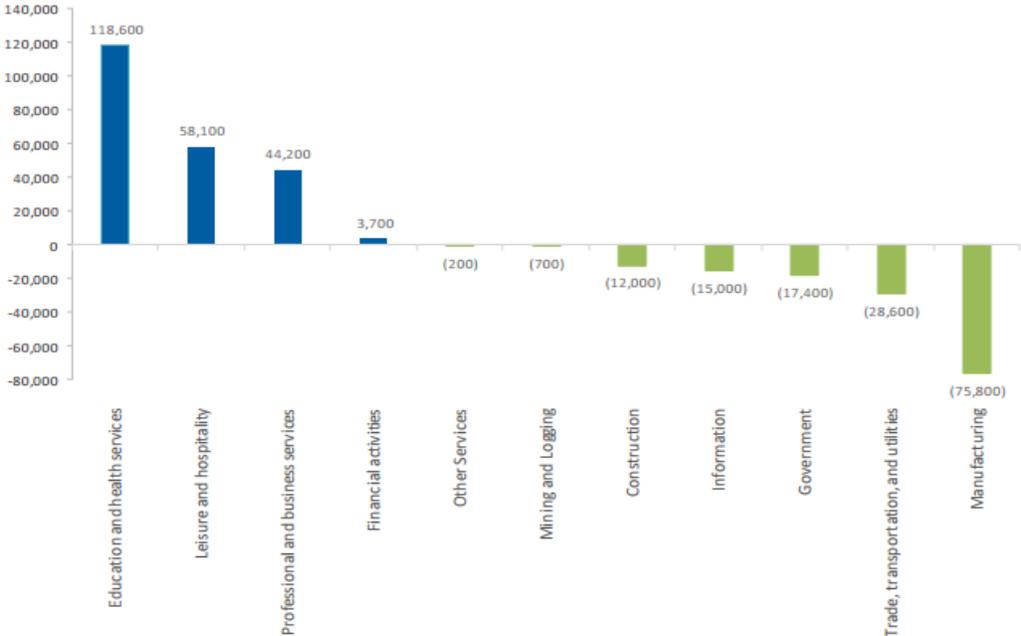
Figure 8: Ohio productivity and compensation falls, 1979 -2013



Source: Hanauer and Granados (2016)

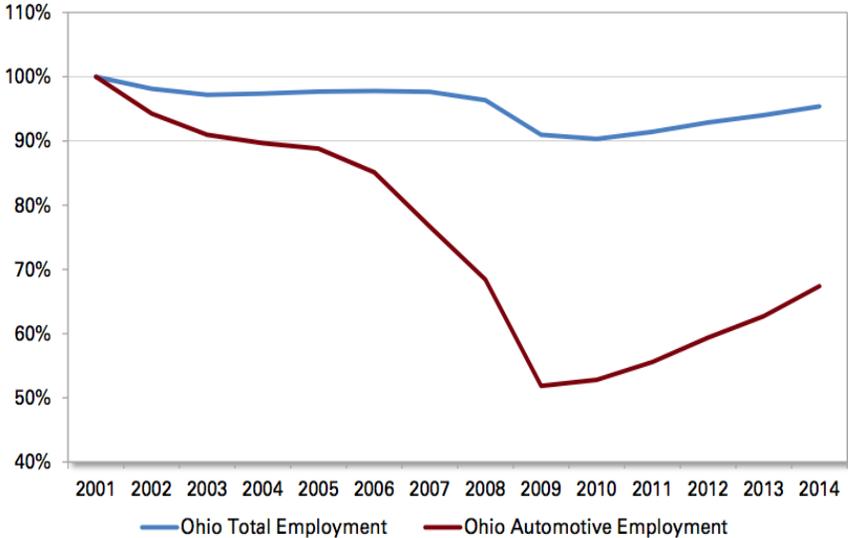


Figure 11. Jobs added or lost by sub-sector. Dec 2007-June 2016



Source: Hanauer and Granados (2016)

Figure 12: Ohio Automotive Cluster and Ohio Total Employment as a % age of 2001 Employment, 2001-2014



Source: Quarterly Census of Employment and Wages

Figure 13: Regional, State and National Age distributions

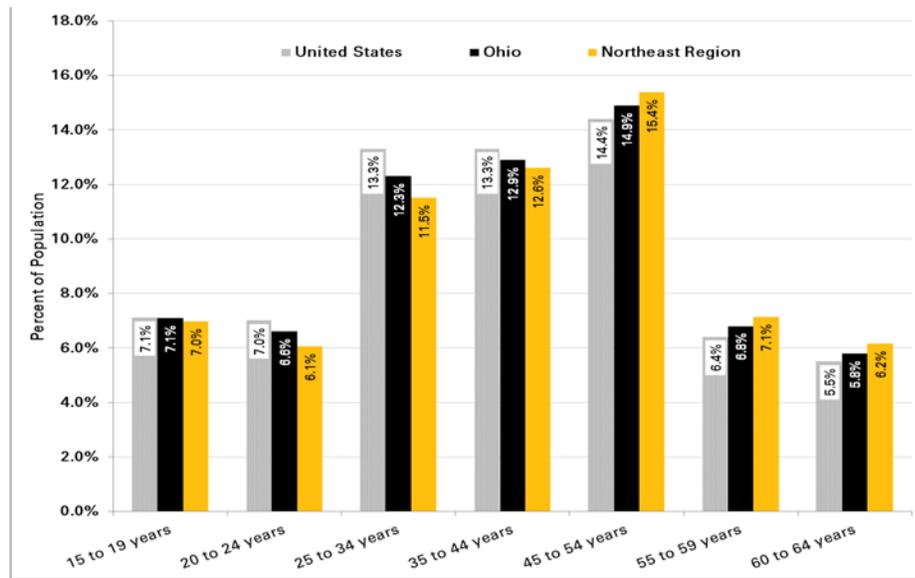
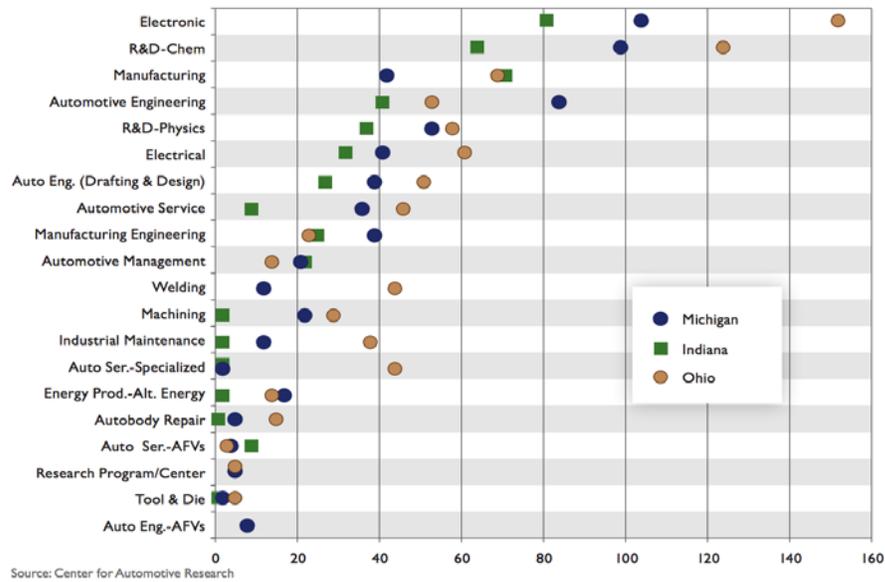
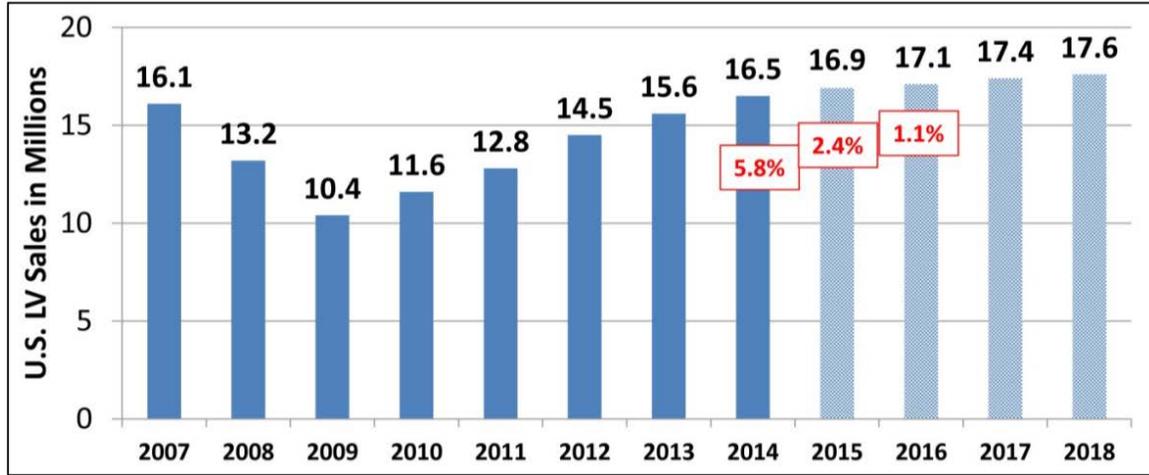


Figure 14: Automotive Programs by State



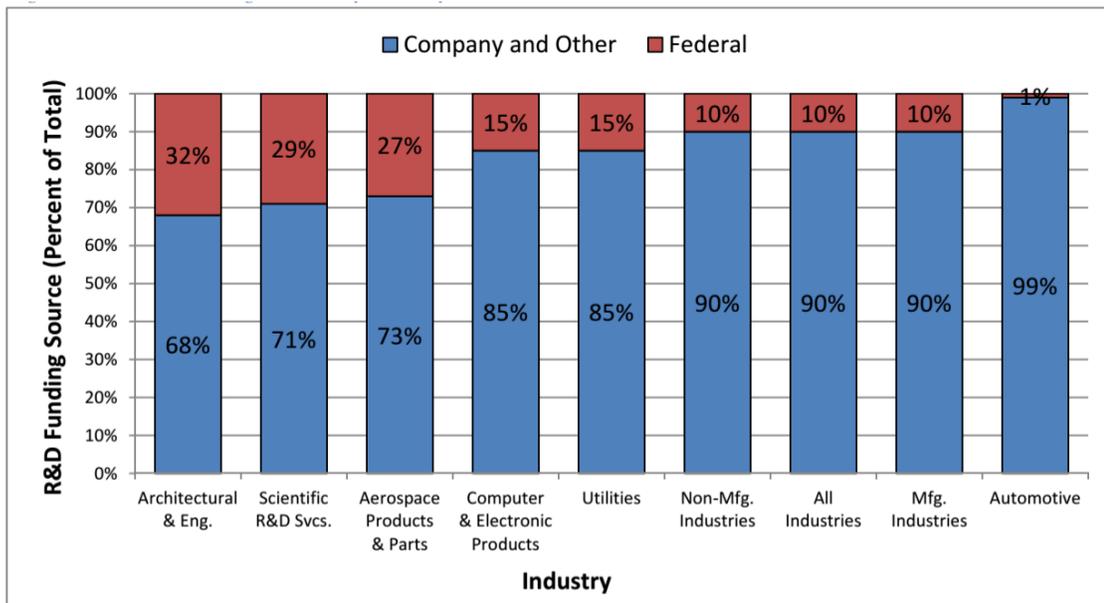
Source: Driving Workforce Change. Regional Impact of Auto Industry Transformation to a Green Economy. Website: <http://www.cargroup.org/wp-content/uploads/2017/02/Driving-Workforce-Change.pdf>

Figure 15: U.S. Automotive Sales and Forecast, 2007-2018



Source: Center for Automotive Research, January 2015

Figure 16: R&D Funding Sources by Industry



Source: National Science Foundation, 2009