OCTOBER 2016

FTI CONSULTING

THE ECONOMIC BENEFITS OF A CONTINUED U.S. MANUFACTURING RENAISSANCE

CRITICAL THINKING
AT THE CRITICAL TIME™

Table of Contents

Executive Summary....1

1. The U.S. manufacturing renaissance has been powerful....2

   Employment....3

   Labor Income....4

2. Manufacturer capital spending looks bright through 2020....6

3. The manufacturing renaissance is slated to continue and will generate substantial economic benefits....9

   GDP....10

   Employment....11

   Labor Income....12

4. Conclusion....13

Appendix A: Description of the REMI PI+ Model....14

Executive Summary

The U.S. manufacturing sector has experienced a significant rebirth. From 2012 to 2015, for instance, domestic and foreign manufacturing firms poured $1.1 trillion of capital into the economy, representing a 40 percent increase relative to the previous four-year period from 2008 to 2011. A key driver in this rebirth has been the shale oil and natural gas revolution.

Advances in technology, principally horizontal drilling and hydraulic fracturing, have unleashed low-cost oil, natural gas, and natural gas liquids (NGLs) for U.S. manufacturers to use in producing valuable products for domestic and foreign consumption. This white paper examines the economic benefits of investments and expanded manufacturing output that is expected from a continued U.S. manufacturing renaissance.

The table below puts the economic benefits of a continued manufacturing renaissance in perspective – the employment impacts, higher GDP, higher wages, and several other measurements from investments in manufacturing capital and growth in manufacturing output from 2016 through 2020.

Table 1: Economic Impacts of the U.S. Manufacturing Renaissance

Job Creation

- 3.1 million to 6.1 million net additional jobs attributable to the manufacturing renaissance between 2016 and 2020
- Roughly 40 percent of net additional jobs in the construction and manufacturing industries with the rest in the general economy

Gross Domestic Product

- The manufacturing renaissance adds $350 billion in GDP in 2016, growing to $775 billion by 2020
- This is an increase of 1.75 to 3.75 percent to U.S. GDP beyond where it would be otherwise

Personal Income

- The manufacturing renaissance adds $200 billion in aggregate personal income in 2016 and $470 billion by 2020
- Per capita impact of $550 to $1,015, concentrated mainly in the households and regions most affected by manufacturing

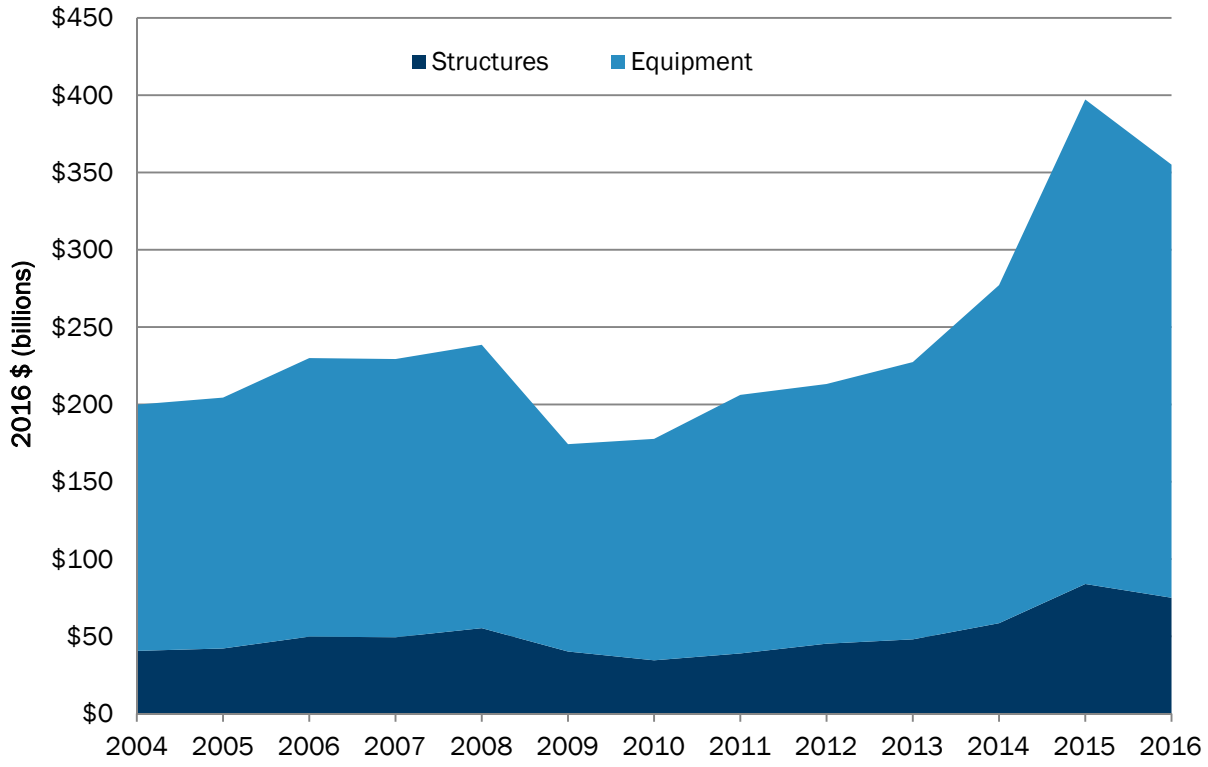
The continuation of the manufacturing renaissance looks bright, and it will have a significant influence on jobs, income, and on economic growth. This white paper discusses how investments in infrastructure, industrial space, equipment, software, and intellectual property has contributed to the U.S. economy and how it very likely will continue through 2020 given the leading indicators associated with the industry.

1. The U.S. manufacturing renaissance has been powerful

Capital investment in manufacturing plants and equipment, a leading indicator of the trajectory of the industry, has surged in the past four years. From 2008 to 2011, investments in equipment and structures in the U.S. manufacturing industry totaled $797 billion (or almost $200 billion per year). For the most recent four years of data from 2012 to 2015, this has increased to over $1.1 trillion (or almost $300 billion per year).[1] Most of the facilities under construction during this boom would not yet be operational. Thus, they have not yet had an impact on the total level of U.S. manufacturing employment, production, or exports, but will in the immediate future.

Figure 1 shows historical capital expenditures in the U.S. manufacturing sector, along with an estimate for 2016.[2] Manufacturing investments cratered during the Great Recession from a peak of $239 billion in 2008 (i.e., just prior to the recession) to a low of $174 billion in 2009. Investments slowly recovered starting in 2010 and exceeded their prerecession peak in 2014. The greatest upswing has occurred in the past two years. This includes $397 billion in manufacturing investment in 2015 and a projected $355 billion in 2016.

Figure 1: U.S. Manufacturing Investments

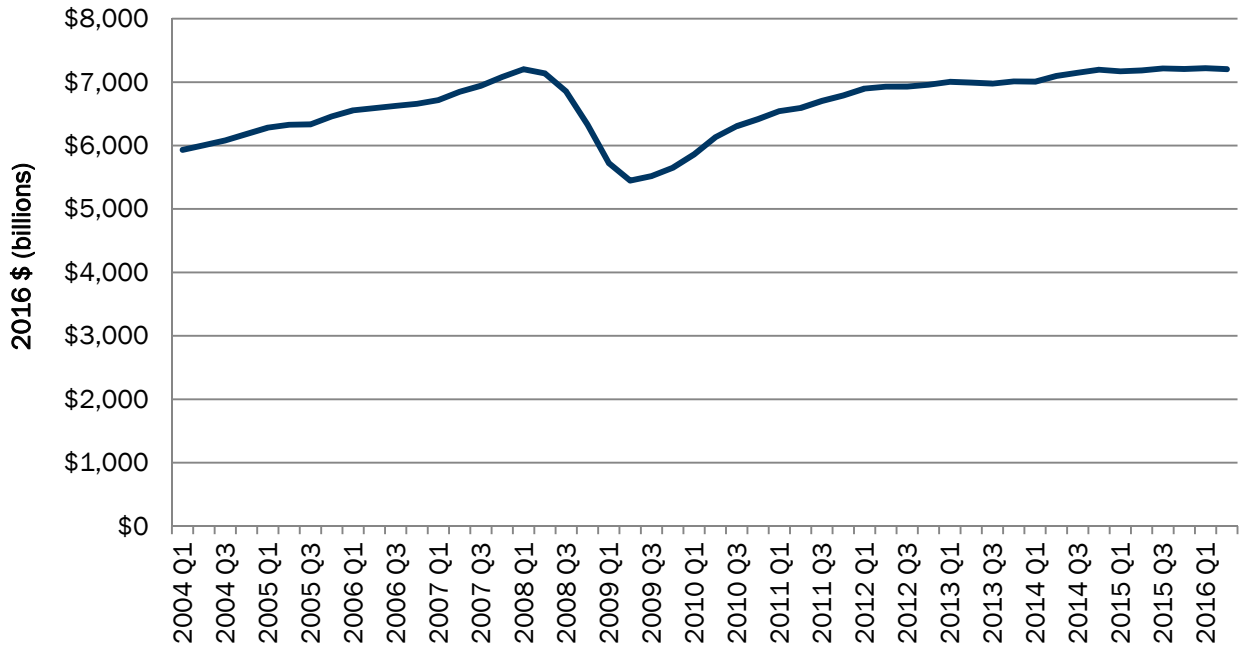


The real output of the manufacturing sector follows similar historical patterns. In 2004, real U.S. manufacturing output was around $6 trillion and slowly rose to $7.20 trillion in the first quarter of 2008 at the prerecession peak. Output then collapsed as well, dropping to $5.44 trillion in the second quarter of 2009. It then slowly recovered and has since matched its prerecession peak of $7.0 trillion to $7.2 trillion of annual real output.

[1] "Annual Capital Expenditures Survey (ACES)," *U.S. Census Bureau*, <http://www.census.gov/programs-surveys/aces/about.html>; data is available through 2013, expenditures for 2014 and 2015 estimated from Jack Kaskey, "Chemical Plant Investments Drive U.S. Manufacturing Surge," *Bloomberg*, June 21, 2016, <http://www.bloomberg.com/news/articles/2016-06-21/chemical-plant-investments-drive-u-s-manufacturing-surge-chart>

[2] *Ibid.*, individual expenditures (i.e., structures and equipment) for 2014 through 2016 estimated using the average share of spending on structures relative to total expenditures over the 2004 to 2013 timeline

Figure 2: U.S. Manufacturing Annualized Real Output[3]



While production levels have increased, manufacturing output has held steady since late 2012 or 2013 due to declining commodity prices. A modest correction in commodity prices would create an uptick in output. Additionally, continued investments will increase future output. Investments are a strong indicator of future growth.

Previous reports and projections back in 2011 and 2012 anticipated two key drivers for the U.S. manufacturing renaissance. The first was the favorable spread between international oil prices and domestic natural gas prices in 2011 and 2012 would continue.[4] The second was that China's economy would mature, losing some of its international competitiveness and reorienting towards domestic production.[5]

The favorable oil-gas price spread between 2011 and 2012 (as well as 2013 and most of 2014) drove the surge in manufacturing investments in the past several years. With oil prices collapsing in late 2014 and 2015, the spread diminished and a number of potential projects have been placed on hold. Nonetheless, many projects are still being developed past their initial planning stages and into construction. Projected manufacturing investment in 2016 is $355 billion (or 28 percent higher than the five-year average of 2009 to 2013).

The maturation of the Chinese economy has occurred as predicated, and there appears to be no signs of reversal. With higher wages in the coastal regions of China and its inimitable supply of cheap labor being exhausted, Chinese competiveness on world markets has declined and its economy has turned towards domestic consumption.

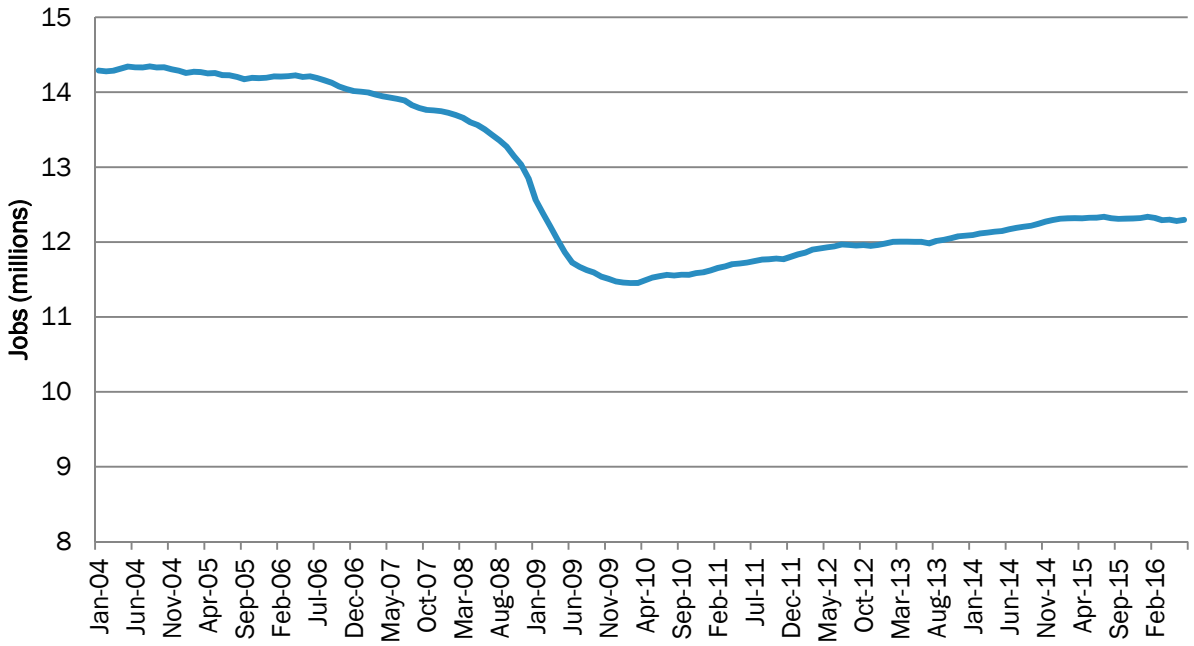
Employment

The manufacturing sector experienced a large decline in employment during the Great Recession, but it has begun to recuperate. Since its lowest point, the sector has added over 840,000 jobs, as shown in Figure 3.[6] This is a 7.4 percent

[3] "Manufacturing Sector: Real Output," Federal Reserve Economic Data (FRED), <https://fred.stlouisfed.org/series/OUTMS>
[4] Anthony Scamuffa, Mark Lustig, Tavor White, Robert W. McCutcheon, and Garrett Gee, "Shale Gas: Reshaping the U.S. Chemicals Industry," *PWC*, October 2012, <https://www.pwc.com/us/en/industrial-products/publications/assets/pwc-shale-gas-chemicals-industry-potential.pdf>
[5] Harold L. Sirkin, Michael Zinser, and Douglas Hohner, "Made in America, Again: Why Manufacturing Will Return to the U.S.," August 2011, <https://www.bcg.com/documents/file84471.pdf>
[6] "Employment, Hours, and Earnings from the Current Employment Statistics Survey," *Bureau of Labor Statistics (BLS)*, <http://data.bls.gov/timeseries/CES3000000001?data_tool=XGtable>

increase since the trough in February 2010 to nearly 12.3 million currently. One should note that Figure 3 only shows direct jobs and does not include a multiplier effect throughout the general economy.

Figure 3: U.S. Manufacturing Annualized Employment



Total manufacturing employment is an imperfect means to assess the health of the industry given the high productivity of those jobs and continued productivity growth. Labor productivity in the manufacturing sector has increased 28 percent since 2004 and 22 percent since 2009.[7] Rapid productivity growth keeps the output of the industry elevated even without adding a significant quantity of new jobs. The industry has much higher productivity than the general economy and an outsized influence with its extensive supply chains and high multipliers.

From 2012 to present, manufacturing workers generated $118 to $121 of output for each hour of work.[8] Workers in the rest of the economy, predominantly the large service and government sectors, generated only $104 to $107 per hour.[9] Besides being 10 percent to 15 percent more productive on an hourly basis, manufacturing workers tend to work longer workweeks. The average manufacturing employee works 40.7 hours per week while the average private worker overall puts in 34.5 hours per week.[10] This adds another 18 percent of additional productivity to manufacturing workers for 30 percent higher than the general economy overall. Furthermore, the modeling shows that even low value-added sectors such as textiles and furniture have multipliers between two and three times. Large, heavy manufacturers, such as the chemical manufacturing industry, might have jobs multipliers as high as ten to twelve additional jobs per direct job.[11]

Labor Income

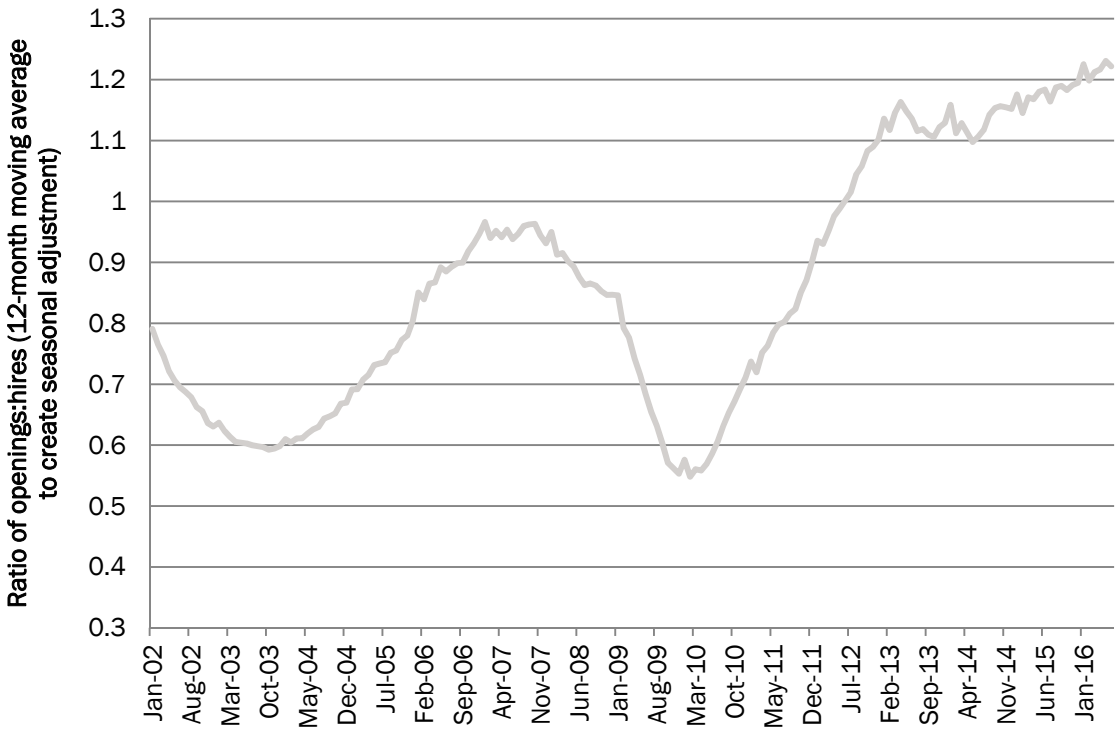
In addition to higher output per employee, the manufacturing industry also boasts higher earnings relative to other private industries. Manufacturing workers earn an hourly rate similar to the national average ($26.00 per hour for manufacturing and $25.69 per hour for all employees).[12] However, as described before, manufacturing workers work an

[7] REMI PI+ model, Standard Regional Control
[8] "Index/Level and Productivity : Manufacturing," *Bureau of Labor Statistics*, <http://beta.bls.gov/dataViewer/view/timeseries/PRS30006093>
[9] "Index/Level and Productivity : Business," *Bureau of Labor Statistics*, <http://beta.bls.gov/dataViewer/view/timeseries/PRS84006093>
[10] "Table B-2 Average weekly hours and overtime of all employees on nonfarm payrolls by industry sector, seasonally adjusted, <http://www.bls.gov/news.release/empsit.t18.htm>
[11] Thomas Kevin Swift, Martha Gilchrist Moore, Smita Bhatia, and Emily Sanchez, "Shale Gas, Competitiveness, and the New U.S. Chemical Industry Investment: An Analysis Based on Announced Projects," *American Chemistry Council (ACC)*, May 2013, <https://chemistrytoenergy.com/sites/chemistrytoenergy.com/files/shale-gas-full-study.pdf>
[12] "Table B-3 Average hourly and weekly earnings of all employees on private nonfarm payrolls by industry sector, seasonally adjusted," <http://www.bls.gov/news.release/empsit.t19.htm>

extra 6.2 hours per week and have superior benefits. Average weekly earnings in the industry are $1,058 compared to $886 for all private workers (a 20 percent difference). These higher earnings increase the multipliers and make these sorts of jobs more impactful.

The labor market for manufacturing workers also presents several strong leading indicators. For example, the market is now "tighter" (i.e., a situation where skilled workers, rather than jobs, are more difficult to come by) than at any point since the Great Recession or even back to the 1990s. In April 2017, there were 397,000 job openings in the sector.[13] This is up 100,000 since 2013 and slightly higher than the prerecession climax in July 2007 of 387,000. The ratio of openings-to-hires (the measurement in Figure 4 of open jobs versus the number of new hires in the industry) has hovered between 1.2 and 1.3 since early 2015, much higher than the 0.5 to 0.8 during recessions and the 0.9 to 1.0 seen during the growth period prior to the Great Recession.[14] The industry is at a historic low for both layoffs and for separations, and its unemployment rate has averaged just 4.2 percent over the past year, well below the national average for all industries of 5.0 percent.[15] Altogether, this signifies an industry that might have more work obtainable than the immediate, available labor force can take up, indicating an industry attempting to expand.

Figure 4: Ratio of Manufacturing Job Openings-to-Hires from JOLTS Data

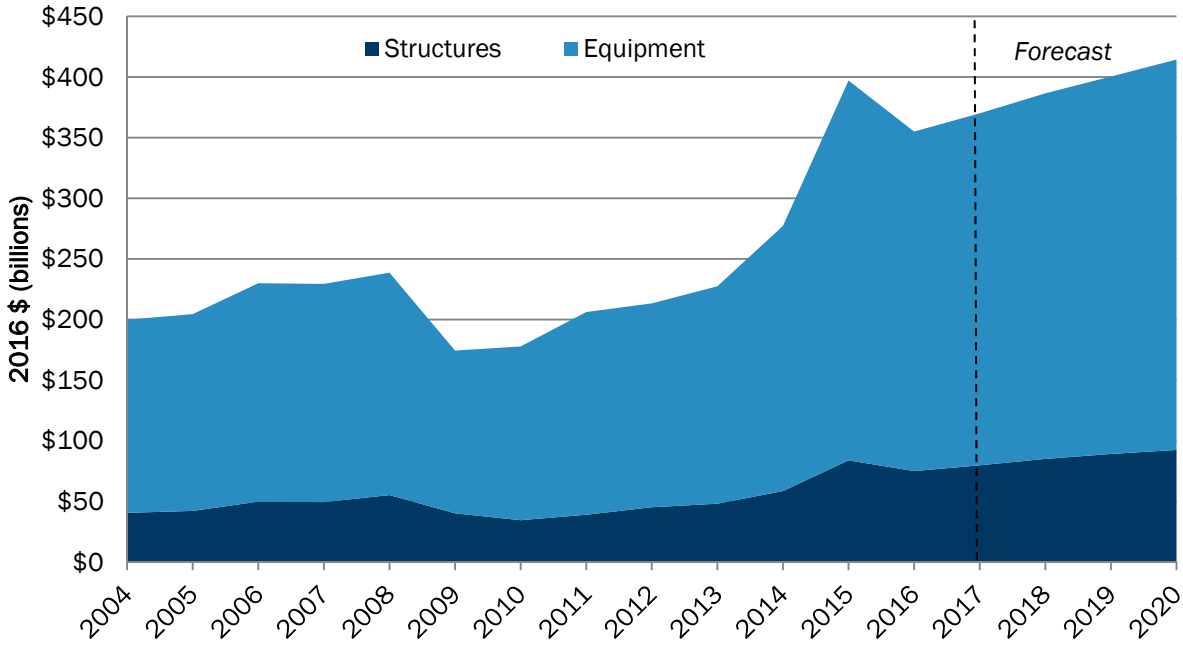


[13] "Jobs and Labor Turnover Survey," *Bureau of Labor Statistics (BLS)*, <http://data.bls.gov/timeseries/JTU30000000JOL?data_tool=XGtable>
[14] Data from n. 13 divided by "Jobs and Labor Turnover Survey," *Bureau of Labor Statistics (BLS)*, <http://data.bls.gov/timeseries/JTU30000000HIL?data_tool=XGtable>, which products a ratio of openings over hires, where a high ratio implies many openings relative to hires, meaning jobs are more difficult to fill
[15] "Labor Force Statistics from the Current Population Survey," *Bureau of Labor Statistics (BLS)*, <http://data.bls.gov/timeseries/LNU04032232?data_tool=XGtable>

2. Manufacturer capital spending looks bright through 2020

Investments in manufacturing capital prior to the Great Recession usually totaled between $200 billion and $250 billion per year (adjusted to 2016 dollars). This fell to under $175 billion during the depths of the recession, and the immediate recovery did not surpass the prerecession peaks. However, since 2014 and into 2015, investments in the manufacturing sector have surged. In 2015, investments reached $390 billion – $82 billion in structures and $308 billion in intellectual property and equipment. Figure 5 below illustrates these trends, where manufacturing investments in the past 30 months greatly exceed anything else seen in the past decade.

Figure 5: U.S. Manufacturing Investments – Historical and Forecast

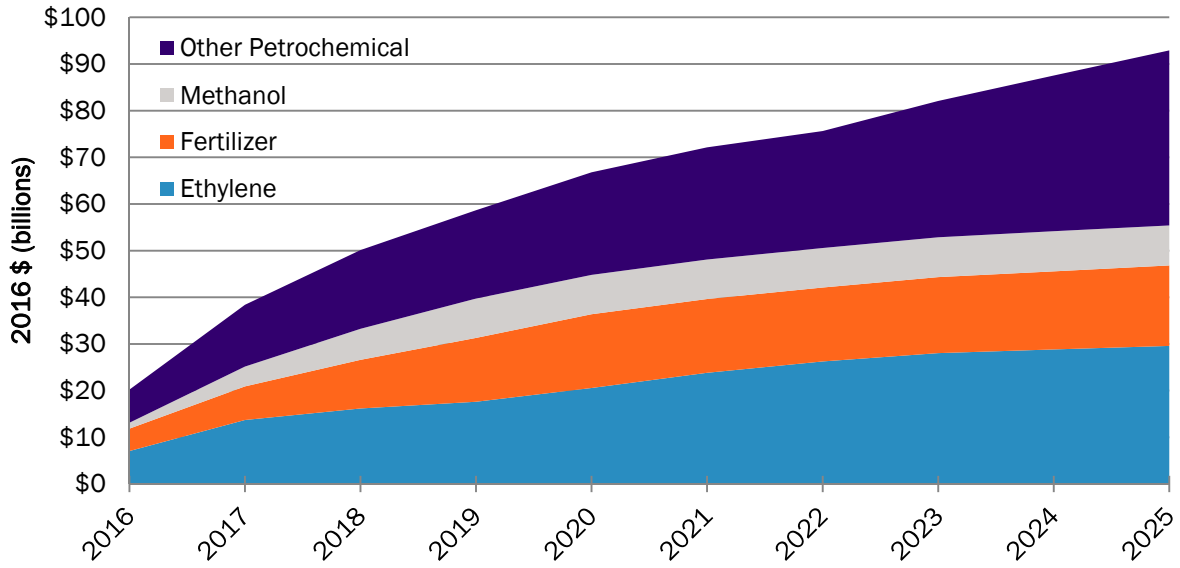


The capital expenditure forecast shown in Figure 5 derives from the growth rates in capital investment used in the modeling exercise. The rates of capital investment in the model come from two macroeconomic forecasts, including a short-term forecast from the Research Seminar in Quantitative Economics (RSQE) at the University of Michigan[16] and a medium-term forecast (through 2024) from the Bureau of Labor Statistics' (BLS) "Industry Employment and Output Projections."[17] In essence, growth in the output of the manufacturing industry in the model drives demand for capital investment in nonresidential structures, equipment, and intellectual property. These, in turn, drive investment rates used to forecast the total capital expenditures for the economy through 2020.

Interestingly, the bulk of the surge in capital investment seen over the past couple years comes from the chemical manufacturing industry. The chemical manufacturing industry and its investments in structures (not including equipment, intellectual property, or software) totaled 18 percent of all manufacturing structure investments in 2011. However, by 2015, this figure was just above the majority at 51 percent. There are several ethane crackers[18] under construction, which will increase the chemical industry's share of capital investments even more. These facilities will process natural gas liquids (NGLs) into useful feedstock for plastics production. As shown in Figure 6 below, fertilizer manufacturing will also be another important chemical subindustry in this expected capital investment growth.

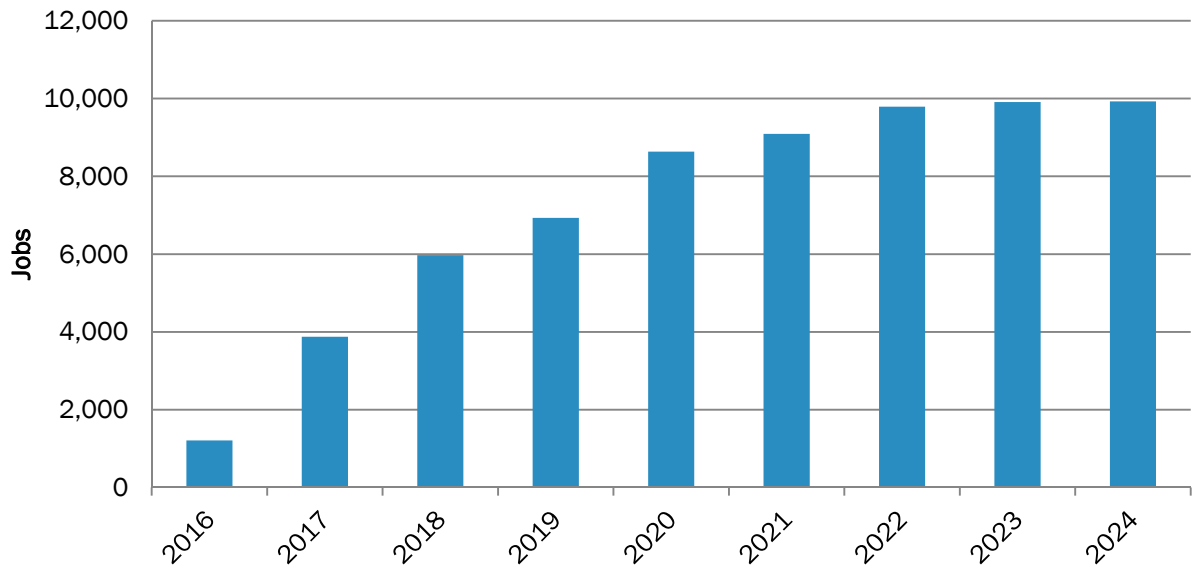
[16] University of Michigan, <http://rsqe.econ.lsa.umich.edu/>
[17] Bureau of Labor Statistics, <http://www.bls.gov/opub/mlr/2015/article/industry-employment-and-output-projections-to-2024-2.htm>
[18] American Fuel and Petrochemical Manufacturers (AFPM), <http://education.afpm.org/petrochemicals/what-is-a-cracker-and-why-should-i-care/>

Figure 6: Cumulative New Investments in Chemical Manufacturing Capacity by Product Type



According to the American Chemistry Council (ACC), a driving force in these investments is the price of natural gas in North America. To quote, "A new competitive advantage has emerged for chemical manufacturing in the United States as vast new supplies of natural gas from largely untapped shale gas resources… are leading to massive capital investment and expansion."[19] These investments will also generate significant direct employment, with the number of announced new jobs in the industry tabulated in Figure 7.

Figure 7: Cumulative New Direct Operational Jobs in Chemical Manufacturing

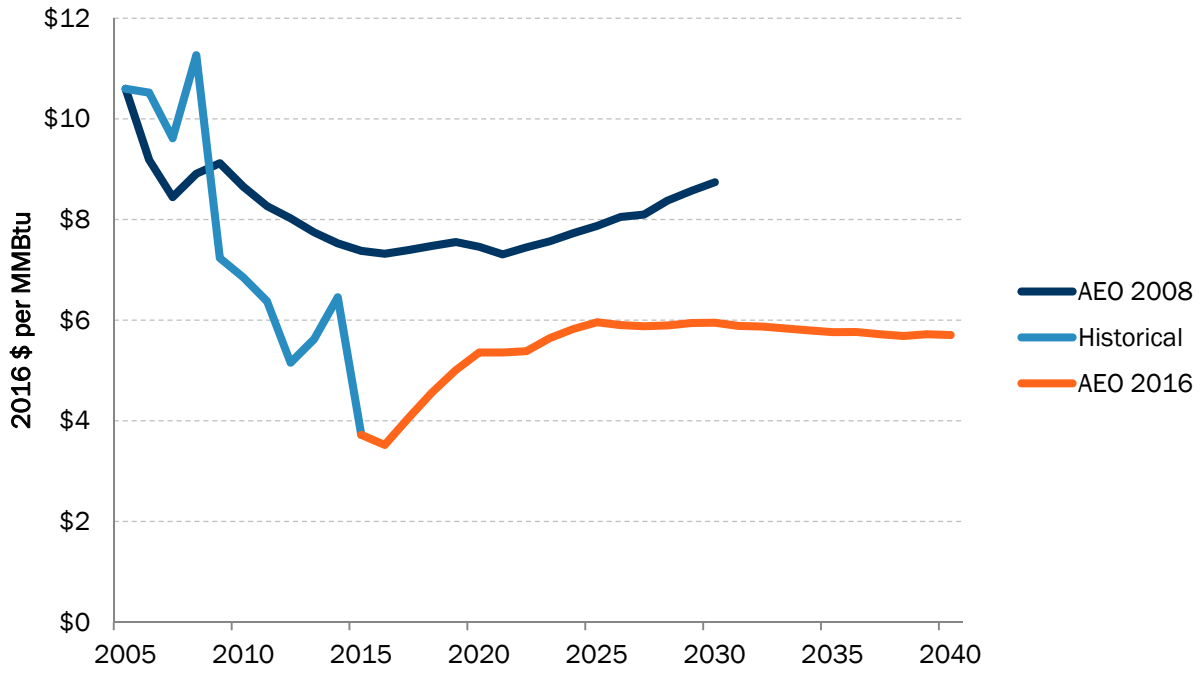


[19] Thomas Kevin Swift, Martha Gilchrist Moore, Smita Bhatia, and Emily Sanchez, "Shale Gas, Competitiveness, and the New U.S. Chemical Industry Investment: An Analysis Based on Announced Projects," *American Chemistry Council (ACC)*, May 2013, <https://chemistrytoenergy.com/sites/chemistrytoenergy.com/files/shale-gas-full-study.pdf>

Lower natural gas prices reduce costs and enhance the global competitiveness of other energy-intensive manufacturing industries, including paper, rubber, glass, iron, steel, aluminum, and refined petroleum. This benefits downstream suppliers and consumers as well depending on those products

Development of shale resources and the resulting lower natural gas prices have been crucial factors driving these investments. For instance, the Energy Information Administration (EIA) and its Annual Energy Outlook (AEO) from 2008 projected gas prices of $7 to $10 per MMBtu (in 2016 dollars).[20] The most recent AEO for 2016 projects a long-term average price of natural gas of approximately $6 per MMBtu (in 2016 dollars)[21] – that is, the current baseline features lower prices than even the most optimistic projections from the past. Figure 8 shows these different price forecasts and expectations have stacked up against each other.

Figure 8: Projected Industrial Natural Gas Prices Before and After Shale Gas Breakthroughs



Ultimately, this report examines how capital investments and new demand contribute to the overall health of the economy. The $75 billion of equipment manufacturing and $375 of manufacturing capital expenditures (overall) from Figure 5 breaking ground in 2016 are not yet operating. Therefore, they have not yet contributed to the employment and output of U.S. manufacturers. Even after making an investment decision and clearing legal and regulatory hurdles, it can take years to construct a manufacturing facility before it can produce. This means these investments will continue to and expand their overall contribution to the economy once they become operational.

Large investments are a strong leading indicator to future growth and, in the meantime, generate considerable numbers of jobs in construction, architecture, engineering, equipment, materials, and consumer industries linked to households and payrolls. Upon their opening and operation, manufacturing facilities will generate jobs in the industry itself, in its supply chain, and in service industries that support industry and supply chain jobs. These two phases – investments and then long-term operations – will form the basis for our analysis of the impacts.

[20] "Annual Energy Outlook 2008 with Projections to 2030," *Energy Information Administration (EIA)*, <https://www.eia.gov/oiaf/archive/aeo08/excel/aeotab_3.xls>
[21] "Energy Prices: Industrial: Natural Gas," *Energy Information Administration (EIA)*, <https://www.eia.gov/forecasts/aeo/data/browser/#/?id=3-AEO2016&region=1-0&cases=ref2016&start=2013&end=2040&f=A&linechart=~~ref2016-d032416a.19-3-AEO2016.1-0&map=ref2016-d032416a.4-3-AEO2016.1-0&ctype=linechart&sourcekey=0>

3. The manufacturing renaissance is slated to continue and will generate substantial economic benefits

This analysis was constructed using the REMI PI+ model (as produced by Regional Economic Models, Inc.) to measure the economic benefit from capital spending and growth in the manufacturing sector. PI+ is a combined input-output (IO), computable general equilibrium (CGE), econometric, and gravity model of the U.S. economy and its component parts.[22] Its main application to this particular analysis is its dynamic nature (i.e., the ability to analyze forecasts over time).

Economic impacts – GDP, employment, and labor income – were examined between two cases for the future of the economy. Those two cases were (1) a **Baseline Scenario** and (2) a **Renaissance Scenario**.

The **Baseline Scenario** froze capital expenditures for manufacturing in the same range as the recovery period from the Great Recession using the five-year average from 2009 to 2013 of almost $200 billion per year. The output of the manufacturing sector remained relatively unchanged through this period. As such, the $200 billion per year is ascribed as the amount of necessary investment or "backdrop" capital expenditures required to keep the industry producing at current levels before the depreciation and obsolescence of structures, equipment, and technology would begin to degrade the productivity of the industry.

The **Renaissance Scenario** defines the "manufacturing renaissance" as capital expenditures beyond the $200 billion per year backdrop and includes the projected growth in manufacturing output from 2016 to 2020. The REMI PI+ is used to project the economic impacts.

Figure 9: Manufacturing Equipment and Structures Capex

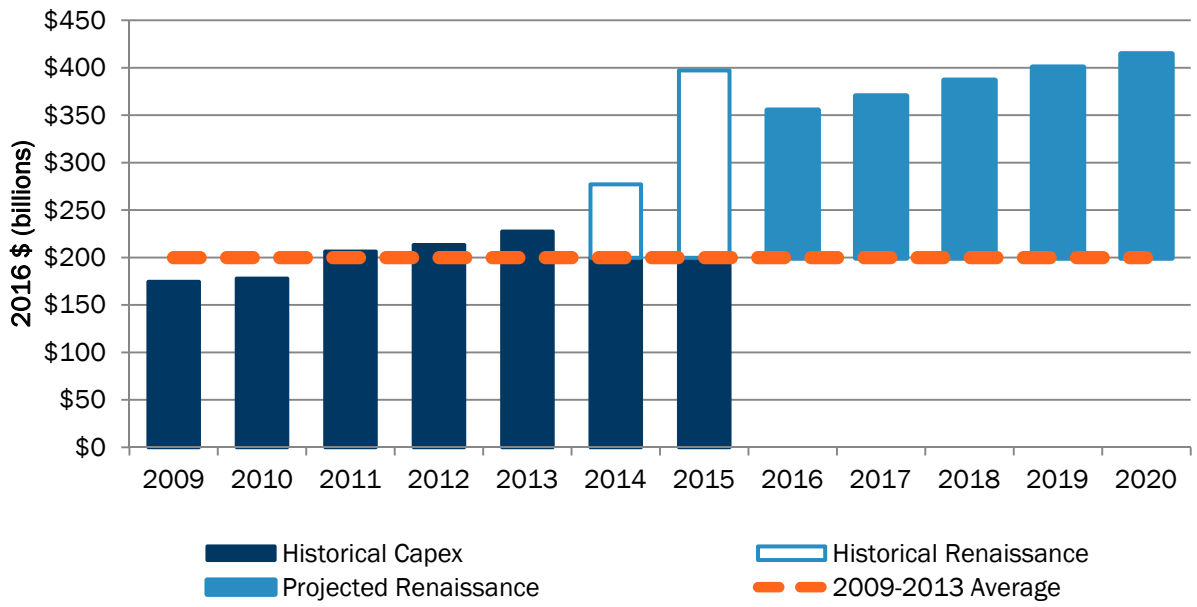


Figure 9 shows the investment portion of the renaissance and the resulting, modeled impact. Post-Recession capital expenditures settled in the $200 billion per year range. Capital expenditures greatly increased in 2014 and 2015. The continued manufacturing renaissance is represented by the incremental investments (light blue bars) as the projected capital expenditures beyond the $200 billion per year baseline.

Figure 10: Annual Incremental Manufacturing Output Forecast

[22] "PI+ v. 1.7 Model Equations," *Regional Economic Models, Inc. (REMI)*, <http://www.remi.com/download/pi-v1-7-model-equations-2?wpdmdl=7421>

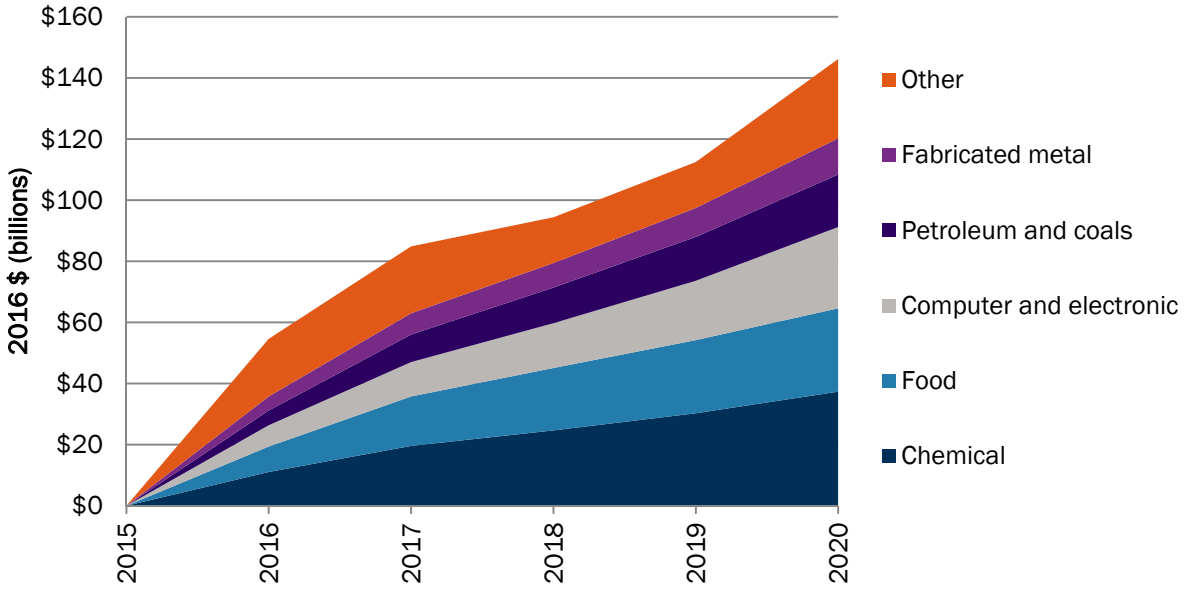
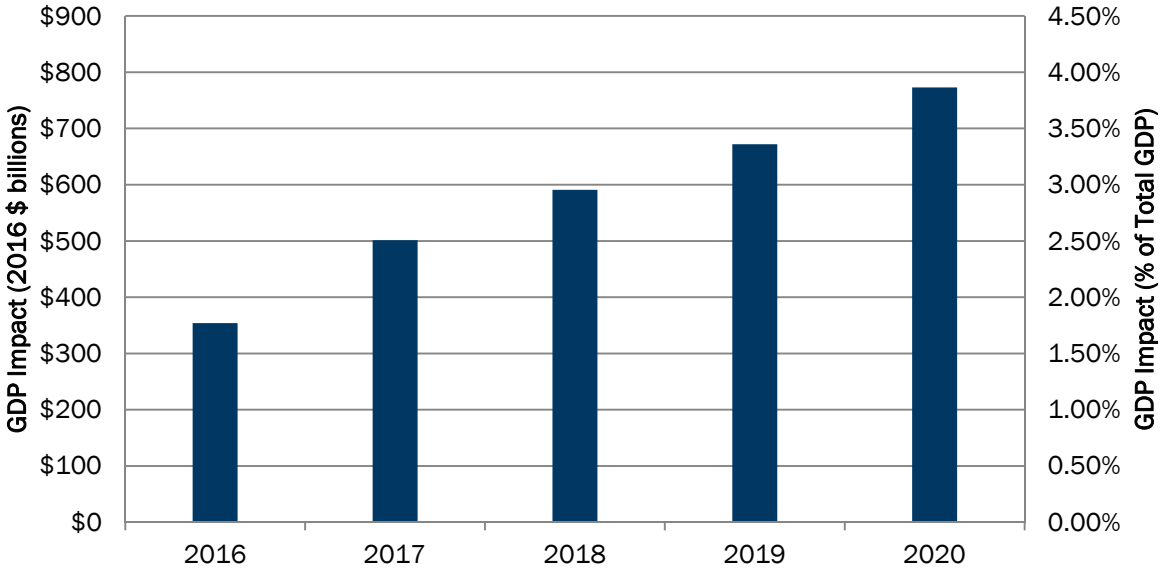


Figure 10 illustrates the increase in manufacturing output by subsector from 2015 forward. The forecasted output from 2016 to 2020 for these subsectors derives from the REMI PI+ model, the RSQE forecast, and the BLS projections. The chemical manufacturing industry makes up the largest share of the increase.

GDP

Figure 11 below shows the additional annual GDP attributable to the manufacturing investments (from Figure 9) and additional manufacturing output from 2016 to 2020 (from Figure 10). The manufacturing renaissance contributes $350 billion to U.S. GDP in 2016 and $775 billion to U.S. GDP in 2020 as more projects come online and begin producing. This is equivalent to a 1.75 percent and later a 3.75 percent increase in GDP relative to the **Baseline Scenario**.

Figure 11: Incremental Annual GDP Attributable to the Manufacturing Renaissance



Employment

Figure 12 below shows the incremental net jobs, direct and secondary, created or sustained by the new manufacturing investments in the **Renaissance Scenario**. In 2016, for instance, this number starts at 3.1 million and rises to 6.1 million by 2020. As shown below, the vast majority of these jobs are in the private economy.

Figure 12: U.S. Job Creation[23] from Manufacturing Renaissance

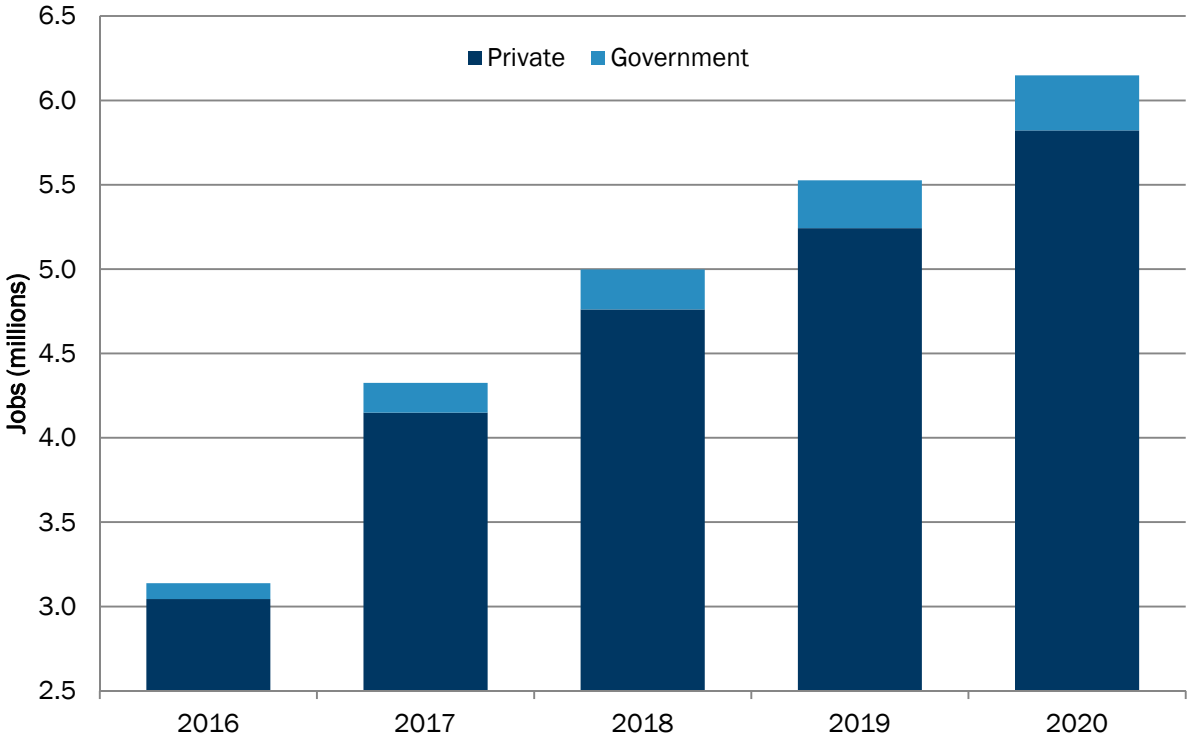


Table 2 shows the distribution of these additional jobs across the top ten industries (calculated from the average number of jobs created by sector from 2016 to 2020). Construction and manufacturing each experience the largest impacts with their direct involvement in capex for structures and manufacturing benefiting from increased output. The manufacturing sector also produces the equipment to populate and finalize new manufacturing facilities (such as the primary metals industry creating steel pipe for a chemical manufacturing firm). The story continues with the impact on service industries such as professional services, retail, administration, and healthcare. The government sector also benefits through the additional tax revenues paid by these industries in the REMI PI+ model.

[23] The data presented here are job-years. That is, it is equal to a count of jobs, for one year, in that year (not full-time equivalents). The data presented are the difference relative to the baseline. For example, "+2 million" in one year means 2 million more units of labor demand in that year for that year, while +3 million the next year means 3 million more units of labor demand for year t+1 in year t+1, which is 1 million more than the past year.

Table 2: Top 10 Impacted Industry Sectors
Share of U.S. Job Creation by NAICS Industries

Industry	Percent of Total
Manufacturing	18%
Construction	15%
Professional, Scientific, and Technical Services	10%
Retail Trade	8%
Administration and Waste Management Services	6%
Healthcare and Social Assistance	6%
Other Services, Except Public Administration	5%
State and Local Government	5%
Finance and Insurance	5%
Accommodation and Food Services	4%
Remainder	18%

Some commentators have downplayed the employment benefits of the manufacturing renaissance so far. For instance, in 2015, the Information Technology and Innovation Foundation (ITIF) released, "The Myth of America's Manufacturing Renaissance: The Real State of U.S. Manufacturing."[24] They argued "U.S. government data point to a different picture, where, coming out of the Great Recession, American manufacturing has still not recovered to 2007 output or employment levels." However, these findings may be premature given the investment surge that started in 2015.

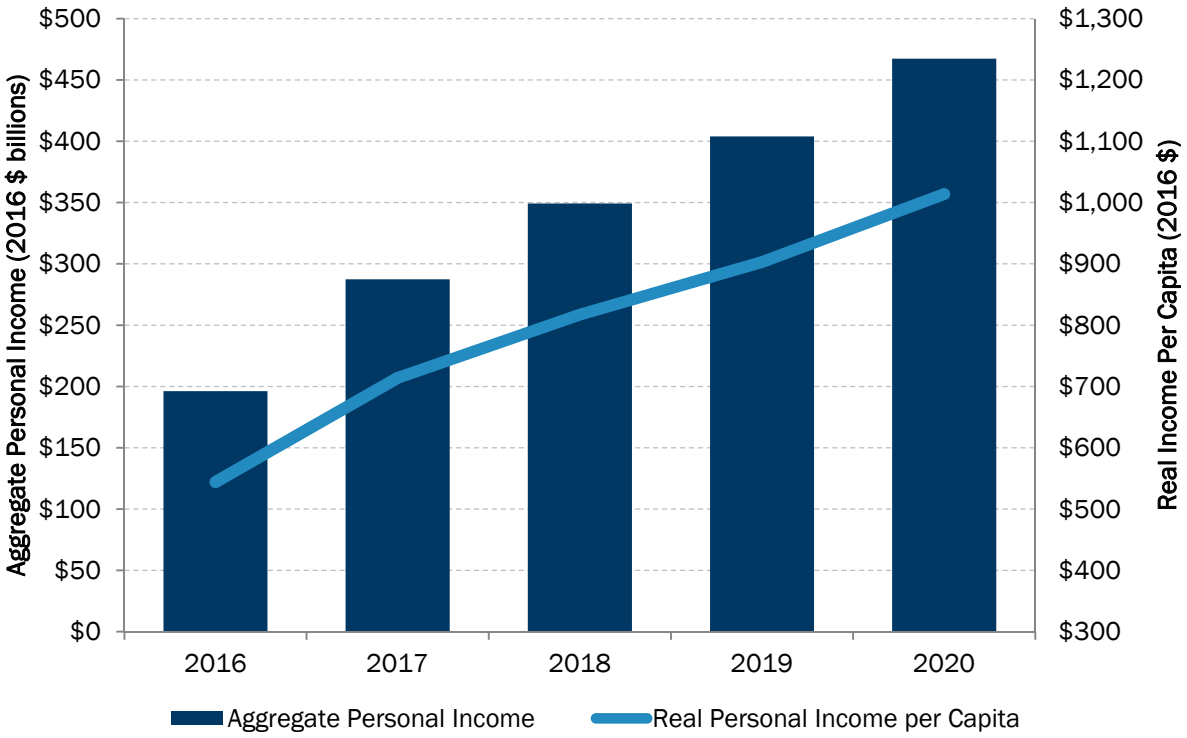
These findings explain some of the shortcomings and timing issues involved with the conclusions of the ITIF study. While correct that output dollars and employment had not recovered beyond 2007 by late 2014 and early 2015, the report does not discuss the strong leading indicators in the manufacturing sector's labor market and capex rates. Output volume for manufacturers has also increased in physical units while commodity prices have often fallen. Investment is a leading indicator of manufacturing growth, so job impacts can follow capex by years.

Labor Income

Figure 13 shows the impact on household income from the investments and expanded output at the core of the manufacturing renaissance. As shown below, the impact on total income across all households, on the left axis, is between $200 billion and $470 billion per year. Dividing the aggregate sum down to the per capita level yields $550 per person in 2016 to $1,050 per person by 2020. These numbers would be mostly concentrated in the direct employees of the manufacturing and construction sectors, in addition to those households providing labor to their supply chains and the support and service industries in the regions most affected by the renaissance.

[24] Adams B. Nager and Robert D. Atkinson, "The Myth of American's Manufacturing Renaissance: The Real State of U.S. Manufacturing," *The Information Technology and Innovation Foundation (ITIF)*, <http://www2.itif.org/2015-myth-american-manufacturing-renaissance.pdf>

Figure 13: U.S. Household and Per Capita Income Impacts



4. Conclusion

The manufacturing sector, while suffering challenging times during the Great Recession and the slow recovery thereafter – in the same vein as many other industries – is poised for a continued breakthrough into the 2020s. An examination of the leading indicators of the industry, including its labor market and, in particular, the rate of capital expenditures in new structures, equipment, intellectual property, and software, reveals that the industry underwent a significant change in 2014 and 2015 as the manufacturing renaissance has taken root.

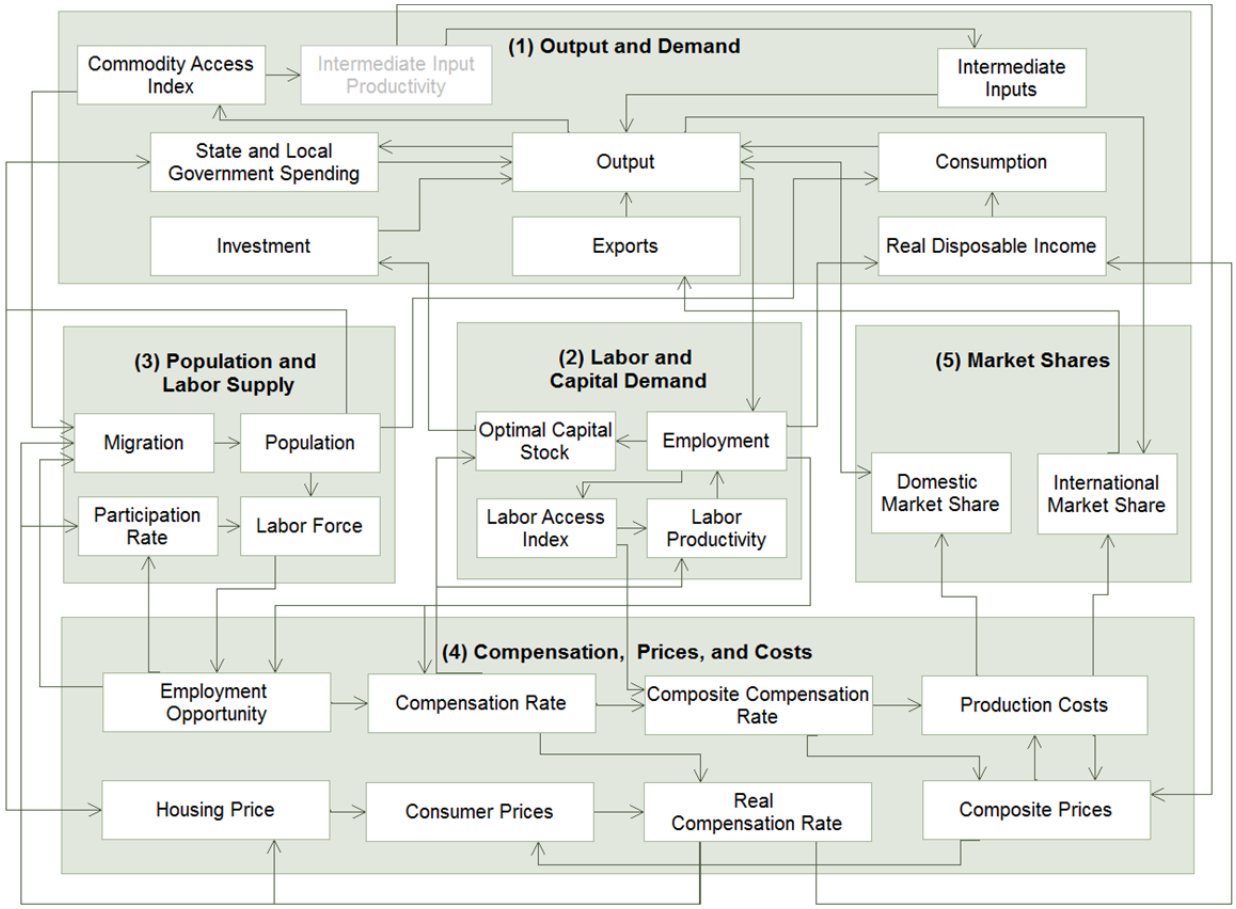
The economic impact of this manufacturing renaissance, including the direct, indirect, and induced effects, has had a tremendous effect on the U.S. economy. Capital expenditures in the manufacturing sector have roughly doubled in the past three years relative to the previous five. With existing and committed projects on deck and gas prices remaining low, investment rates aim to stay robust through 2020 with the chemical industry leading the way.

These investments and additional manufacturing output will support between 3.1 million and 6.1 million jobs over the next five years and add $350 billion to $775 billion annually, incremental to U.S. GDP. Furthermore, household income will increase by $200 billion to $470 billion per year from 2016 to 2020. This translates to a per capita personal income benefit of $550 to $1,015 per capita across all U.S. households.

Appendix A: Description of the REMI PI+ Model

The mechanics inside the REMI PI+ model and the intuition behind it follow a similar path to any input-output model.[25] Direct investments, expenditures, and output affect not just the direct industry but also its supply-chain, employee paychecks, consumer-centric sectors related to household spending patterns, and government through taxes. For example, a new pipeline project connecting natural gas developments to power plants, industrial consumers, or homes requires the employment of construction workers and their equipment, design and engineering professionals, and metal pipes plus other physical materials. All of these needs stimulate the construction, professional services, and the manufacturing sectors, as well as their suppliers (for instance, the mining industry providing ore for steel mills). Workers along every step of the way receive their paychecks, which then go towards paying for housing, healthcare, education, transportation, food, entertainment, and everything else in a household consumption basket, aiding each of those industries throughout the process. All of the workers and the investors involved pay taxes on labor income, capital income, and consumption at the same time, which allows for the operations of and employment within governments. The reasoning behind this immediate then ancillary "multiplier" drives the economic impact results inside the REMI PI+ model.

Figure 1: Flowchart structure of the REMI PI+ model



[25] "The Leontief Economic Model," *California State University-Fullerton*, <http://mathfaculty.fullerton.edu/mathews/n2003/LeontiefModelMod.html>

Ken Ditzel
(703) 966-1954
ken.ditzel@fticonsulting.com

Scott Nystrom
(515) 290-6990
scott.nystrom@fticonsulting.com

Evan Klein
(818) 687-1825
evan.klein@fticonsulting.com

CRITICAL THINKING
AT THE CRITICAL TIME™

About FTI Consulting

FTI Consulting, Inc. is a global business advisory firm dedicated to helping organizations protect and enhance enterprise value in an increasingly complex legal, regulatory and economic environment. FTI Consulting professionals, who are located in all major business centers throughout the world, work closely with clients to anticipate, illuminate and overcome complex business challenges in areas such as investigations, litigation, mergers and acquisitions, regulatory issues, reputation management and restructuring.

www.fticonsulting.com