

# **The Innovative Pharmaceutical Manufacturing Industry: Driving Economic Growth**

**March 2015**



### ***About the Author***

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### ***Acknowledgment***

Anil Sarda, Senior Associate at ndp | analytics, provided analytical assistance. Pharmaceutical Research and Manufacturers of America (PhRMA) provided financial support to conduct this study. The opinions and views expressed in this report are solely those of the author.

Led by the pharmaceutical manufacturing industry, IP-intensive manufacturing industries contribute extraordinary economic value to the U.S. economy.

Compared to other IP-intensive and non-IP intensive manufacturing industries, the pharmaceutical manufacturing industry had the highest R&D investment over the past decade. Consequently, the pharmaceutical manufacturing industry outperformed other manufacturing industries in all key economic measurements, including job creation, wages paid, gross output, net economic contribution, and exports.

# The Innovative Pharmaceutical Manufacturing Industry: Driving Economic Growth

This report is a companion report to analysis of the U.S. manufacturing sector that found research and development (R&D) investment is a key driver of innovation, supporting the growth and sustainability of the nation's economy. The report, "Intellectual Property (IP)-Intensive Manufacturing Industries: Driving U.S. Economic Growth," determined that industries that invest more in R&D (defined as "IP-intensive") tend to be more productive, support higher-value jobs and sustain employment better than industries with low levels of R&D spending ("non-IP-intensive"). Based on data from the National Science Foundation, the U.S. Census Bureau, the U.S. Bureau of Economic Analysis, and the International Trade Commission, the report found that IP-intensive industries accounted for 83% of annual R&D spending across all U.S. manufacturing industries between 2000 and 2010, and R&D investment grew by 53% compared to 34% for non-IP-intensive industries. This companion report was developed with support by PhRMA to explore the economic contributions of manufacturing performed by the innovative biopharmaceutical industry versus other IP-intensive industries across a number of key measures.

## The pharmaceutical manufacturing industry outperforms all other IP-intensive industries across key economic measurements

Led by the pharmaceutical manufacturing industry, IP-intensive manufacturing industries contributed significant economic value to the U.S. economy during the past 15 years, a period covering both economic upturns and downturns. IP-intensive industries are defined in this report as those industries that have a higher research and development (R&D) investment per employee than the average R&D per employee in all manufacturing industries. Adopting and developing new technologies, these U.S. companies create innovative products and services for consumers both domestically and internationally. With higher demand for their products and services and rising revenues, these companies are able to hire additional workers and pay wage premiums to attract needed talent. The U.S. innovative pharmaceutical manufacturing is critically tied to its base of high-skilled STEM workers who are involved in every stage of the manufacturing process that seeks to bring new treatments and cures against our most costly and challenging diseases. Workers in IP-intensive manufacturing industries are shown to have higher economic contributions to the U.S. economy.

### Key Definitions and Data Sources

R&D: Research and development expenses of a manufacturing sector or subsector used in the production of intellectual property published by the National Science Foundation.

Employment: Total number of employees in a manufacturing sector or subsector published by the U.S. Census Bureau.

Wages: Total wages paid to employees of a manufacturing sector or subsector published by the U.S. Census Bureau.

Gross output: Total sales of a manufacturing sector or subsector published by the U.S. Census Bureau.

Value added: The economic contributions of a manufacturing sector or subsector as measured by total sales minus intermediate inputs such as the cost of raw materials and services published by the U.S. Census Bureau.

Exports: Total sales abroad of a manufacturing sector or subsector (i.e. total sales minus domestic sales) published by the U.S. International Trade Commission.

As noted above, this report is based on our comprehensive report that assesses the economic performance of all IP-intensive and non-IP-intensive industries during the period between 2000 and 2012.<sup>1</sup> Our previous report uses R&D investments as a proxy to measure the innovative intensity across industries and R&D investment per employee to identify IP-intensive (which is defined as R&D per employee above the manufacturing average) and non-IP-intensive manufacturing industries. The matrix of economic performance includes employment, wages, output (revenues/sales), value-added (economic contributions), and exports.

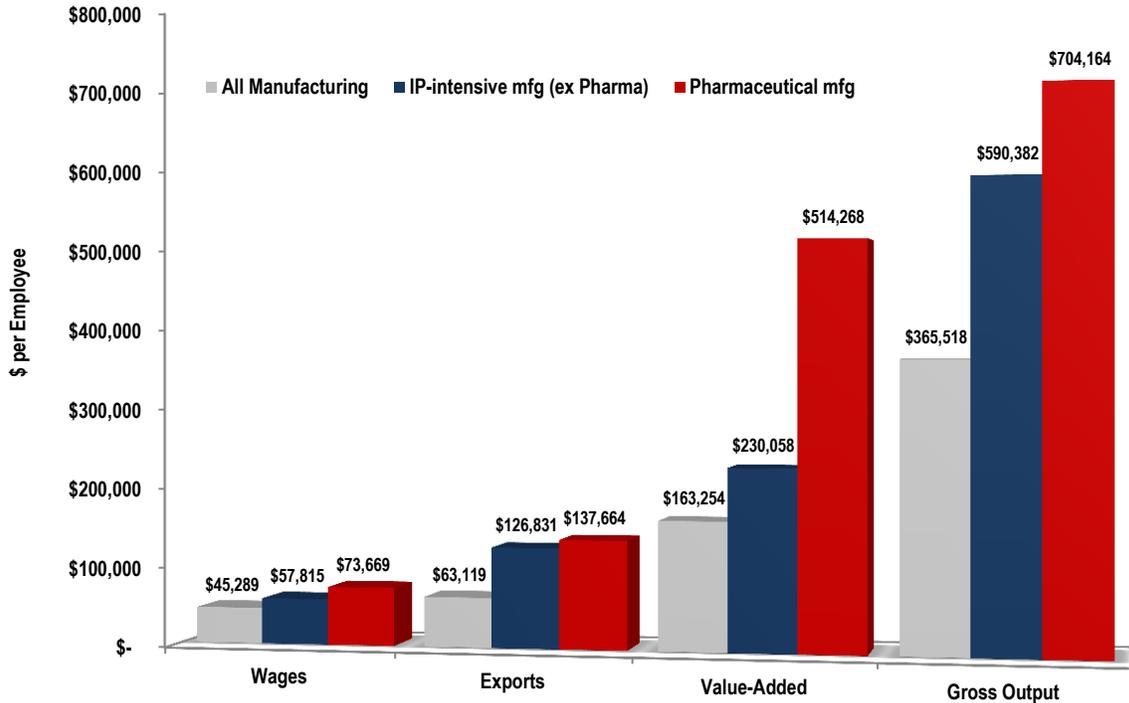
Key highlights of the economic performance of the U.S. pharmaceutical manufacturing industry since 2000 are:

- R&D investment in the pharmaceutical manufacturing industry accounted for 27% of all R&D investment among IP-intensive industries.
- The pharmaceutical manufacturing industry invested more than 5 times in R&D per employee than other IP-intensive manufacturing industries and more than 12 times all IP- and non-IP-intensive manufacturing industries.
- During the recent economic downturn, the pharmaceutical manufacturing industry was able to maintain employment while all other manufacturing industries cut their employment roughly by one-third, reflecting the resilience and sustainability of this sector.
- A worker in the pharmaceutical manufacturing industry made an average of \$74,000 per year, compared to an average of \$58,000 in other IP-intensive industries and an average of \$45,000 in all manufacturing industries.
- The pharmaceutical manufacturing industry outperformed other IP-intensive industries as well as non-IP-intensive industries (Figure 1).
  - Gross output in the pharmaceutical manufacturing industry averaged \$700,000 per employee, compared to \$590,000 in other IP-intensive manufacturing industries and \$365,000 in all manufacturing industries.
  - Net economic contributions (value-added) in the pharmaceutical manufacturing industry averaged \$515,000 per employee, compared to \$230,000 in other IP-intensive manufacturing industries and \$163,000 in all manufacturing industries.
  - Exports of the pharmaceutical manufacturing industry averaged \$140,000 per employee, compared to \$130,000 in other IP-intensive manufacturing industries and \$63,000 in all manufacturing industries.

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<sup>1</sup> Pham, Nam. 2015. "IP-intensive Manufacturing Industries: Driving U.S. Economic Growth." ndp | analytics.

**Figure 1. Economic Performance per Employee, Pharmaceutical versus other Manufacturing Industries, 2000-12**

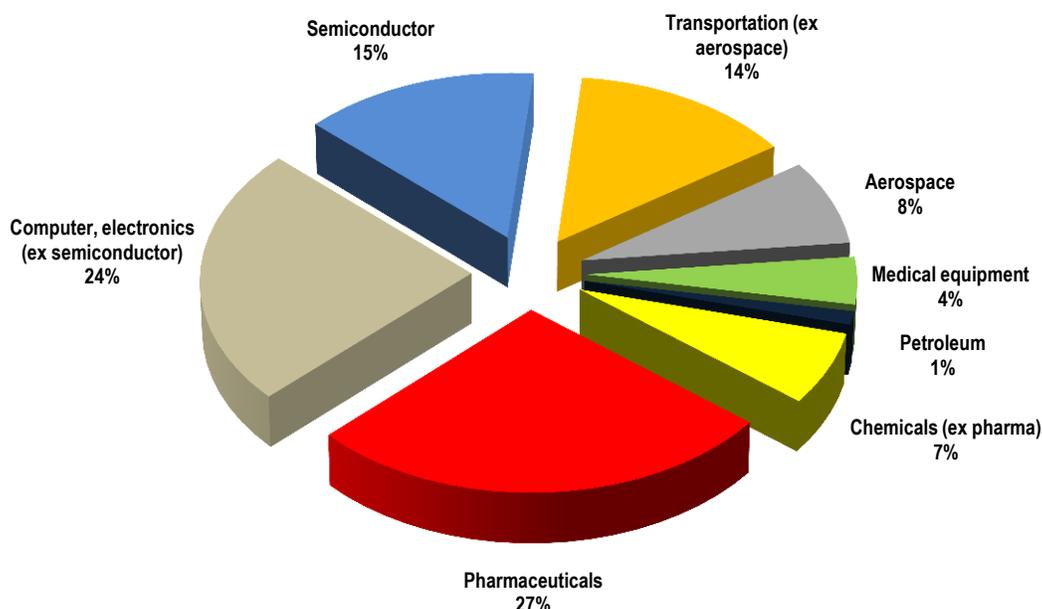


Source: National Science Foundation: BRDIS Survey; U.S. Census Bureau: Annual Survey of Manufactures, County Business Patterns, and Economic Census; U.S. International Trade Commission: DataWeb.

**The pharmaceutical manufacturing industry is highly innovative**

Companies invest in research and development (R&D) to create intellectual property and to produce innovative products and services. During the period 2000-10, R&D investment across U.S. manufacturing averaged \$140.3 billion per year. Five IP-intensive subsectors accounted for 83% of total R&D investment while the combined R&D investment of all other non-IP-intensive industries was only 17%. Among the IP-intensive industries, the pharmaceutical manufacturing industry had the highest share (27%) of total R&D investment (Figure 2).

**Figure 2. Composition of R&D Investment, by IP-intensive Industry, Average 2000-10**  
*The pharmaceutical manufacturing industry accounts for 27% of IP-intensive manufacturing R&D investment in the U.S.*



Sources: National Science Foundation: BRDIS Survey.

R&D investment in the pharmaceutical manufacturing industry grew an average of 14.4% per year during the period between 2000 and 2010, compared to 1.5% for other IP-intensive industries. The annual growth rate of R&D investment of the pharmaceutical manufacturing industry outpaced all other manufacturing industries during recent economic upturns and downturns (Table 1).

**Table 1. Average R&D Investment and Annual Growth Rates, 2000-10**

*R&D investment in the pharmaceutical manufacturing industry grew faster than in other manufacturing industries*

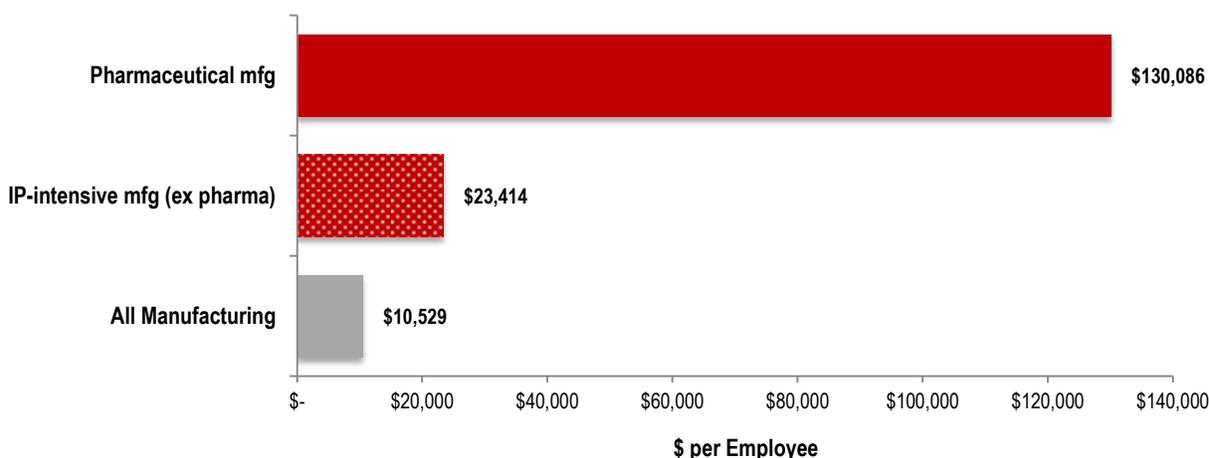
	R&D Average 2000-10 (\$ billions)	Average Annual Growth (%)			
		2000-10	2009-10	2005-08	2000-04
<b>All Manufacturing Industries</b>	<b>\$140.3</b>	<b>4.2%</b>	<b>-0.8%</b>	<b>7.0%</b>	<b>3.9%</b>
<b>IP-Intensive</b>	<b>\$116.7</b>	<b>4.3%</b>	<b>-0.9%</b>	<b>7.0%</b>	<b>4.4%</b>
Pharmaceutical & medicine	31.6	14.4%	1.4%	11.2%	25.2%
Others	85.1	1.5%	-2.1%	5.2%	-0.3%

Sources: National Science Foundation: BRDIS Survey.

During the period 2000-10, R&D investment in the pharmaceutical manufacturing industry averaged over \$130,000 per employee compared to an average of \$23,500 per employee in other non-IP-intensive industries and \$10,500 per employee in all manufacturing industries (Figure 3). Furthermore, R&D

investment per employee grew by more than 14% per year compared to 6% per year in other IP-intensive manufacturing industries.

**Figure 3. Annual Average R&D Investment per Employee, by Industry, 2000-10**  
*The pharmaceutical industry invests twelve times more R&D per employee than all manufacturing industries*



Sources: National Science Foundation: BRDIS Survey; U.S. Census Bureau: County Business Patterns.

### The pharmaceutical manufacturing industry grew faster than other manufacturing industries

Gross output of the pharmaceutical manufacturing industry, accounting for approximately 8% of total output of IP-intensive manufacturing industries, grew faster than other IP-intensive manufacturing industries and all manufacturing industries. R&D investment is the crucial element for companies to be innovative and to grow. The pharmaceutical manufacturing industry has the highest R&D investment intensity across U.S. manufacturing industries, 18.3% of their gross output compared to 4.4% of other IP-intensive industries and 3.0% of all U.S. manufacturing industries during 2000-10 (Table 2).

**Table 2. Annual Average Output, Growth Rates, and Shares of R&D, 2000-12**  
*The pharmaceutical manufacturing industry grew faster than other manufacturing industries*

	Annual Gross Output (\$ billions)	Annual Growth Rate (%)	R&D as % of Gross Output (%)
<b>All Manufacturing Industries</b>	<b>\$4,734.8</b>	<b>2.6%</b>	<b>3.0%</b>
<b>IP-Intensive</b>	<b>\$2,232.0</b>	<b>3.5%</b>	<b>5.4%</b>
Pharmaceutical & medicine	168.8	4.2%	18.3%
Others	2,063.2	3.5%	4.4%

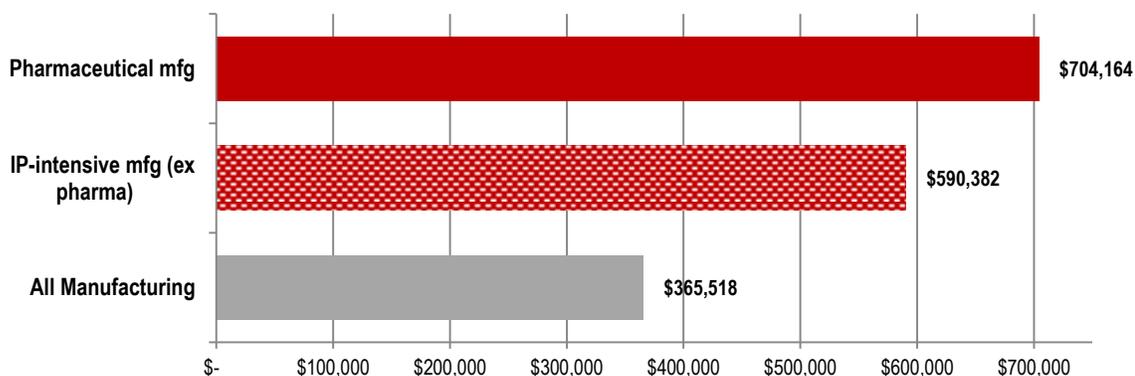
Sources: National Science Foundation: BRDIS Survey. R&D as % of output (2000-10); U.S. Census Bureau: Annual Survey of Manufactures, County Business Patterns and Economic Census.

## Gross output per employee in the pharmaceutical manufacturing industry was twice that of all manufacturing industries

During 2000-12, gross output in the pharmaceutical manufacturing industry was more than \$700,000 per employee, compared to the average of \$590,000 per employee in other IP-intensive manufacturing industries and \$360,000 in all manufacturing industries (Figure 4).

**Figure 4. Annual Average Output per Employee, 2000-12**

*Workers in the pharmaceutical manufacturing industry produce higher levels of output than the average of other manufacturing industries*



Sources: National Science Foundation: BRDIS Survey. R&D as % of output (2000-10); U.S. Census Bureau: Annual Survey of Manufactures, County Business Patterns and Economic Census.

## The pharmaceutical manufacturing industry is one of the largest contributors to the U.S. economy across all manufacturing industries

While gross output includes values of intermediate materials, the value added measurement excludes values of intermediate products to measure the net value of economic contributions of the industry to the economy. The value-added of the pharmaceutical manufacturing industry averaged more than 13% of the value-added of all IP-intensive industries. During the period 2000-2012, the pharmaceutical manufacturing industry grew an average of 4.3% annually compared to an average of 1.9% per year of all other IP-intensive industries and 1.5% of all manufacturing industries (Table 3).

The amount of R&D investment provides an explanation for the economic performance of the manufacturing industries. The pharmaceutical manufacturing industry invests nearly 25% of its value-added in research and development for its products and innovation, compared to an average of 10.8% of other IP-intensive industries and 6.7% of all manufacturing industries (Table 3).

**Table 3. Annual Average Value-Added, Growth Rates, and Shares of R&D, 2000-12**  
*Economic value-added in the pharmaceutical manufacturing industry grew faster than other manufacturing industries*

	Annual Value-Added (\$ billions)	Annual Growth Rate (%)	R&D as % of Gross Output (%)
<b>All Manufacturing Industries</b>	<b>\$2,125.5</b>	<b>1.5%</b>	<b>6.7%</b>
<b>IP-Intensive</b>	<b>\$932.7</b>	<b>2.2%</b>	<b>12.7%</b>
Pharmaceutical & medicine	123.4	4.3%	24.9%
Others	809.3	1.9%	10.8%

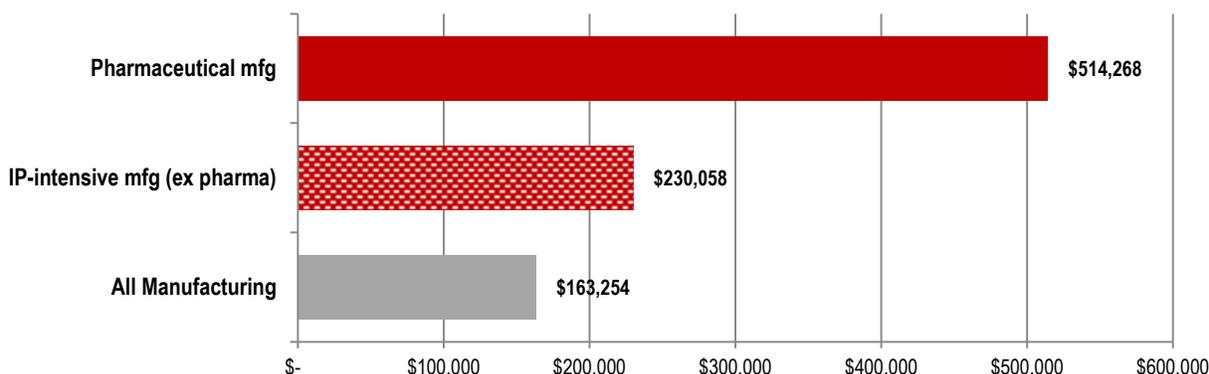
Sources: National Science Foundation: BRDIS Survey. R&D as % of output (2000-10); U.S. Census Bureau: Annual Survey of Manufactures, County Business Patterns and Economic Census.

**Like gross output, value added per employee in the pharmaceutical manufacturing industry outpaced other manufacturing industries**

During the period 2000-12, net economic contributions (value-added) per employee in the pharmaceutical manufacturing industry averaged approximately \$514,000 per year. The economic performance of pharmaceutical industry workers is more than twice the average of all other IP-intensive manufacturing industries and more than three times the average of all manufacturing industries (Figure 5).

**Figure 5. Annual Average Value-added per Employee, 2000-12**

*Economic value-added of workers in the pharmaceutical manufacturing industry are substantially higher than in other manufacturing industries*



Sources: U.S. Census Bureau: Annual Survey of Manufactures, County Business Patterns, and Economic Census.

**The pharmaceutical manufacturing industry maintained its employment level over the last decade, covering periods of economic upturn and downturn**

After a decade of job declines, U.S. manufacturing sectors started adding new jobs in the summer of 2010. During the past decade, U.S. manufacturing sectors lost nearly 5.3 million jobs and approximately one-third of total jobs. IP-intensive manufacturing industries also suffered job losses, although the effect was smaller.

While jobs were lost in all other industries, overall jobs in the pharmaceutical and medicine manufacturing industry remained unchanged from its 2000 level (Table 4).

**Table 4. Employment, by Industry, 2000-12<sup>2</sup>**

	Average 2000-12	2000	2012	Job Creation/ Losses (+/-)	% Change in 2000 Level
<b>All Manufacturing Industries</b>	<b>13,318,788</b>	<b>16,473,994</b>	<b>11,176,710</b>	<b>(5,297,284)</b>	<b>-32.2%</b>
<b>IP-Intensive</b>	<b>3,846,180</b>	<b>4,729,343</b>	<b>3,304,457</b>	<b>(1,424,886)</b>	<b>-30.1%</b>
Pharmaceutical & medicine	239,879	227,461	227,434	(27)	0.0%
Others	3,606,301	4,501,882	3,077,023	(1,424,859)	-31.7%

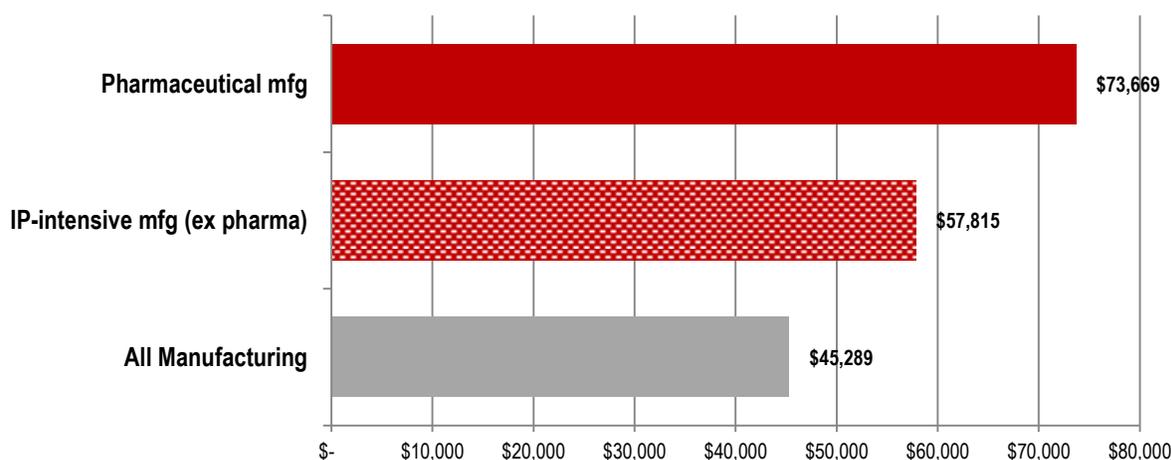
Sources: U.S. Census Bureau: County Business Patterns and Economic Census.

### Wages in the pharmaceutical manufacturing industry are higher than other manufacturing industries

Workers in the pharmaceutical manufacturing industry earn higher wages than their counterparts in other IP-intensive and all manufacturing industries. During 2000-12, workers in the pharmaceutical manufacturing industry made an average of nearly \$74,000 per employee per year compared to nearly \$58,000 per employee in other IP-intensive manufacturing industries and \$45,000 in all manufacturing industries (Figure 6).

**Figure 6. Annual Average Wages per Employee, 2000-12**

*Workers in the pharmaceutical manufacturing industry earn higher wages than in other industries*



Source: National Science Foundation: BRDIS Survey; U.S. Census Bureau: County Business Patterns and Economic Census.

<sup>2</sup> As noted, we use employment data published by the Census Bureau that is based on the establishment data. Since a manufacturing company may have establishments outside of manufacturing industries, our analyses underestimate the employment counts.

## Pharmaceutical manufacturers tripled their exports between 2000 and 2012

Export sales in the pharmaceutical manufacturing industry more than tripled between 2000 and 2012, rising from nearly \$17 billion in 2000 to \$50 billion in 2012. R&D investment of the pharmaceutical manufacturing industry is equivalent to 99% of the industry's exports, compared to 21% of other IP-intensive industries and less than 19% of all manufacturing industries (Table 5).

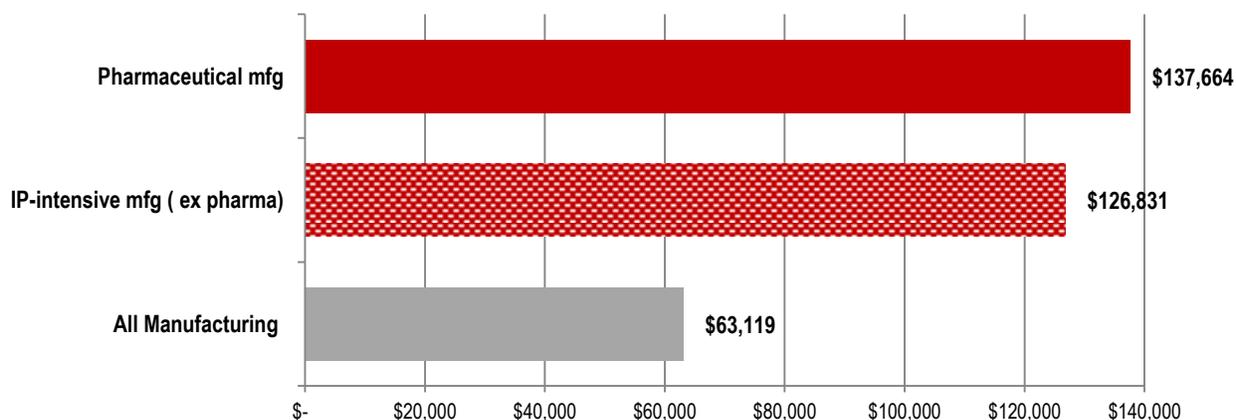
**Table 5. Annual Average Exports, Growth Rates, and Shares of R&D, 2000-12**  
*The pharmaceutical manufacturing industry's exports grew nearly 10% annually since 2000*

	Annual Exports (\$ billions)	Annual Growth Rate (%)	R&D as % of Exports (%)
<b>All Manufacturing Industries</b>	<b>\$806.2</b>	<b>5.0%</b>	<b>18.8%</b>
<b>IP-Intensive</b>	<b>\$473.2</b>	<b>4.9%</b>	<b>26.5%</b>
Pharmaceutical & medicine	32.9	9.9%	99.0%
Others	440.3	4.6%	21.1%

Sources: U.S. Census Bureau: County Business Patterns and Economic Census; U.S. International Trade Commission: DataWeb.

During the same period, annual export sales per employee in the pharmaceutical manufacturing industry averaged approximately \$138,000 compared to \$127,000 in other IP-intensive industries and \$63,000 in all manufacturing industries (Figure 7).

**Figure 7. Annual Average Exports per Employee in IP-Intensive and All Manufacturing Industries, 2000-12**  
*Exports per employee in the pharmaceutical manufacturing industry are twice that of all manufacturing industries*



Sources: U.S. Census Bureau: County Business Patterns and Economic Census; U.S. International Trade Commission: DataWeb.

## **FINAL REMARKS**

This brief report reinforces the importance of research and development (R&D) investment in supporting innovation. As seen in the pharmaceutical manufacturing industry, R&D investment and the activity and output generated is positively correlated with the economic performance of the industry during both economic upturns and downturns.

Evidence in the past 15 years shows that IP-intensive manufacturing industries outperformed others and contributed significant economic value to U.S. economic growth. The pharmaceutical manufacturing industry is leading other industries in terms of R&D investment. Consequently, the economic performance of the pharmaceutical manufacturing industry outpaces others.

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