NIST Special Publication 1142

The Current State and Recent Trends of the U.S. Manufacturing Industry

Douglas S. Thomas

http://dx.doi.org/10.6028/NIST.SP.1142

National Institute of Standards and Technology
U.S. Department of Commerce

NIST Special Publication 1142

The Current State and Recent Trends of the U.S. Manufacturing Industry

Douglas S. Thomas
Applied Economics Office
Engineering Labaratory

http://dx.doi.org/10.6028/NIST.SP.1142

December 2012

U.S. Department of Commerce
Rebecca Blank, Acting Secretary

National Institute of Standards and Technology
Patrick D. Gallagher, Under Secretary of Commerce for Standards and Technology and Director

National Institute of Standards and Technology Special Publication 1142
Natl. Inst. Stand. Technol. Spec. Publ. 1142, 150 pages (December 2012)
http://dx.doi.org/10.6028/NIST.SP.1142
CODEN: NSPUE2

Abstract

This report brings together multiple sources of aggregate manufacturing industry data and industry subsector data to develop a quantitative depiction of the U.S. manufacturing industry. It compares the U.S. manufacturing industry to its international counterparts in order to provide context to domestic activities. This approach promotes a better understanding of the U.S. manufacturing industry and provides an evidence-based depiction of both the industry and its subsectors. Domestic and international data on employment, compensation, output, value added, net income (profit), and research and development expenditures are explored and evaluated. A number of techniques are utilized to compare and analyze these data including input-output analysis. Many of the industry's subsectors are discussed individually with a focus on medium- and high-technology sectors.

The U.S. produces approximately 18 % of the world's manufactured goods, making it the largest manufacturing nation in the world, according to 2008 United Nations Statistics Division (UNSD) data. This data also shows that U.S. manufacturing growth lags behind that of many countries and is growing slower than the whole of the U.S. economy. Compound annual growth in U.S. manufacturing is below the 20th percentile of 180 nations. Countries such as the United Kingdom, Japan, Canada, France, Germany, Australia, and Italy were among the many countries that had a higher growth rate than the U.S. This corresponds with data from the Bureau of Economic Analysis (BEA) that shows that U.S. manufacturing's average annual ten year growth has declined from around 4 % in 1957 to -1 % in 2008. While manufacturing value added is larger in the U.S. than in any other country, U.S. manufacturing per capita has lagged slightly behind some industrialized nations, such as Germany and Japan. At least 20 other nations had a higher manufacturing value added per capita than the U.S. in 2008, according to UNSD data. In 2005, the U.S. had a higher rate of manufacturing businesses exiting the market than entering it while other countries such as Canada had a higher rate of businesses entering the market. Seemingly, this trend has left the U.S. manufacturing industry with one of the lowest numbers of active employer enterprises per capita and having a share of total employment lower than Germany, Italy, Japan, France, Canada, and the United Kingdom. Despite slow growth, U.S. research and development expenditures in manufacturing, both nominal and per capita, are among the highest being greater than Germany, Canada, Australia, and China, according to OECD data. This is complimented by the fact that the U.S. is among the top publishers of scientific and technical journals as well as patent applications, both in nominal and per capita data from the World Bank. Additionally, manufacturing continues to play a significant role in the U.S. economy as it accounts for 23% of U.S. output according to BEA data and 28% according to OECD data.

Keywords: Competitiveness; Industry; Manufacturing; Statistics; Technology

Preface

This study was conducted by the Applied Economics Office in the Engineering Laboratory at the National Institute of Standards and Technology. The study provides aggregate manufacturing industry data and industry subsector data to develop a quantitative depiction of the U.S. manufacturing industry.

Disclaimer

Certain trade names and company products are mentioned in the text in order to adequately specify the technical procedures and equipment used. In no case does such identification imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the products are necessarily the best available for the purpose.

Cover Photographs Credits

Microsoft Clip Art Gallery Images used in compliance with Microsoft Corporation's non-commercial use policy.

Acknowledgements

The author wishes to thank all those who contributed so many excellent ideas and suggestions for this report. Special appreciation is extended to Simon Frechette and Conrad Bock of the Engineering Laboratory's Systems Integration Division and to Frederick Proctor of the Engineering Laboratory's Intelligent Systems Division for their technical guidance, suggestions, and support. Additionally, the author would like to thank economists Stephen Campbell and Dr. Gregory Tassey of the Associate Director for Innovation and Industry Services' Economic Analysis Office for their insight and ideas. Special appreciation is also extended to Dr. David Butry, Dr. Stanley Gilbert, and Dr. Robert Chapman of the Engineering Laboratory's Applied Economics Office for their thorough reviews and many insights and to Ms. Carmen Pardo for her assistance in preparing the manuscript for review and publication. The author also wishes to thank Dr. Nicos Martys, Materials and Structural Systems Division, for his review.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Reading Figures and Tables: Figures in this report frequently have two images and one legend. The legend applies to both images. Tables frequently have colored bars (red or green). These bars provide comparisons between other figures in the table, often between countries or industries. Red bars signify instances where a lower value is preferred such as rankings (i.e., being 1st is preferred over 31st).

LIST OF ACRONYMS

ASM – Annual Survey of Manufactures
BEA – Bureau of Economic Analysis
BLS – Bureau of Labor Statistics
BOY – Beginning of Year
CES – Current Employment Statistics
CIP – Competitive Industrial Performance Index
CPI – Consumer Price Index
CPS – Current Population Survey
EIN – Employer Identification Number
EOY – End of Year
EPO – European Patent Office
FDI – Foreign Direct Investment
FOB – Free on Board
GDP – Gross Domestic Product
GNP – Gross National Product
IBRD – International Bank for Reconstruction and Development
IDA – International Development Association
IMD – International Institute for Management Development
IMF – International Monetary Fund
ISIC – International Standard Industrial Classification
NAICS – North American Industry Classification System
NCSES – National Center for Science and Engineering Statistics
NSF – National Science Foundation
OECD – Organization for Economic Co-operation and Development
PCT – Patent Co-operation Treaty
PEO – Professional Employer Organizations
PPP – Purchasing Power Parity
SDBS – Structural and Demographic Business Statistics
SNA – System of National Accounts
STAN – Structural Analysis Database
UN – United Nations
UNIDO – United Nations Industrial Development Organization
UNSD – United Nations Statistics Division
USPTO – United States Patent and Trademark Office

1 Introduction

1.1 Background

The U.S. produces approximately 18 % of the world's manufactured goods, making it the largest manufacturing nation in the world, according to 2008 United Nations Statistics Division (UNSD) data. Medium and high technology goods, as defined by the United Nations Industrial Development Organization (UNIDO), account for 56 % of U.S. manufacturing value added in 2003.[1] Additionally, the industry impacts 23 % of U.S. output, according to 2009 data from the Bureau of Economic Analysis. Thus, the manufacturing industry is indispensable to the U.S. economy; however, numerous media articles have discussed the decline of U.S. manufacturing with many proposing that the U.S. has lost its competitive edge in manufacturing.[2] According to industry data, however, it is unclear whether the U.S. manufacturing industry is declining. After controlling for inflation, the industry grew 21% between 1980 and 2007, as measured in value added from the Bureau of Economic Analysis; thus, the industry is actually growing in terms of the value of the goods being produced. It is likely that at least some of this concern is due to changes in manufacturing employment,[3] which, in recent years, has steadily decreased.[4] This trend, however, pervades internationally and is, to some extent, due to significant increases in productivity. Declining employment is easily observed by the average individual. Stories of lost jobs, unemployed workers, and outsourcing overseas are more common news stories than increases in productivity. While employment has decreased, many people would be surprised to learn that General Motors employed over 96,000 workers in the U.S. during 2008[5] or that some business consultants are advising companies to locate manufacturing plants in the U.S. because it is more cost effective.[6, 7] And, while there has been concern that semiconductor fabrication plants are being moved overseas,[8] Intel has at least 6 semiconductor fabrication plants in the U.S. with one of them being built as recently as 2007. As of 2010, other companies are building or planning to build additional fabrication plants in the U.S.[9] This does not mean that the U.S. manufacturing industry does not have deficiencies, but it does mean that the current state and recent trends of the U.S. industry

[1] UNIDO Strategic Research Database. Competitive Industrial Performance Index. 2003. <http://www.unido.org/index.php?id=5058>
[2] Sirkin, Harold L. "Made in the USA Still Means Something." Bloomberg Businessweek. April 10, 2009. <http://www.businessweek.com/managing/content/apr2009/ca20090410_054122.htm>
[3] US-China Business Council. "US Manufacturing: Dying… Or Still Going Strong?" 2006. <https://www.uschina.org/public/documents/2006/09/us-manufacturing.pdf>
[4] Congressional Budget Office. "Factors Underlying the Decline in Manufacturing Employment Since 2000." December 23, 2008. <http://www.cbo.gov/ftpdocs/97xx/doc9749/12-23-Manufacturing.pdf>
[5] Carbaugh, Robert J. *International Economics*. (Mason, OH: South Western Cengage Learning, 2011), 78.
[6] Economist. "The Dwindling Allure of Building Factories Offshore." May 12, 2011. <http://www.economist.com/node/18682182?fsrc=rss&story_id=18682182>
[7] Sirkin, Harold L. "Manufacturers: Rethink Your Bond with China." Bloomberg Businessweek. February 13, 2009. <http://www.businessweek.com/managing/content/feb2009/ca20090213_657126.htm>
[8] Center for Public Policy Innovation. "The Decline in Semiconductor Manufacturing in the United States." June 2010. <http://cppionline.org/docs/The-Decline-of-Semiconductor-Manufacturing.pdf>
[9] SEMI. Semiconductor, LED, and MEMS Fabs and Foundries. <http://www.semi.org/en/>

are not obviously apparent. In addition to employment trends, there are numerous other worries concerning the industry: research and development expenditures,[10, 11] U.S. labor costs, globalization, availability of qualified workers,[12] U.S. corporate taxes,[13] the ability to acquire funding for business ventures, location of industry supply chains,[14] and lower growth rates to name a few.

Many industry experts have endorsed media claims in suggesting that the U.S. manufacturing industry is losing its competitive edge; however, many disagree on what it means for a nation to be competitive and what metrics are appropriate for measuring competitiveness. Commentary by Tassey, Krugman, and others has illustrated divergent views in regard to competitiveness.[15, 16, 17, 18, 19, 20] This makes it all the more important to track a variety of aspects of the industry. This can be challenging, however, as the industry can appear to be contracting or expanding depending on what aspect of the industry one is examining and depending on the methods used to adjust industry data. Employment, for example, has steadily decreased,[21] while value added has increased.

Over time manufacturing processes have changed dramatically. Robotic arms and other machinery have radically changed the manufacturing environment. For instance, just a few decades ago a company such as Standard Motor Products, which produces replacement parts for car engines, had a number of employees who were illiterate. Today, many of the employees at Standard Motor Products not only need to be able to read, they

---

[10] Tassey Gregory. "Rationales and Mechanisms for Revitalizing U.S. Manufacturing R&D Strategies." *Journal of Technology Transfer*. 35 (2010): 283-333.
[11] Pisano, Gary P. and Willy C. Shih. Restoring American Competitiveness. *Harvard Business Review*. July-August (2009).
[12] Committee on Prospering in the Global Economy of the 21st Century: An Agenda for American Science and Technology, National Academy of Sciences, National Academy of Engineering, Institute of Medicine. "Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future." National Academies Press. <http://www.nap.edu/catalog.php?record_id=11463>
[13] Engardio, Pete. "Can the Future Be Built in America." Bloomberg Businessweek. April 26, 2009 <http://www.businessweek.com/magazine/content/09_38/b4147046115750.htm>
[14] Bhatnagar, Rohit and Amrik S. Sohal. "Supply Chain Competitiveness: Measuring the Impact of Location Factors, Uncertainty and Manufacturing Practices." *Technovation.* 25 (2005): 443-456.
[15] Tassey Gregory. "Rationales and Mechanisms for Revitalizing U.S. Manufacturing R&D Strategies." *Journal of Technology Transfer*. 35 (2010): 283-333.
[16] Krugman, Paul. "Making Sense of the Competitiveness Debate." *Oxford Review of Economic Policy*. Vol. -12 no. 3 (1996): 17-25.
[17] Krugman, Paul. "Competitiveness, A Dangerous Obsession." *Foreign Affairs*. Vol 73. Num 2. March/April (1994): 28-44.
[18] US-China Business Council. "US Manufacturing: Dying… Or Still Going Strong?" 2006. <https://www.uschina.org/public/documents/2006/09/us-manufacturing.pdf>
[19] World Economic Forum. *The Global Competitiveness Report*. 2010-2011. <http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2010-11.pdf>
[20] Toder, Eric. "International Competitiveness: Who Competes Against Whom and for What?" Tax Policy Center: Urban Institute and Brookings Institution. January (2012). <http://www.taxpolicycenter.org/UploadedPDF/412477-international-competitiveness.pdf>
[21] Congressional Budget Office. "Factors Underlying the Decline in Manufacturing Employment Since 2000." December 23, 2008. <http://www.cbo.gov/ftpdocs/97xx/doc9749/12-23-Manufacturing.pdf>

need to know the computer language of the machinery producing the parts.[22, 23] The increase in productivity that is often the result of these changes means fewer employees are needed to make the same products, possibly resulting in lower employment levels in manufacturing. And, while American manufacturing efficiency is improving, other nations have been developing and improving their own manufacturing industries. Emerging economies such as China have gone from producing some manufactured goods to producing a significant amount of goods. Understanding the current state and recent trends of the U.S. manufacturing industry in light of these issues is difficult. Tassey's "Rationales and Mechanisms for Revitalizing U.S. Manufacturing R&D Strategies"[24] and the commentaries that follow it, illustrate that determining the current and future state of U.S. manufacturing is controversial. Some experts have stated that U.S. multinationals have "abandoned" the U.S. and their global expansion "tends to 'hollow out'" U.S. operations while exporting jobs abroad. Others counter that operations and investment of U.S. multinationals are highly concentrated in the U.S. and maintain a large presence while increasing overseas activities.[25, 26, 27] Determining the current state and recent trends of the U.S. manufacturing industry is complex and there is a need for an assemblage of data that measures components of the industry.

1.2 Purpose

The purpose of this report is to track domestic manufacturing activity in order to develop a quantitative depiction of U.S. manufacturing in context of the global industry. The report first discusses the primary data available on the industry, both nationally and internationally, and then provides a synopsis of the data. As displayed in Table 2.3, numerous sources of data are used to depict the manufacturing industry, including data from the Organization for Economic Co-operation and Development (OECD), United Nations (UN), and U.S. Bureau of Labor Statistics (BLS). There are two aspects that can be discussed that relate to the U.S. manufacturing industry. The first includes the trends and current state of the industry. This includes the quality and quantity of production along with expenditures on research and development activities. The second is the environment in which the manufacturing industry must operate. This includes taxes, regulations, infrastructure, the labor market, and current economic conditions among other things. This report largely focuses on the current state and recent trends of U.S.

---

[22] Davidson, Adam. "The Transformation of American Factory Jobs, In One Company." NPR. January 13, 2012. <http://www.npr.org/blogs/money/2012/01/13/145039131/the-transformation-of-american-factory-jobs-in-one-company?ft=1&f=100>

[23] Davidson, Adam. "Making It in America." *The Atlantic*. January/February (2012). <http://www.theatlantic.com/magazine/archive/2012/01/making-it-in-america/8844/?single_page=true>

[24] Tassey Gregory. "Rationales and Mechanisms for Revitalizing U.S. Manufacturing R&D Strategies." *Journal of Technology Transfer*. 35 (2010): 283-333.

[25] Slaughter, Matthew J. "How U.S. Multinational Companies Strengthen the U.S. Economy." United States Council for International Business. (March 2010). <http://www.uscib.org/docs/foundation_multinationals.pdf>

[26] National Science Foundation. "Asia's Rising Science and Technology Strength." May 2007. <http://www.nsf.gov/statistics/nsf07319/>

[27] Sirkin, Harold L. "Made in the USA Still Means Something." Bloomberg Businessweek. April 10, 2009. <http://www.businessweek.com/managing/content/apr2009/ca20090410_054122.htm>

manufacturing domestically and as compared to its international counterparts such as major trading partners and those countries that are often considered as competitors.

1.3 Scope and Approach

This report brings together multiple datasets on the current state of the U.S. manufacturing industry. It then uses various strategies to compare these data internationally to develop a quantitative depiction of the U.S. manufacturing industry in context of its international counterparts. Data and information on the manufacturing industry is extensive. Understanding these resources and identifying the relevant statistics that can be extracted from them requires both familiarity with and an understanding of industry data. In order to understand the current state and recent trends in manufacturing, data is needed on both the domestic and international manufacturing industries. There are many sources of information that provide data on individual nations. Unfortunately, identifying, adjusting, and accumulating these data would require a considerable amount of time and resources. Therefore, this report relies on sources that provide data on multiple nations to make international comparisons. However, in depth data on the U.S. is used to understand the details of the domestic manufacturing industry. In order to make meaningful comparisons of international data a variety of factors, such as population and exchange rates, need to be considered. For instance, the U.S. may be the largest producer of manufactured goods in the world; however, it may not be the largest on a per capita basis. These types of issues are important in examining U.S. manufacturing.

National economies are often compared to companies competing for market share. This is a common analogy made when discussing the U.S. manufacturing industry; unfortunately, this comparison can be rather misleading.[28, 29, 30, 31, 32] A national economy is the primary supplier of goods and services to its labor force while a single company, generally, is not the primary supplier of goods and services to its employees. Additionally, a national economy provides the income for the majority of the nation's consumers while a business, generally, does not provide the income for the majority of its customers. Moreover, a national economy represents a system of exchange in which a company operates as one entity of that system. Companies can go out of business while

[28] Krugman, Paul R. "Making Sense of the Competitiveness Debate." Oxford Review of Economic Policy. Vol 12, no. 3 (1996): 17-25. Paul Krugman won the 2008 Nobel Memorial Prize in Economic Sciences for his work on international trade and economic geography.

[29] Krugman, Paul R. "Competitiveness, A Dangerous Obsession." *Foreign Affairs*. Vol 73. Num 2. March/April (1994): 28-44.

[30] The World Economic Forum defines competitiveness of a nation as "the set of institutions, policies, and factors that determine the level of productivity of a country." This definition relates to productivity and is not consistent with the idea of countries competing for market share. World Economic Forum. *The Global Competitiveness Report*. 2010-2011.
<http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2010-11.pdf>

[31] Porter, Michael E. *The Competitive Advantage of Nations*. 1st ed. (New York: The Free Press, 1990).

[32] Porter asserts that competitiveness is measured by productivity and that measuring a country's competitiveness as its share of world markets is "deeply flawed." Porter, Michael E. "Building the Microeconomic Foundations of Prosperity: Findings from the Business Competitiveness Index." In Porter, Michael E., Klaus Schwab, Xavier Sala-i-Martin, and Augusta Lopez-Claros. The Global Competitiveness Report 2003-2004. (New York: Oxford University Press, 2004).

nations do not. Domestic demand for goods and services constitutes a great proportion of the demand for a nation's domestically-produced products where the demand for goods and services from a company is primarily external. In addition to these analogies, frequently, anecdotal observations are used to characterize the manufacturing industry;[33] however, the insight from these types of observations is somewhat limited, as the manufacturing industry includes hundreds of thousands of establishments with millions of employees making trillions of dollars worth of goods. Anecdotal observations provide a limited narrow scope of the industry that does not necessarily reflect or apply to the industry as a whole. This report will largely avoid these types of comparisons and anecdotes as they can add confusion to complex matters. This approach reduces the possibility of mischaracterizing the industry and provides an evidence-based depiction of the manufacturing industry and its subsectors.

Although this report depicts the manufacturing industry with a focus on medium- and high-tech industry, the sectors included in these categories are only generally identified. There does not seem to exist a well-established criteria for identifying what types of manufacturing are high-tech, medium-tech, or low-tech; however, the definition by the OECD is commonly used, which utilizes research and development intensities.[34] It is often the case that authors refer to medium- and high-tech manufacturing and simply specify the industries to which they are referring. For the purpose of this report, medium-tech manufacturing includes chemical, mechanical, and electronic equipment manufacturing while high-tech manufacturing includes computer and related product manufacturing, which is consistent with the definition provided in the RAND Technical Report on High Technology Manufacturing and with the definition used by the United Nations Industrial Development Organization.[35] This broader definition allows for an examination of medium- and high-tech industries while also being able to examine the manufacturing industry as a whole. It also allows for a more general comparison between countries, as international data is often limited.

This report begins by identifying stakeholders and metrics for the manufacturing industry. It is then followed with a presentation of international and domestic data relating to stakeholder's vested interests. International data tends to be broader in nature, which allows for some comparison of U.S. manufacturing to its international counterparts. Although limited in nature, this comparison provides critical context in which to view the U.S. manufacturing industry and its subsectors. In contrast, domestic data is much more detailed in nature, which allows for a more comprehensive discussion on medium and high tech manufacturing. Following the chapters on international and domestic data is a chapter that discusses the data as a whole in order to characterize the

[33] Greenwald, Bruce C.N. and Judd Kahn. Globalization: The Irrational Fear that Someone in China will Take Your Job. (Hoboken, NJ: John Wiley & Sons 2009).
[34] OECD. "Measuring Globalisation: OECD Handbook on Economic Globalisation Indicators." May 2005. <http://www.oecd-ilibrary.org/economics/measuring-globalisation-oecd-handbook-on-economic-globalisation-indicators-2005_9789264108103-en >
[35] Kelley, Charles, Mark Wang, Gordon Bitko, Michael Chase, Aaron Kofner, Julia Lowell, James Mulvenon, David Ortiz, and Kevin Pollpeter. "High-Technology Manufacturing and U.S. Competitiveness." RAND Technical Report. March 2004. <http://www.rand.org/pubs/technical_reports/2004/RAND_TR136.pdf>

U.S. manufacturing industry. The final chapter discusses data needs. The report includes five appendices. Appendix A and Appendix B present two competitiveness indices. Appendix C and Appendix D provide detailed data from the Annual Survey of Manufactures while Appendix E contains a glossary of terms.

2 Manufacturing Industry Stakeholders, Metrics, and Data

To track the current state and recent trends in the U.S. manufacturing industry it is necessary to determine what types of data are relevant and provide some context for the data. There are many datasets that track the U.S. manufacturing industry, but they do not all have equal importance. This report identifies manufacturing industry stakeholders and tracks stakeholder costs and benefits. To provide context to the level of costs and benefits, they are compared to their international counterparts.

Individual manufacturing stakeholders are affected by the industry in different ways. Therefore, it is useful to identify individual stakeholders and classify them into stakeholder groups. This classification can then be used to identify the primary investment each stakeholder has in the manufacturing industry along with their expected return. Stakeholders evaluate benefits and costs of manufacturing industry investments purely from their "stakeholder" point of view; therefore, it is important to identify each stakeholder's investment and expected return. These "points of view" can provide some guidance as to what metrics might be used to characterize the manufacturing industry.

2.1 Manufacturing Industry Stakeholders

There are a number of stakeholders for the manufacturing industry. The most direct and obvious ones are the owners and employees; these are the individuals directly responsible for production. As seen in the manufacturing supply chain in Figure 2.1, there are many suppliers of goods and services that also have a stake in the industry; these include resellers, providers of transportation and warehousing, raw material suppliers, suppliers of intermediate goods, and suppliers of professional services. The items in the figure colored in blue represent suppliers of services, computer hardware, software, and other costs. Gold represents refuse removal, intermediate goods, and recycling while orange represents machinery, structures, and compensation with red being the repair of the machinery and structures. Green represents the suppliers of materials. These items all feed into the design and production of manufactured goods which are inventoried and/or shipped. The depreciation of capital and net income are also included in the figure, which affect the market value of shipments. In addition to the stakeholders in the figure, there are also public vested interests, the end users, and financial service providers.

As seen in Table 2.1, stakeholders may have a direct investment in manufacturing, such as industry owners and employees, or an indirect investment through supply chains or industry outputs. Each stakeholder is associated with a primary form of investment. For example, employees invest their labor while owners invest land and capital. Owners often have labor and/or intellectual property invested as well; however, their primary investment is in the form of land and capital as seen in Table 2.1. Each stakeholder has invested these items with the expectation of receiving compensation or a return on investment. Employees, for instance, expect to be compensated for their labor and owners

Figure 2.1: Manufacturing Supply Chain

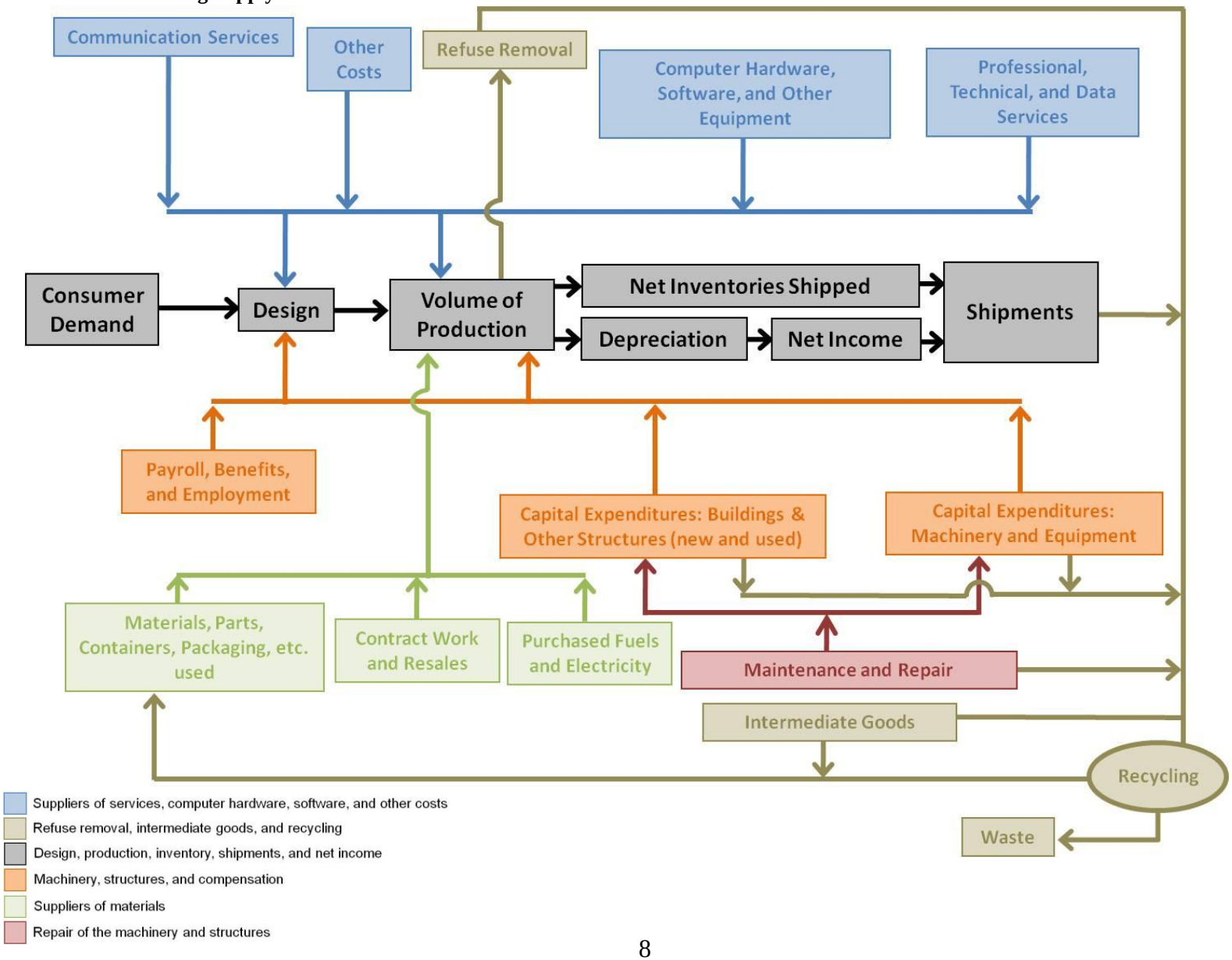


Table 2.1: Stakeholders

Stakeholders	Affiliation	Primary Investment	Expected Return
Owners	Private Producers	Land, Capital Goods, and Financial Capital	Profit From Sales
Employees (manufacturing industry and suppliers)	Laborers	Labor	Income
Resellers	Private Distributer	Land, Capital Goods, and Labor	Profit From Markup
Retailers	Private Distributer	Land, Capital Goods, and Labor	Profit From Markup
Wholesalers	Private Distributer	Land, Capital Goods, and Labor	Profit From Markup
Standards and Codes Organizations	Public/Private Interest	Labor and Intellectual Property	Economic Success
Transportation and Warehousing	Support Service	Land, Capital Goods, and Labor	Profit From Fees
Air Transportation Providers	Transportation	Land, Capital Goods, and Labor	Profit From Fees
Ground Transportation Providers	Transportation	Land, Capital Goods, and Labor	Profit From Fees
Warehousing and Storage Providers	Storage Facility	Land and Capital Goods	Profit From Fees
Professional Societies	Public/Private Support Services	Labor and Intellectual Property	Economic Success and Profit from Fees
Finance Services	Insurance and Finance	Financial Capital	Profit From Fees
Insurance Providers	Insurance	Financial Capital	Profit From Fees
Health and Medical Insurance Providers	Insurance	Financial Capital	Profit From Fees
Financiers	Financier	Financial Capital	Capital Gains
Public Vested Interests	Public	Labor and Financial Capital	Economic Success
Policy Makers	Public	Labor and Financial Capital	Economic Success
Tax Payers	Public	Financial Capital	Economic Success
Industry Suppliers	Public/Private Suppliers	Land, Capital Goods, and Labor	Profit
Mining Material Suppliers	Private Suppliers	Land, Capital Goods, and Labor	Profit From Sales
Agriculture Product Suppliers	Private Suppliers	Land, Capital Goods, and Labor	Profit From Sales
Electric Utility Suppliers	Private Suppliers	Land, Capital Goods, and Labor	Profit From Sales
Water Utility Suppliers	Public/Private Suppliers	Land, Capital Goods, and Labor	Profit From Sales
Natural Gas Suppliers	Private Suppliers	Land, Capital Goods, and Labor	Profit From Sales
Facility Construction Providers	Private Suppliers	Land, Capital Goods, and Labor	Profit From Sales
Maintenance and Repair Providers	Private Suppliers	Land, Capital Goods, and Labor	Profit From Sales
Communication Services Providers	Private Support Services	Land, Capital Goods, and Labor	Profit From Fees
Other Fuel Suppliers	Private Suppliers	Land, Capital Goods, and Labor	Profit From Sales
Refuse Removal Service Providers	Private Support Services	Land, Capital Goods, and Labor	Profit From Fees
Professional Services	Public/Private Support Services	Land, Capital Goods, Labor, and Intellectual Property	Profit From Fees
Legal Service Providers	Public/Private Support Services	Labor	Profit From Fees
Information Service Providers	Private Support Services	Land, Capital Goods, and Labor	Profit From Fees
Research Organizations	Public/Private Suppliers	Labor and Intellectual Property	Profit From Fees
Accounting Service Providers	Private Support Services	Labor	Profit From Fees
Engineering Service Providers	Private Support Services	Labor and Intellectual Property	Profit From Fees
Computer Service Providers	Private Support Services	Labor	Profit From Fees
Scientific and Technical Service Providers	Private Support Services	Labor and Intellectual Property	Profit From Fees
Advertisers	Private Support Services	Labor and Intellectual Property	Profit From Fees
Other Professional Services	Private Support Services	Labor and Intellectual Property	Profit From Fees
Consumers	End User	Product Purchasing Price	Final Product Utilization

expect to receive a profit. There are six different categories of assets used in Table 2.1 that can be vested into the industry: financial capital, capital goods, land, labor, intellectual property, and the end users purchasing price. A successful industry might be considered one that has a suitable magnitude of production that results in competitive net benefits for its stakeholders. The expected returns from the industry include profits from sales, markup, or fees; income; industry success; capital gains; and utility from the final use of the product. The expected returns for each stakeholder are categorized in Table 2.1.

Summary of Primary Investments

Land: Naturally-occurring goods such as water, air, soil, mineral, and flora used in the production of products (i.e., the totality of goods or services that a company makes available).

Labor: Human effort used in production, which includes technical and marketing expertise.

Capital Goods: Human made goods used in the production of products.

Financial Capital: Funds provided by investors to purchase capital goods for production of products.

Intellectual Property: Ideas, trademarks, copyrights, trade secrets, and patents used to produce products

Purchasing Price: Market value of products sold

Summary of Expected Returns

Profit from sales: The financial benefit realized when revenues exceed costs and taxes for a product.

Capital Gains: An increase in the value of a capital asset

Income: Compensation for an individual's service or labor

Profit from Markup: The difference between the cost of a product and its selling price.

Economic Success: A constant and suitable magnitude of production resulting in competitive benefits (profits, capital gains, income, and product utilization) for an industry's stakeholders.

Profit from Fees: The financial benefit realized when revenues exceed costs and taxes for a service.

Final Product Utilization: The utility gained from the end user of a product.

2.2 Manufacturing Industry Metrics and Data

As previously discussed, a successful industry might be considered one that has a suitable magnitude of production that results in competitive net benefits for its stakeholders; however, measuring the magnitude of production as well as the benefits for stakeholders is complicated. It is not clear what level of production is a suitable magnitude of production. A suggested approach is to compare U.S. production to production in other developed and emerging economies, which will provide context for U.S. levels of production. For example, the decline of U.S. production of product x may appear as though U.S. manufacturing is moving to other nations; however, production of product x may be declining globally and may have little to do with the health of the U.S. manufacturing industry. Alternatively, the U.S. may be declining in production of product x, but is increasing its production of product y in its place. In light of these possibilities it is important to determine the context of production levels of U.S. manufacturing.

In addition to measuring production levels, it is also useful to measure stakeholder's costs and benefits. These costs and benefits, like production levels, also require context and comparison to other developed and emerging economies. Furthermore, there are many stakeholders involved, as seen in Table 2.1. Each stakeholder has costs and benefits that may or may not have well-developed metrics and available data. Furthermore, the data must be separated to reflect national and international costs and benefits. For example, in order to examine retailer's and wholesaler's costs and benefits from the U.S. manufacturing industry, the costs and benefits to retailers and wholesalers of domestically produced products must be separated from products produced abroad. In many instances, this type of data is not fully developed; however, there are some estimates that can be made using Leontief's input-output model. [36] As seen in Table 2.2, there are a number of metrics available for each stakeholder's benefits and costs. In regards to manufacturing, several types of expected returns have well established datasets that can be utilized. The remaining ones must often be measured using indirect metrics.

There are three aspects of U.S. manufacturing data to consider: (1) how the current industry compares to other countries, (2) the trends in the domestic industry, and (3) the industry trends compared to other countries trends. A number of data sets must be utilized to make these comparisons; however, the various data sets available are not all published in the same format. International data tends to be in the International Standard Industrial Classification (ISIC) version 3.1, a revised United Nations system for classifying economic data. Manufacturing is broken into 23 major categories (ISIC 15 through 37) with additional subcategories. For the purposes of this report, categories 15 through 22 are often aggregated; these include food, beverages, tobacco, textiles, apparel,

[36] Miller, Ronald E. and Peter D. Blair. *Input-Output Analysis: Foundations and Extensions*. (New York: Cambridge University Press, 2009): 16.

Table 2.2: Stakeholder's Expected Returns and Associated Metrics

Expected Return	Description	Contributing factors	Primary Metrics
Profit from sales (owners)	Revenue less production costs	Revenue (sales) Labor costs and/or wages Cost of land Cost of capital Productivity	Sales Labor costs and/or wages Capital expenditures Value added per expenditure dollar Value added per unit of labor Productivity indices
Capital Gains	Compensation for the use of assets	Rate of return	Interest rates
Income	Compensation for labor (manufacturing industry and suppliers)	Productivity	Labor costs and/or wages Value added per unit of labor Productivity indices Number of employed workers
Profit from Markup	Market selling price less cost	Costs Sales	Costs Sales
Economic Success	Levels of production and productivity that result in economic prosperity	Production Productivity Product quality Technological intensity	Industry value added Subsector value added Research and development expenditures Innovation metrics (patents and journal articles) Productivity Product quality metrics
Profit from fees and sales by non-manufacturing industries	Profit (revenue less production costs) from products purchased from non-manufacturing industries	Revenue (sales) Labor costs and/or wages Cost of land Cost of capital Productivity	Sales Labor costs and/or wages Capital expenditures Value added per expenditure dollar Value added per unit of labor Productivity indices Value of products supplied
Final product utilization	Utility	Price Quality Technological intensity	Consumer Price Index Product quality metrics Research and development expenditures Innovation metrics (patents and journal articles)

leather, wood, and media products. This allows for more detailed analysis of medium- and high-tech products. Domestic data tends to be in the North American Industry Classification System (NAICS). It is the standard used by Federal statistical agencies classifying business establishments in the U.S. NAICS was jointly developed by the U.S. Economic Classification Policy Committee, Statistics Canada, and Mexico's Instituto Nacional de Estadistica y Geografia and was adopted in 1997. Similar to ISIC, NAICS has several major categories each with subcategories. Historic data and some organizations continue to use the predecessor of NAICS, which is the Standard Industrial Classification system.

As seen in Table 2.3, there are a number of sources for data both domestically and internationally. Domestic sources include the U.S. Census Bureau, Bureau of Economic Analysis (BEA), National Science Foundation (NSF), and Bureau of Labor Statistics (BLS). International sources include the United Nations (UN), the Organization for Economic Co-operation and Development (OECD), World Economic Forum, and the International Institute for Management Development's (IMD) World Competitiveness Center. There are, of course, additional sources of data; however, those listed in Table 2.3 are many of the most prominent and cited sources of data on the domestic and international manufacturing industries.

Industry data being compared over time or between national currencies must be adjusted to a common comparable metric. Time series data is adjusted for inflation using a price

index. The most suitable price index for tracking trends in the physical volume of production is the producer price index for the specific industry being discussed as it reflects the average change in the selling prices received by domestic producers for their output. It is typically used to measure real growth in output.[37] However, industry specific producer price indices may not cover the entire span of time being discussed. In these cases, an approximation is used if the missing time span is relatively short. If the missing data spans a longer period of time, a closely related producer price index is selected. It is important to note that when multiple time series industry data are adjusted using different price indices the values no longer represent proportional changes in the value of production between industries. There are two primary factors that affect the aggregate value of manufactured goods: the physical volume of goods and the price (i.e., the product of price and physical volume equals aggregate value of goods). Data adjusted using the same price index accurately reflects proportional changes in the value of production because the original proportional magnitude is maintained between industries; however, it does not accurately reflect changes in the volume of production for each industry over time (e.g., declining cost of computer and electronic products). Thus, caution should be used when discussing the trends in manufacturing over time as the price index used to adjust manufacturing industry and subsector data can have a significant effect on the appearance of these trends. For this report, if a producer price index is not available then a consumer price index is used. In addition to adjusting for inflation, data in different currencies must be converted to a common currency. Some data sets used in this report, such as data from the United Nations Statistics Division (UNSD), are already converted to U.S. dollars using the International Monetary Fund's (IMF) market exchange rates. Other data sets, such as that from the OECD, are not converted. These data were converted using the OECD purchasing power parity (PPP) rates. This conversion eliminates the differences in price levels between countries; thus, in effect the resulting values reflect only differences in the volume of goods and services purchased. In some cases the time span of the data extends beyond OECD PPP data availability; therefore, the PPP rate from the Center for International Comparisons at the University of Pennsylvania was used.

[37] Bureau of Labor Statistics. "Producer Price Indexes: How Does the Producer Price Index Differ from the Consumer Price Index." <http://www.bls.gov/ppi/ppicpippi.htm>

Table 2.3: Sources of Data

	Domestic Data and Information	International Data and Information
Production and Processes of Production	Annual Survey of Manufactures (U.S. Census Bureau) Economic Census (U.S. Census Bureau) Gross Domestic Product (BEA) Manufacturers' Shipments, Inventories, and Orders (U.S. Census Bureau)	Gross Domestic Product (UN) Manufacturing Value Added (OECD) Manufacturing Value Added (UN) Competitive Industrial Performance Index (UN) Foreign Trade (U.S. Census Bureau)
Research and Development	Research and Development (National Science Foundation)	Research and Development Expenditures (OECD)
Labor	Producer Price Index (BLS) Manufacturing Employment (BLS) Productivity Index (BLS) Pay and Benefits (BLS)	Unit Labor Costs (OECD) Labor Compensation per Employee (OECD) Labor Compensation per hour (OECD) Hours Worked in Manufacturing (OECD) Education Attainment (OECD) Employment (UN) Wages (UN) Population (U.S. Census Bureau International Database)
Technology	Research and Development (National Science Foundation)	Patent Applications (OECD) Percent of Patents that are Foreign Owned (OECD)
All Categories		Global Competitiveness Report (World Economic Forum) Competitiveness Yearbook (IMD World Competitiveness Center)

3 International Data: How the U.S. Compares to the Rest of the World

This chapter discusses international data, which includes data on production in the U.S. and abroad. It lays out the principal data available on the manufacturing industry and then discusses the definitions used and trends in the data. There are many sources of information that provide data on individual nations. Unfortunately, identifying, adjusting, and accumulating this data would require a considerable amount of time and resources. Therefore, this report relies on sources that provide data on multiple nations to make international comparisons. These sources include the United Nations, Organization for Economic Cooperation and Development, World Bank, and a selection of international comparative indices.

As previously discussed, a successful industry might be considered one that has a suitable magnitude of production that results in competitive net benefits for its stakeholders. It is on this basis that data was selected to be incorporated into this chapter. Data was selected to compare net benefits of U.S. stakeholders to those abroad. This includes the total value added, net income, compensation, and employment among other things. Without this comparison, it is difficult to find meaning in many of the trends in U.S. manufacturing. For instance, it is difficult to argue that one rate of growth is sound and another rate is unsound without some comparison to the international community. In some instances rankings or percentiles are used to compare U.S. stakeholders to those abroad. Data related to research and development expenditures are also presented as these items reflect advancements in the industry.

It is important to note that although the U.S. proportion of research and production activities has declined, it is necessary to examine the nation's nominal and real performance relative to its population and resources to gain an understanding of what is happening. It should be expected that as emerging economies make progress in becoming developed countries that U.S. and other developed nation's proportion of production and research will decline due to the growth of total global production and research activities.[38] That is, it is not to be expected that the U.S. will keep up with the aggregate growth of global research and production as much of these increases are the result of utilizing previously idle or under-utilized resources in emerging economies. A decline in the proportion of U.S. activities, therefore, is not unexpected and is not necessarily a decline in the performance of the domestic industry. A greater concern is its nominal and real performance relative to its population and/or resources. It is in this context that this report will compare U.S. manufacturing activity to that of other nations.

[38] Mandel, Benjamin R. "Why is the U.S. Share of World Merchandise Exports Shrinking." Federal Reserve Bank of New York: Current Issues. Vol. 18, No. 1. 2012. <http://www.newyorkfed.org/research/current_issues/ci18-1.pdf>

3.1 United Nations

The United Nations (UN) is an international organization founded by 51 nations in 1945; the organization now has 193 member states. In addition to its commitment to maintaining peace and security, the UN compiles and disseminates statistical information on the global economy. It provides these statistics through the United Nations Statistics Division and the United Nations Industrial Development Organization. Data from these two entities are characterized below.

United Nations Statistics Division (UNSD) National Accounts Main Aggregates Database: The UNSD disseminates global statistics, develops standards for statistical activities, and provides assistance to nations developing statistical data. Their National Accounts Main Aggregates Database provides annual collections of official national accounts data. This information is collected via the United Nations National Accounts Questionnaire. For some countries a full set of official data is not reported. For these instances estimation procedures are employed to estimate the data. These data were converted from national currencies into U.S. Dollars by applying market exchange rates as reported by the International Monetary Fund (IMF).[39]

According to the UNSD data, as of 2008, the U.S. produced the largest volume of manufactured goods compared to all nations as seen in Figure 3.1. This figure contains manufacturing value added for the ten largest manufacturing nations and illustrates the magnitude and importance of the U.S. manufacturing industry to the global economy as well as the domestic economy. China produced about 2% less than the U.S. in 2008, but is expected to continue to grow rapidly. As seen in the pie charts in Figure 3.1, the U.S. produced 28 % of the worlds manufactured goods in 1985 and declined to 18 % in 2008. Although significant, this decline may not be a point of concern. It is important to note that in order for underdeveloped countries to become developed countries, their production and income will need to approach that of the developed world. This, inevitably, results in a decline in the proportion or market share that each developed country represents. Thus, a decline in the U.S. share of global manufacturing is not by itself a point of concern. A decline may simply be the result of progress in emerging economies. Concern about such a decline often stems from the misleading analogy of the U.S. being compared to a company losing market share. When companies expand their market share it is often at the cost of another company. When an emerging economy increases production, however, it creates more demand for goods and services which increases the total market size. Thus, the increase in market share from increased production in one country may or may not be at the cost of another country.

Between 1985 and 2008, the U.S. manufacturing industry grew at a compound annual growth rate of approximately 1.1 %, according to UN data; consequently, it is growing slower than the whole of the U.S. economy, which grew at a 2.3 % rate. Manufacturing in Canada, Japan, Germany, and the U.K grew faster at rates of 2.7 %, 1.9 %, 3.6 % and

[39] United Nations Statistics Division. "National Accounts Main Aggregates Database." <http://unstats.un.org/unsd/snaama/Introduction.asp>

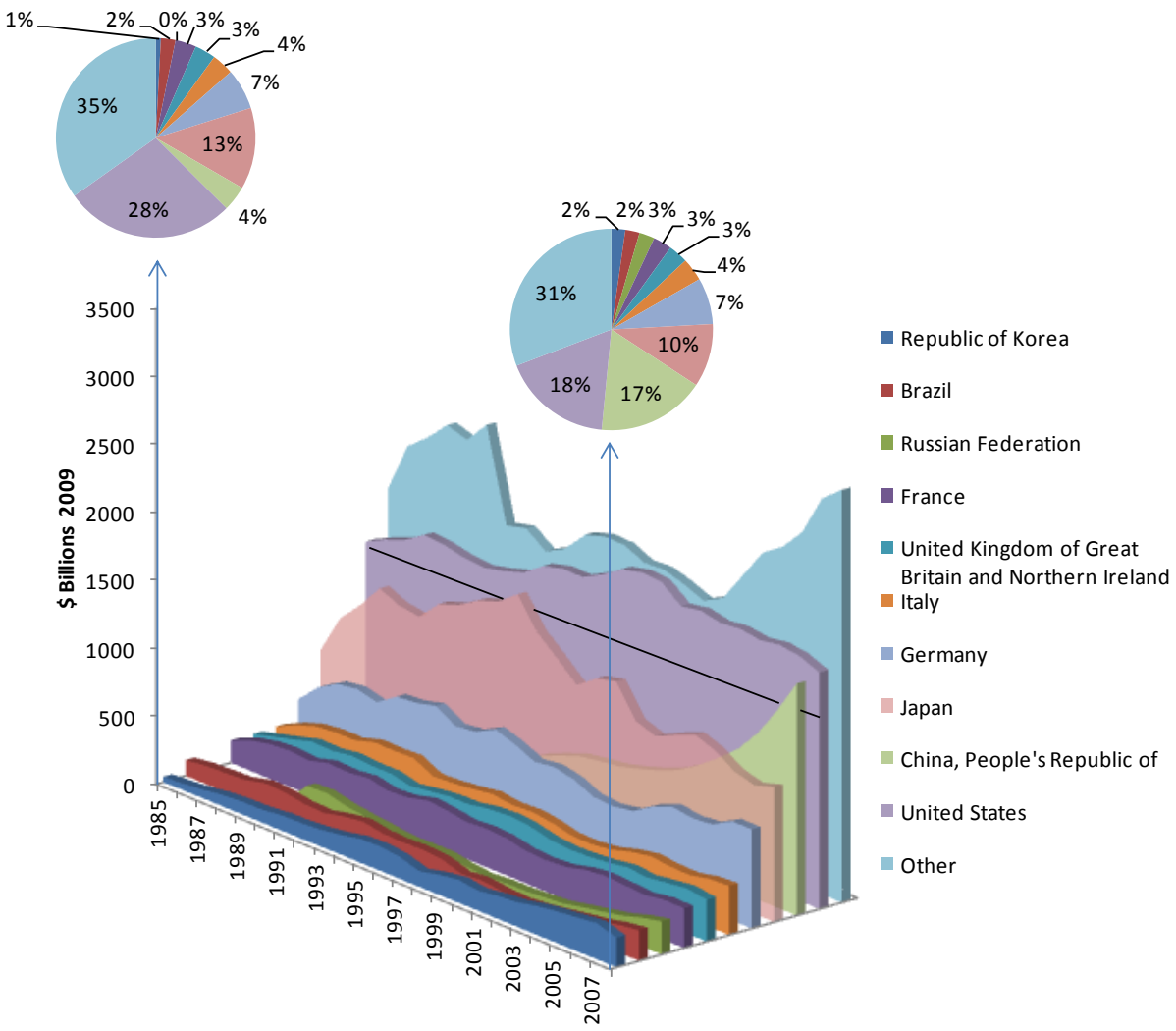


Figure 3.1: UNSD Manufacturing GDP by Nation ($billions 2009)
Note: Converted to U.S. dollars using market exchange rates as reported by the International Monetary Fund (IMF) and adjusted to 2009 dollars using the BLS producer price index for manufacturing. UNSD data begins in 1970; however, the producer price index begins in 1985.
Note: The pie charts represent the percent of global manufacturing GDP that each nation represents for the year indicated.

2.8 % respectively. India and China grew much faster at rates of 5.1 % and 9.8 %; emerging economies, such as these, can employ idle or underutilized resources and adopt technologies that are already proven in other nations to achieve high growth rates. Developed countries are already utilizing resources and are employing advanced technologies; thus, comparing U.S. growth to growth in China or India has limited meaning.

U.S. manufacturing growth from 1985 to 2008 is among the slowest with 151 out of 180 countries having a larger compound annual growth rate, putting it below the 20th percentile (see Figure 3.2). It is important to note, however, that the U.S. was in the midst of a recession in 2008; therefore, it is useful to examine growth to the peak of U.S.

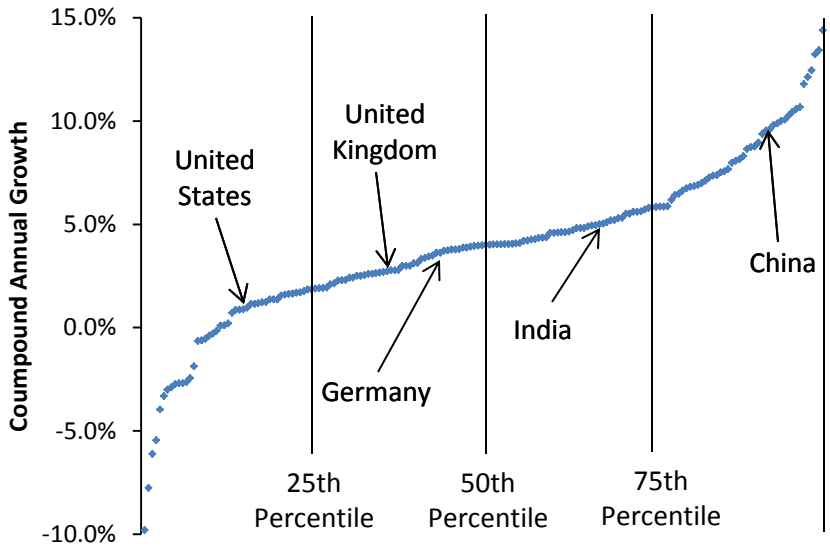


Figure 3.2: UNSD Manufacturing Value Added for 180 Countries, Compound Annual Growth Rate (1985-2008)

manufacturing. Accordingly, the industry grew 45 % between 1985 to the peak of U.S. manufacturing in 1999. At least 156 countries had larger growth from 1985 to their manufacturing peak (growth from 1985 to the highest level of manufacturing for each country); this puts the U.S. below the 15th percentile of 182 nations.

While manufacturing value added is larger in the U.S. than in any other country, U.S. manufacturing per capita has lagged slightly behind some industrialized nations, such as Germany and Japan. Out of 199 countries, at least 20 other nations had a higher manufacturing value added per capita than the U.S. in 2008, according to UNSD data. This ranking is down from being 2nd in 1985. Between 1985 and 1995, the rank had slipped to 16th; however, it slowly climbed to 7th between 1995 and 2000. From there it slowly declined to 21st in 2008. As illustrated in Figure 3.3, U.S. per capita manufacturing value added has fluctuated slightly between 1985 and 2008; however, the level in 2008 is only 1.5 % higher than it was in 1985. Many countries had much higher increases; such as Germany and the United Kingdom, which increased 114.9 % and 72.1 %, respectively. Out of 172 countries, the U.S. ranks as the 130th largest increase, putting it below the 25th percentile.

Manufacturing as a percent of total Gross Domestic Product (GDP) has declined in the U.S. as it has declined in many industrialized nations across the globe. In 1970, manufacturing was approximately 24.3 % of U.S. GDP. By 2008, it represented approximately 13.0 % as illustrated in Figure 3.4, which contains the same top ten manufacturing nations shown in Figure 3.1. During this same period, total manufacturing GDP for all countries for which data is available went from 26.7 % to 17.1 % of total GDP. This percentage declined for 111 out of 179 countries (62.0 %). In 1970, approximately 87.0 % of 185 countries listed in the UNSD data had a lower manufacturing to GDP ratio than the U.S. In 2008, approximately 59.8 % of 209 had a lower ratio.

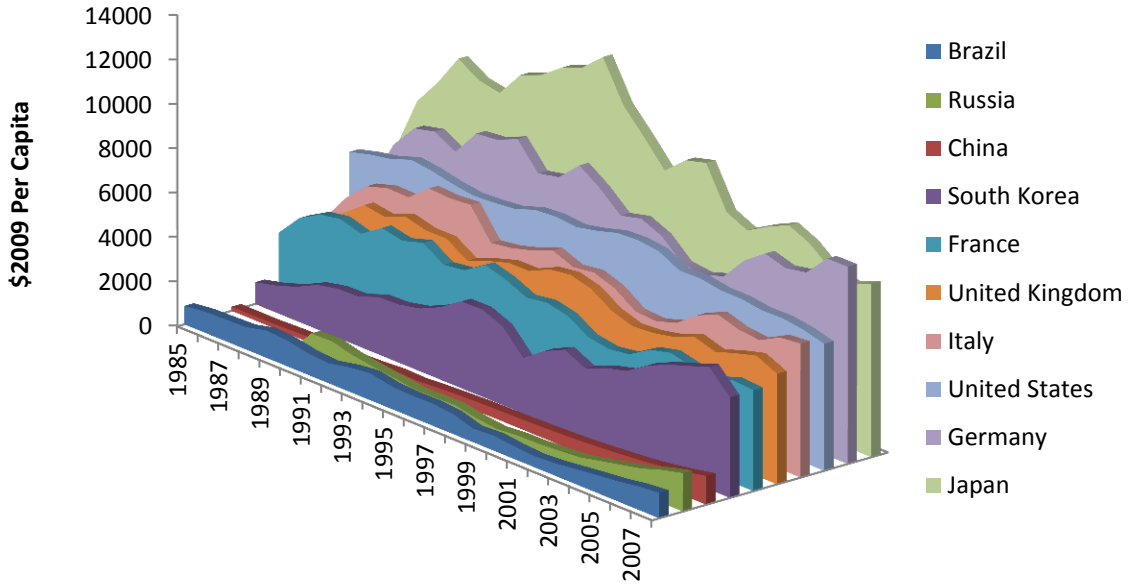


Figure 3.3: UNSD Manufacturing GDP per Capita
Note: population data is based on U.S. Census Bureau estimates of international population

United Nations Industrial Development Organization's (UNIDO) Statistical Country Briefs: The Statistical Country Briefs include national account data and industrial statistics compiled from various databases maintained by UNIDO. Industrial data on manufacturing are defined at the two (sometimes three) digit level of the International Standard Industrial Classification, Revision 3 (ISIC Rev. 3) system. National data has been converted to current U.S. dollars using the average period exchange rate in the IMF International Financial Statistics.[40]

Manufacturing employees exchange their time for income or wages. U.S. wages in the manufacturing industry are not the highest; however, they are not the lowest either. Among the nations shown in Table 3.1, the U.S. had the second highest level of wages slightly behind Germany, in 2006. This is the case for many of the subsectors shown in the table. Among those subsectors shown, the U.S. has the highest wages for other chemical product manufacturing, insulated wire and cable manufacturing, television and radio transmitter manufacturing, and transport equipment manufacturing. It is important to note that China's wages are among the lowest.

U.S. manufacturing industry stakeholders rely not only on the size of the industry, but the technology level of the products being produced. UNIDO data provides an opportunity to compare various aspects of U.S. manufacturing to other nations. Unfortunately, access to UNIDO data for all nations is somewhat limited; therefore, a selection of countries is used in Table 3.2 for comparison. These countries represent major U.S. trading partners,

[40] UNIDO. "Statistical Country Briefs." <http://www.unido.org/index.php?id=1000313>

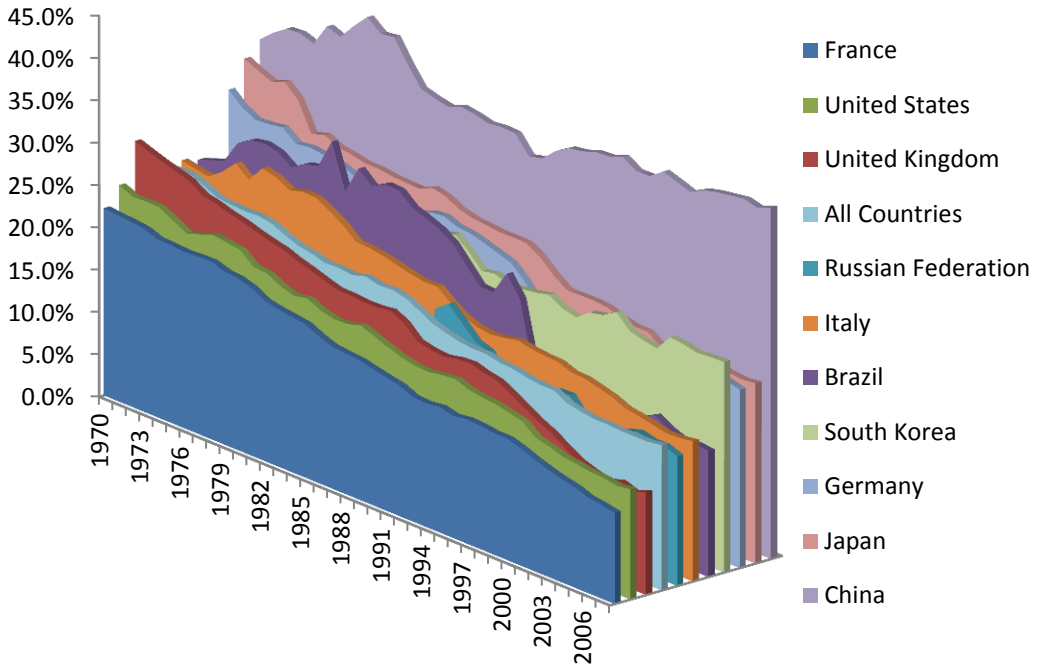


Figure 3.4: UNSD Manufacturing as a Percent of GDP (1970-2008)

countries that are often considered competitors with the U.S., and nations that are similar to the U.S. As seen in Table 3.2, data are unavailable for some industries for some countries. Among the countries shown in the table, the U.S. has the largest value added for ISIC codes 24, 25, 26, 28, 29, 30, 31, 32, 33, and 34-35 (note that data for ISIC 15-22, 23, and 36-37 are unavailable for the U.S.). In terms of the percent of total national value added, the U.S. is within 11 percentage points of all the countries listed for all the types of manufacturing listed with the largest gaps being in ISIC codes 24, 27, 29, and 34-35. The total value added, value added per capita, and value added per employee for all manufacturing exceeds that of all the other countries listed as is the case for ISIC codes 24, 30, and 33. China, however, has more employees involved with all types of manufacturing listed in the table while having a lower value added. This employment phenomenon may be a result of Chinese labor laws, the remnants of a command economy, or the types of products being produced.[41] For the U.S., chemical manufacturing represents the largest percent of total value added for those industries shown with transportation being the second largest.

Per capita value added for all manufacturing is larger in the U.S. than the other countries listed in Table 3.2. The largest per capita sector of U.S. manufacturing is chemical manufacturing. Among the countries listed, the U.S. has the highest per capita manufacturing for ISIC codes 24, 26, 30, and 33. U.S. Employment in manufacturing exceeds that of Germany, India, Japan, Mexico, and the United Kingdom; however,

[41] Shepherd, Robert J. "The People's Dynasty: Culture and Society in Modern China." Modern Scholar. Lecture Series. (2010).

China has more than five times as many employees. China's large employment numbers result in very low value added per employee, which is approximately 10 % of the corresponding value for total manufacturing in the U.S. Among those listed, the U.S. has the largest value added per employee for ISIC codes 24, 25, 30, 31, 33, and 34-35.

Table 3.1: Annual Wages by Select Manufacturing Subsectors, $2006 (UNIDO Statistical Country Briefs)

ISIC		United States	Australia	Canada	China	Germany	India	Japan	Mexico	UK
241	Basic chemicals	65 446	23 435	44 103	2 961	51 943	3 543	53 073	14 705	137 197
242	Other chemical products	59 745	21 470	35 966	3 373	57 691	2 223	45 239	8 845	55 913
243	Man-made fibres	44 316	-	33 839	2 657	52 736	3 420	45 650	5 977	54 290
291	General-purpose machinery	47 230	-	35 203	3 132	53 395	2 823	35 743	4 970	45 267
292	Special-purpose machinery	50 827	18 472	34 600	3 074	50 892	2 670	30 779	5 619	45 282
293	Domestic appliances n.e.c.	37 923	17 638	29 843	3 043	53 630	1 833	35 212	4 984	40 303
300	Office, accounting, and computing machinery	59 817	11 343	37 729	4 147	70 390	3 480	43 515	5 320	45 685
311	Electric motors, generators, and transformers	38 990	21 186	36 320	3 133	44 936	3 214	33 759	6 727	37 010
312	Electricity distribution and control apparatus	46 087	-	30 732	3 435	62 388	2 430	32 865	5 081	38 607
313	Insulated wire and cable	44 887	28 126	42 403	3 118	43 053	2 054	43 020	5 838	37 510
314	Accumulators, primary cells, and primary batteries	42 015	13 072	29 501	3 090	51 851	2 320	48 597	6 686	39 297
315	Electric lamps and lighting	40 876	18 427	26 292	2 567	45 296	1 512	36 820	3 742	37 524
319	Other electrical equipment	48 021	-	31 073	3 016	51 849	2 059	34 669	5 356	40 521
321	Electronic valves and tubes and other components	55 543	26 475	33 892	3 565	55 980	3 099	45 244	5 505	43 609
322	Television and radio transmitters and apparatus for line telephony and line telegraphy	67 472	16 401	38 514	5 642	61 505	3 073	48 407	3 551	59 603
323	Television and radio receivers, sound or video recording or reproducing apparatus, and associated goods	46 191	-	31 765	3 931	53 013	2 918	39 034	6 655	39 793
341	Motor vehicles	58 581	16 823	51 412	4 903	74 085	5 132	67 092	11 669	54 979
342	Motor vehicle bodies, trailers, and semi-trailers	36 128	17 122	26 187	4 461	38 978	1 391	57 883	4 729	35 933
343	Motor vehicle parts, accessories, and engines	50 106	18 596	34 735	3 013	56 674	2 318	43 575	5 463	43 468
351	Building and repairing of ships and boats	42 304	25 202	26 690	4 629	48 154	2 645	37 076	4 764	42 845
352	Railway and tramway locomotives and rolling stock	47 708	22 369	34 042	3 706	52 651	1 942	39 345	7 066	65 370
353	Aircraft and spacecraft	69 177	59 865	41 670	4 455	74 180	7 349	53 046	6 402	59 247
359	Transport equipment	48 259	-	31 042	2 580	38 689	2 429	27 510	5 057	28 202
15-37	Total Manufacturing	47 204	-	30 824	2 899	47 720	1 781	30 486	4 847	41 929

Note: The green bars represent a visual comparison between countries. For example, the UK has the highest annual wages for ISIC 241; therefore, it has the longest bar for ISIC 241.

Table 3.2: Detailed Manufacturing Value Added Industry Comparisons, 2006 (UNIDO Statistical Country Briefs)

		Food, apparel, wood product, and printing manufacturing	Refined petroleum products and nuclear fuel	Chemicals	Rubber and plastics	Other nonmetallic mineral products	Basic metals	Fabricated metals	Machinery and equipment	Office, accounting and computing machinery	Electrical machinery and apparatus, n.e.c.	Radio, television and communication equipment	Medical, precision and optical instruments	Transport equipment	Other manufacturing	TOTAL
	ISIC	15-22	23	24	25	26	27	28	29	30	31	32	33	34-35	36-37	
Value Added ($billion 2006)	United States	-	-	351	100	80	86	154	181	36	70	110	135	243	-	2 306
	Australia	-	-	-	3	5	8	8	3	0	-	-	-	6	-	80
	Canada	-	-	14	7	5	9	11	10	2	4	3	-	28	-	156
	China	-	-	140	39	65	185	59	109	29	62	87	17	92	28	1 295
	Germany	97	7	35	27	17	27	54	89	5	42	14	25	99	15	576
	India	17	-	13	2	4	12	2	5	1	3	1	1	9	1	81
	Japan	-	7	101	51	33	63	64	116	15	38	85	24	133	-	939
	Mexico	29	-	13	4	6	-	3	4	1	6	3	-	11	-	88
	UK	-	-	23	14	8	6	22	22	2	9	5	11	31	12	262
Percent of Total Value Added	United States	-	-	15.2%	4.3%	3.5%	3.8%	6.7%	7.9%	1.6%	3.0%	4.8%	5.9%	10.5%	-	100.0%
	Australia	-	-	-	3.4%	6.1%	10.2%	9.6%	4.0%	0.2%	-	-	-	7.6%	-	100.0%
	Canada	-	-	9.0%	4.7%	3.2%	5.9%	6.9%	6.4%	1.0%	2.6%	2.2%	-	17.8%	-	100.0%
	China	-	-	10.8%	3.0%	5.0%	14.3%	4.6%	8.4%	2.2%	4.8%	6.7%	1.3%	7.1%	2.2%	100.0%
	Germany	16.8%	1.2%	6.1%	4.7%	3.0%	4.7%	9.4%	15.4%	0.8%	7.4%	2.4%	4.4%	17.1%	2.6%	100.0%
	India	21.4%	-	16.1%	2.5%	4.4%	14.3%	2.8%	5.6%	0.8%	3.8%	1.7%	0.9%	10.5%	1.3%	100.0%
	Japan	-	0.8%	10.7%	5.5%	3.5%	6.7%	6.8%	12.4%	1.6%	4.0%	9.0%	2.5%	14.2%	-	100.0%
	Mexico	32.8%	-	14.5%	4.1%	6.6%	-	3.6%	4.7%	1.0%	6.8%	3.5%	-	12.4%	-	100.0%
	UK	-	-	8.7%	5.3%	3.2%	2.2%	8.2%	8.3%	0.9%	3.4%	1.8%	4.2%	11.7%	4.4%	100.0%
Employment (thousands)	United States	-	1 298	383	62	-	141	-	-	101	679	196	553	910	-	12 549
	Australia	-	-	-	7	24	-	5	-	6	-	8	-	-	-	-
	Canada	-	133	63	19	74	83	-	-	11	128	24	60	-	-	1 947
	China	-	3 936	3 175	1 580	5 531	2 224	801	-	817	8 238	1 612	4 412	4 300	1 281	72 304
	Germany	3 286	783	109	23	52	42	19	316	58	641	64	203	924	249	6 934
	India	5 040	289	398	648	542	127	85	-	55	719	87	120	430	38	8 804
	Japan	-	675	183	66	129	77	22	406	49	575	78	426	1 060	-	7 549
	Mexico	-	-	181	52	408	113	42	-	38	210	41	385	330	-	4 314
	UK	-	230	87	-	39	20	-	-	32	170	29	82	236	227	3 138
Value Added per Employee ($thousands 2006)	United States	-	-	917	1 607	-	612	-	-	360	103	562	244	267	-	184
	Australia	-	-	-	379	205	-	1 568	-	24	-	-	-	-	-	-
	Canada	-	-	223	389	67	112	-	-	149	31	139	-	-	-	80
	China	-	-	44	25	12	83	74	-	35	8	54	4	21	22	18
	Germany	29	9	322	1 168	335	649	2 786	280	80	66	212	124	107	61	83
	India	3	-	33	3	7	91	27	-	12	4	16	6	20	28	9
	Japan	-	11	550	782	255	817	2 907	286	311	66	1 088	56	125	-	124
	Mexico	-	-	70	70	14	-	75	-	22	28	74	-	33	-	20
	UK	-	-	264	-	216	301	-	-	75	52	159	135	130	51	83
Value Added per Capita ($2006)	United States	-	-	1 177	333	269	290	517	607	122	234	369	452	812	-	7 722
	Australia	-	-	-	130	237	396	374	157	8	-	-	-	296	-	3 891
	Canada	-	-	431	226	154	284	329	304	49	122	104	-	851	-	4 785
	China	-	-	107	30	50	142	45	84	22	48	67	13	70	22	993
	Germany	1 177	87	424	327	212	330	659	1 075	56	515	165	307	1 199	183	6 999
	India	16	-	12	2	3	10	2	4	1	3	1	1	8	1	73
	Japan	-	58	789	403	257	492	503	911	119	296	665	186	1 041	-	7 353
	Mexico	269	-	119	34	54	-	29	39	8	55	28	-	101	-	820
	UK	-	-	376	229	139	97	353	359	39	146	77	182	504	190	4 306

Note: The green bars represent a visual comparison between countries for each category (listed in the far left column) and subsector (listed in the top row) combination. For example, the U.S. has the largest value added for ISIC 15-22; therefore, it also has the longest green bar within the value added category for the ISIC 15-22 subsector.

3.2 Organization for Economic Cooperation and Development

The Organization for Economic Cooperation and Development contains 34 member countries and was founded in 1961 in order to advance the economic and social well-being of people from across the globe. The OECD assembles and disseminates data characterizing its member countries along with non-member countries. A selection of OECD data is described below.

3.2.1 Production

Organization for Economic Co-operation and Development's (OECD) Structural Analysis (STAN) Data: The OECD StatExtracts provides various economic data, including value added by industry for OECD member countries. The STAN database provides detailed industrial data across a number of countries. It includes annual measures of output, labor input, investment, and international trade. Similar to data from the United Nations, some observations are estimates and are not official member country submissions and data is organized based on the International Standard Industrial Classification, Revision 3 (ISIC Rev. 3).[42] National currencies are converted to dollars using the OECD purchasing power parity (PPP) rates for gross domestic product. This conversion eliminates the differences in price levels between countries; thus, in effect the resulting values reflect only differences in the volume of goods and services purchased.

Table 3.3 below presents STAN data for 9 countries; these are the same countries presented in Table 3.2. They represent major U.S. trading partners, countries that are often considered competitors with the U.S., and nations that are similar to the U.S. Unfortunately, STAN data is unavailable for three of the nations shown. Among the OECD countries for which data is shown in Table 3.3, the U.S. has the largest value added for all the manufacturing categories except basic metal and other manufacturing, which emphasizes the importance of U.S. manufacturing for the global economy. With the exception of ISIC 15-22, the percent of total value added in the U.S. for each manufacturing category is within 9 percentage points of the other nations. This shows some consistency which suggests that the sectors of U.S. manufacturing are not all that different from the other countries listed. That is, the proportion of manufacturing that each sector represents is similar to proportions in the other nations. Among the nations listed in Table 3.3, the U.S. has the largest value added per capita for refined petroleum products and nuclear fuel manufacturing along with office, accounting, and computing machinery manufacturing. Figure 3.5 provides a graph for three of the manufacturing subsectors: office, accounting, and computing machinery (ISIC 30); transportation equipment plus machinery and equipment (ISIC 29, 34-35); and chemicals (ISIC24). The U.S. has the largest value added for each sector shown for nearly the whole time period with the exception of 1991 where Japan exceeded the U.S. for office, accounting and computing machinery. In terms of value added per capita, the U.S. does not maintain the largest position.

[42] OECD. "StatExtracts." <http://stats.oecd.org/Index.aspx>

Chemical manufacturing has been a large component of U.S. manufacturing as seen in Figure 3.6 and has grown significantly between 1985 and 2008. The largest component of total manufacturing is food, apparel, wood product, and printing manufacturing (ISIC 15-22), which is not shown in the figure. Refined petroleum products and nuclear fuel increased 42 % between 2000 and 2009. This increase is likely due in part to pressure to increase domestic oil production, technological advances in oil extraction using hydraulic fracturing, and increases in price.

Table 3.3: OECD Value Added, 2006

		Food, apparel, wood product, and printing manufacturing	Refined petroleum products and nuclear fuel	Chemicals	Other nonmetallic mineral products	Rubber and plastics	Basic metals	Fabricated metals	Machinery and equipment	Office, accounting and computing machinery	Electrical machinery and apparatus, n.e.c.	Radio, television and communication equipment	Medical, precision and optical instruments	Transport equipment	Other manufacturing	TOTAL
	ISIC	15-22	23	24	26	25	27	28	29	30	31	32	33	34-35	36-37	
Value Added ($billion 2006)	USA	479.4	140.0	207.9	65.1	45.4	59.7	125.6	116.6	30.4	45.6	101.2	68.3	189.1	-	1 785.4
	Australia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	76.3
	Canada	61.0	3.9	12.0	8.1	5.3	12.4	12.5	11.8	0.6	2.5	5.2	-	19.9	-	163.9
	China	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Germany	102.0	7.0	59.0	27.3	17.5	26.2	55.0	89.0	4.4	43.2	14.6	26.3	98.0	15.2	584.7
	India	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Japan	83.6	52.9	63.3	36.3	27.1	72.9	39.3	101.7	10.9	37.2	86.5	14.7	119.5	-	864.8
	Mexico	94.4	14.5	25.1	7.1	15.5	23.3	8.5	11.1	3.9	11.4	6.7	1.8	34.4	7.7	265.3
	United Kingdom	78.8	3.6	29.6	11.3	8.6	5.0	21.1	20.7	4.7	7.8	5.2	9.3	26.4	-	242.5
Percent of Total Value Added	USA	26.9%	7.8%	11.6%	3.6%	2.5%	3.3%	7.0%	6.5%	1.7%	2.6%	5.7%	3.8%	10.6%	-	100.0%
	Australia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0%
	Canada	37.2%	2.4%	7.3%	4.9%	3.2%	7.6%	7.7%	7.2%	0.4%	1.6%	3.2%	-	12.1%	-	100.0%
	China	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Germany	17.4%	1.2%	10.1%	4.7%	3.0%	4.5%	9.4%	15.2%	0.8%	7.4%	2.5%	4.5%	16.8%	2.6%	100.0%
	India	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Japan	9.7%	6.1%	7.3%	4.2%	3.1%	8.4%	4.5%	11.8%	1.3%	4.3%	10.0%	1.7%	13.8%	-	100.0%
	Mexico	35.6%	5.5%	9.4%	2.7%	5.8%	8.8%	3.2%	4.2%	1.5%	4.3%	2.5%	0.7%	13.0%	2.9%	100.0%
	United Kingdom	32.5%	1.5%	12.2%	4.7%	3.5%	2.1%	8.7%	8.5%	1.9%	3.2%	2.1%	3.8%	10.9%	-	100.0%
Value Added per Capita ($2006)	USA	1 606	469	696	218	152	200	420	390	102	153	339	229	633	-	5 979
	Australia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Canada	1 868	120	366	248	163	379	384	360	19	78	161	-	608	-	5 017
	China	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Germany	1 238	85	717	331	212	318	667	1 081	54	525	177	320	1 190	185	7 100
	India	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Japan	655	414	495	284	212	571	307	797	85	291	677	115	936	-	6 770
	Mexico	878	135	233	66	144	217	79	103	36	106	63	17	320	72	2 469
	United Kingdom	1 295	59	486	186	141	83	347	340	76	129	85	152	433	-	3 986

Note: The green bars represent a visual comparison between countries for each category (listed in the far left column) and subsector (listed in the top row) combination. For example, the U.S. has the largest value added for ISIC 15-22; therefore, it also has the longest green bar within the value added category for the ISIC 15-22 subsector.

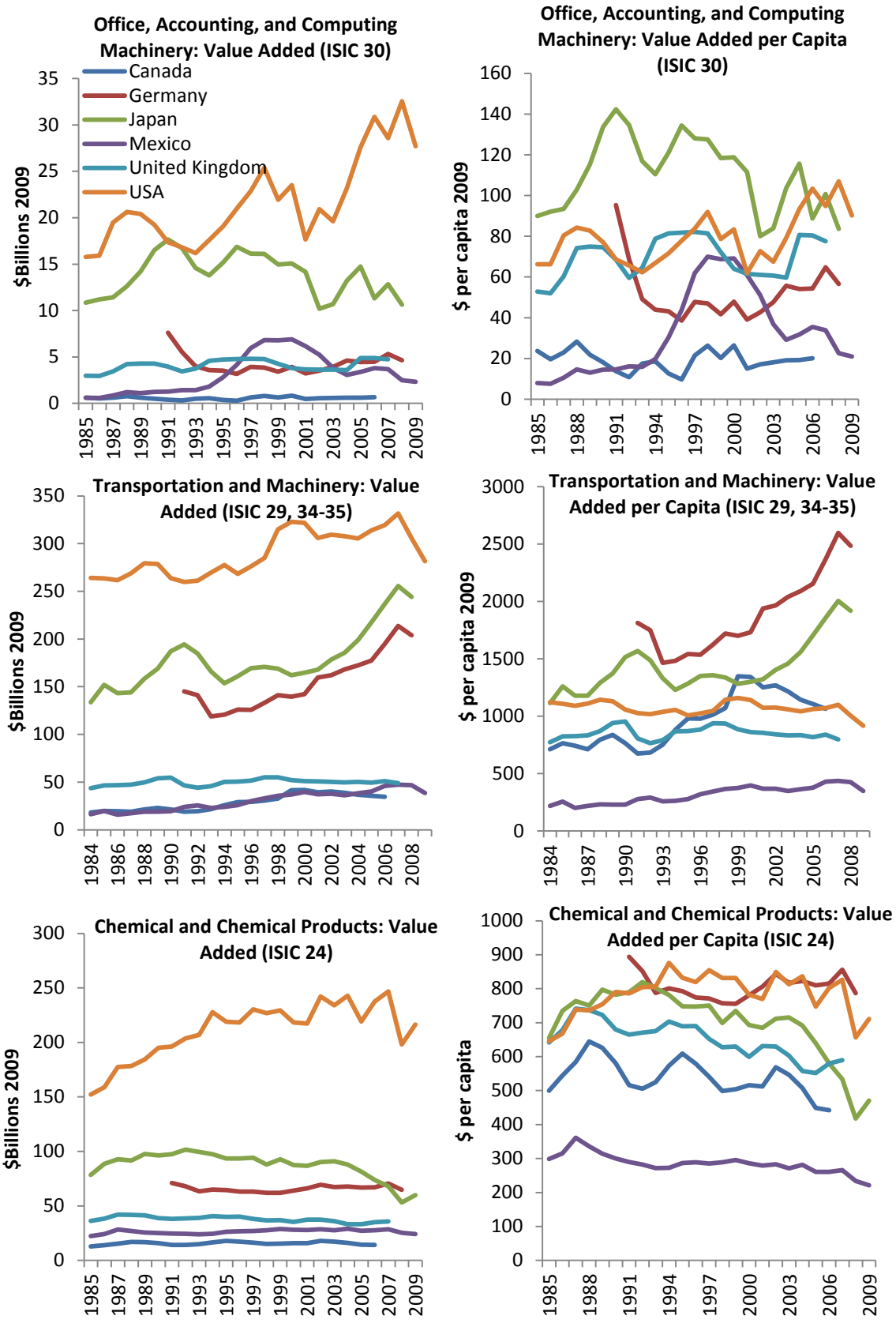


Figure 3.5: Selected Manufacturing Subsectors: Value Added and Value Added per Capita

Among all OECD countries for which data is available in 2009, the U.S. ranks above the 70th percentile in value added per capita for the following manufacturing sectors (see Table 3.4): food, apparel, wood product, and printing; refined petroleum products and nuclear fuel; chemicals; office, accounting, and computing machinery; radio, television and communication equipment; medical, precision, and optical instruments; transport equipment; and other manufacturing. The remaining sectors in manufacturing are below the 50th percentile: other nonmetallic mineral products; rubber and plastics; basic metals; fabricated metals; machinery and equipment; and electrical machinery and apparatus. Between 2000 and 2009, some sectors had significant changes in their ranking while others remained relatively stable. It is important to note, in Table 3.4, that the number of countries for which data is available changes from year to year, which affects the percentile calculations.

Some U.S. sectors of manufacturing may rank high among OECD countries in terms of value added per capita; however, they may not rank high in terms of their return on investment in capital and labor. Earning a profit is a primary motivator for establishing a business. If a sector of U.S. manufacturing has a low return on investment, a company may decide to establish its production elsewhere. Table 3.5 uses the gross operating

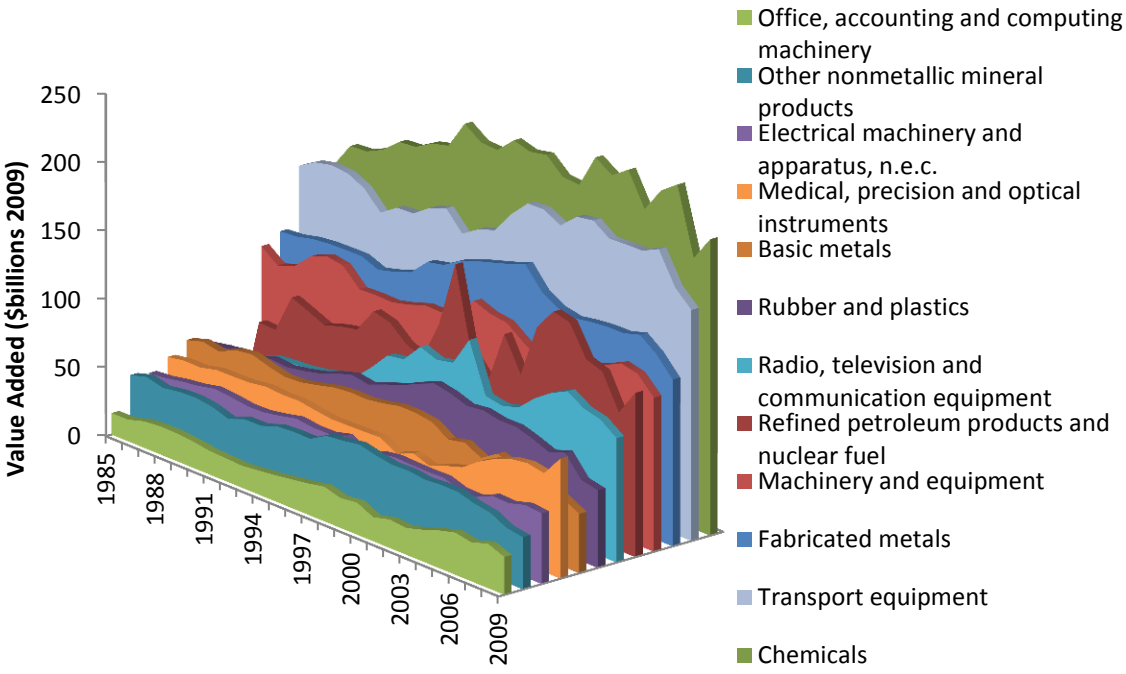


Figure 3.6: U.S. Manufacturing Value Added (excluding ISIC 15-22, 36, and 37) by Subsector (OECD Structural Analysis Database)
Note: Data for this figure was adjusted using the PPI for all manufacturing and the PPI for NAICS 324, 325, 326, 327, 331, 332, 3332, 3342, and 336991.

surplus per expenditure dollar to proxy as a return on investment in a particular sector of manufacturing. Gross operating surplus is gross output less a subset of costs (i.e., intermediate expenditures, compensation, and taxes less subsidies) and does not take into account the depreciation of capital; therefore, it does not fully represent a return on investment. The OECD data does not contain U.S. values for depreciation. Expenditures is the sum of intermediate expenditures, compensation, and taxes less subsidies. As seen in the table, the U.S. is above the 70th percentile for four sectors of manufacturing in 2009 and total manufacturing; however, data for 2009 is available from only a few countries. Unfortunately, data was not available for four of the sectors. Although there is some fluctuation in the rankings between 2001 and 2009 a number of the sectors never rise above the 70th percentile: food, apparel, wood product, and printing; other nonmetallic mineral products; basic metals; and fabricated metals.

Productivity in the U.S. is considered to be quite high and this is reflected in Table 3.6, which shows the U.S. rank of the ratio of value added to the number of hours worked in manufacturing among OECD countries; unfortunately, a number of sectors do not have data available. In this table, total manufacturing in the U.S. is ranked above the 90th percentile in 2009 and has consistently ranked above the 80th percentile in other years. Additionally, four of the six sectors for which there is data are ranked above the 80th percentile in 2009: food, apparel, wood product, and printing; refined petroleum products and nuclear fuel; chemicals; and machinery and equipment. U.S. wages consistently rank above the 70th percentile and often above the 90th percentile as seen in Table 3.7. In 2009, the highest rankings were in chemicals, other nonmetallic mineral products, fabricated metals, and machinery and equipment.

Table 3.4: U.S. Value Added per Capita by Year, Percentile (OECD Structural Analysis Database)

		Food, apparel, wood product, and printing manufacturing	Refined petroleum products and nuclear fuel	Chemicals	Other nonmetallic mineral products	Rubber and plastics	Basic metals	Fabricated metals	Machinery and equipment	Office, accounting and computing machinery	Electrical machinery and apparatus, n.e.c.	Radio, television and communication equipment	Medical, precision and optical instruments	Transport equipment	Other manufacturing
	ISIC	15-22	23	24	26	25	27	28	29	30	31	32	33	34-35	36-37
U.S. Percentile	2001	80.6	92.3	72.4	76.7	29.0	41.9	64.5	56.7	86.2	40.0	80.0	62.1	80.6	93.5
	2002	80.6	88.5	75.9	70.0	29.0	45.2	54.8	50.0	86.2	46.7	80.0	62.1	80.6	93.5
	2003	80.6	92.3	69.0	66.7	25.8	41.9	51.6	43.3	86.2	43.3	80.0	69.0	80.6	93.5
	2004	80.6	92.3	69.0	66.7	22.6	45.2	61.3	50.0	90.0	36.7	76.7	72.4	77.4	93.5
	2005	80.6	96.2	69.0	66.7	19.4	45.2	58.1	46.7	89.7	40.0	80.0	72.4	74.2	93.5
	2006	70.0	96.0	67.9	55.2	13.3	43.3	56.7	44.8	92.9	37.9	75.9	71.4	73.3	93.3
	2007	74.1	95.7	65.4	55.6	3.7	37.0	48.1	40.7	88.5	25.9	77.8	70.4	70.4	92.6
	2008	72.0	90.5	58.3	40.0	0.0	33.3	33.3	36.0	95.5	27.3	81.8	73.9	56.0	84.0
	2009	72.7	88.9	71.4	45.5	0.0	31.6	36.8	36.4	93.8	33.3	80.0	88.9	72.7	81.8
Number of Countries Ranked	2001	31	26	29	30	31	31	31	30	29	30	30	29	31	31
	2002	31	26	29	30	31	31	31	30	29	30	30	29	31	31
	2003	31	26	29	30	31	31	31	30	29	30	30	29	31	31
	2004	31	26	29	30	31	31	31	30	30	30	30	29	31	31
	2005	31	26	29	30	31	31	31	30	29	30	30	29	31	31
	2006	30	25	28	29	30	30	30	29	28	29	29	28	30	30
	2007	27	23	26	27	27	27	27	27	26	27	27	27	27	27
	2008	25	21	24	25	25	24	24	25	22	22	22	23	25	25
	2009	22	18	21	22	22	19	19	22	16	15	15	18	22	22

Table 3.5: U.S. Rank of Gross Operating Surplus per Dollar of Expenditure (OECD Structural Analysis Database)

		Food, apparel, wood product, and printing manufacturing	Refined petroleum products and nuclear fuel	Chemicals	Rubber and plastics	Other nonmetallic mineral products	Basic metals	Fabricated metals	Machinery and equipment	Office, accounting and computing machinery	Electrical machinery and apparatus, n.e.c.	Radio, television and communication equipment	Medical, precision and optical instruments	Transport equipment	Other manufacturing	TOTAL
	ISIC	15-22	23	24	25	26	27	28	29	30	31	32	33	34-35	36-37	
U.S. Percentile	2001	3.6	95.7	65.4	70.4	32.1	15.4	53.8	55.6	-	91.3	-	-	56.0	-	48.3
	2002	7.1	82.6	73.1	51.9	50.0	38.5	42.3	29.6	-	91.3	-	-	76.0	-	72.4
	2003	7.1	95.7	65.4	51.9	35.7	23.1	46.2	22.2	-	87.5	-	-	20.0	-	65.5
	2004	14.3	91.3	73.1	63.0	35.7	57.7	61.5	44.4	-	54.2	-	-	48.0	-	79.3
	2005	17.9	95.7	53.8	55.6	35.7	46.2	61.5	55.6	-	41.7	-	-	60.0	-	82.8
	2006	7.4	86.4	72.0	46.2	14.8	48.0	52.0	61.5	-	82.6	-	-	58.3	-	79.3
	2007	12.0	90.5	79.2	68.0	8.0	25.0	62.5	60.0	-	72.7	-	-	43.5	-	77.8
	2008	9.5	83.3	45.0	40.0	9.5	40.0	45.0	61.9	-	64.7	-	-	27.8	-	78.3
	2009	52.6	81.3	83.3	44.4	57.9	43.8	62.5	73.7	-	85.7	-	-	28.6	-	78.9
Number of Countries Ranked	2001	28	23	26	27	28	26	26	27	-	23	-	-	25	-	29
	2002	28	23	26	27	28	26	26	27	-	23	-	-	25	-	29
	2003	28	23	26	27	28	26	26	27	-	24	-	-	25	-	29
	2004	28	23	26	27	28	26	26	27	-	24	-	-	25	-	29
	2005	28	23	26	27	28	26	26	27	-	24	-	-	25	-	29
	2006	27	22	25	26	27	25	25	26	-	23	-	-	24	-	29
	2007	25	21	24	25	25	24	24	25	-	22	-	-	23	-	27
	2008	21	18	20	20	21	20	20	21	-	17	-	-	18	-	23
	2009	19	16	18	18	19	16	16	19	-	14	-	-	14	-	19

Table 3.6: U.S. Rank of the Ratio of Value Added to Hours of Work (OECD Structural Analysis Database)

		Food, apparel, wood product, and printing manufacturing	Refined petroleum products and nuclear fuel	Chemicals	Rubber and plastics	Other nonmetallic mineral products	Basic metals	Fabricated metals	Machinery and equipment	Office, accounting and computing machinery	Electrical machinery and apparatus, n.e.c.	Radio, television and communication equipment	Medical, precision and optical instruments	Transport equipment	Other manufacturing	TOTAL
	ISIC	15-22	23	24	25	26	27	28	29	30	31	32	33	34-35	36-37	
U.S. Percentile	2001	87.5	73.3	92.9	69.2	50.0	-	-	86.7	-	-	-	-	-	-	85.0
	2002	88.2	75.0	93.3	78.6	64.7	-	-	81.3	-	-	-	-	-	-	90.0
	2003	88.2	81.3	93.3	78.6	52.9	-	-	81.3	-	-	-	-	-	-	90.0
	2004	88.2	87.5	93.3	71.4	58.8	-	-	81.3	-	-	-	-	-	-	90.0
	2005	88.2	87.5	86.7	78.6	64.7	-	-	81.3	-	-	-	-	-	-	95.0
	2006	82.4	87.5	93.3	57.1	35.3	-	-	68.8	-	-	-	-	-	-	95.0
	2007	87.5	86.7	92.9	61.5	25.0	-	-	66.7	-	-	-	-	-	-	94.7
	2008	86.7	85.7	92.9	38.5	26.7	-	-	73.3	-	-	-	-	-	-	94.4
	2009	91.7	83.3	91.7	63.6	58.3	-	-	91.7	-	-	-	-	-	-	93.3
Number of Countries Ranked	2001	16	15	14	13	16	-	-	15	-	-	-	-	-	-	20
	2002	17	16	15	14	17	-	-	16	-	-	-	-	-	-	20
	2003	17	16	15	14	17	-	-	16	-	-	-	-	-	-	20
	2004	17	16	15	14	17	-	-	16	-	-	-	-	-	-	20
	2005	17	16	15	14	17	-	-	16	-	-	-	-	-	-	20
	2006	17	16	15	14	17	-	-	16	-	-	-	-	-	-	20
	2007	16	15	14	13	16	-	-	15	-	-	-	-	-	-	19
	2008	15	14	14	13	15	-	-	15	-	-	-	-	-	-	18
	2009	12	12	12	11	12	-	-	12	-	-	-	-	-	-	15

Table 3.7: Wages by Year, Percentile (OECD Structural Analysis Database)

	Year	Food, apparel, wood product, and printing manufacturing 15-22	Refined petroleum products and nuclear fuel 23.0	Chemicals 24.0	Rubber and plastics 25.0	Other nonmetallic mineral products 26.0	Basic metals 27.0	Fabricated metals 28.0	Machinery and equipment 29.0	Office, accounting and computing machinery 30.0	Electrical machinery and apparatus, n.e.c. 31.0	Radio, television and communication equipment 32.0	Medical, precision and optical instruments 33.0	Transport equipment 34-35	Other manufacturing 36-37	TOTAL
U.S. Percentile	2001	86.4	84.2	95.2	86.4	90.9	88.9	94.4	95.5	94.4	94.1	94.1	94.4	94.4	-	95.5
	2002	86.4	84.2	95.2	86.4	95.5	89.5	94.7	95.5	94.4	94.1	94.1	94.4	94.4	-	95.5
	2003	86.4	84.2	95.2	86.4	95.5	94.7	94.7	95.5	94.4	94.1	94.1	94.4	94.4	-	95.5
	2004	86.4	84.2	95.2	86.4	95.5	89.5	94.7	95.5	88.9	88.2	94.1	94.4	94.4	-	95.5
	2005	85.7	83.3	95.0	85.7	95.2	89.5	94.7	95.2	94.4	88.2	94.1	94.4	94.4	-	95.5
	2006	90.5	88.9	95.0	81.0	90.5	89.5	89.5	95.2	94.4	88.2	94.1	94.4	94.4	-	95.5
	2007	90.0	88.2	94.7	80.0	95.0	88.9	88.9	95.0	94.1	87.5	93.8	94.1	94.1	-	95.2
	2008	86.7	84.6	93.3	86.7	87.5	84.6	92.3	93.3	91.7	81.8	90.9	91.7	91.7	-	94.1
	2009	76.9	81.8	92.3	84.6	92.9	80.0	90.0	92.3	88.9	87.5	87.5	88.9	88.9	-	93.8
Number of Countries Ranked	2001	22	19	21	22	22	18	18	22	18	17	17	18	18	-	22
	2002	22	19	21	22	22	19	19	22	18	17	17	18	18	-	22
	2003	22	19	21	22	22	19	19	22	18	17	17	18	18	-	22
	2004	22	19	21	22	22	19	19	22	18	17	17	18	18	-	22
	2005	21	18	20	21	21	19	19	21	18	17	17	18	18	-	22
	2006	21	18	20	21	21	19	19	21	18	17	17	18	18	-	22
	2007	20	17	19	20	20	18	18	20	17	16	16	17	17	-	21
	2008	15	13	15	15	16	13	13	15	12	11	11	12	12	-	17
	2009	13	11	13	13	14	10	10	13	9	8	8	9	9	-	16

As previously discussed, manufacturing as a percent of GDP decreased for many countries and the aggregate of all countries (see Figure 3.4). During the same 1970 to 2008 period, manufacturing share of employment has decreased for many countries as seen in Figure 3.7, which shows all OECD countries for which data is available. Meanwhile production for many of these countries has remained relatively constant or increased during the 1984 to 2008 period (see Figure 3.3). Since employment is declining and output is remaining relatively constant or increasing, then, manufacturing labor productivity is increasing faster than the growth in demand for domestically produced manufactured products. Additionally, since manufacturing as a percent of GDP has decreased, then, the economy is growing faster than the demand for domestically manufactured products.

There is some discussion as to whether productivity increases directly explain declines in manufacturing employment in the U.S. According to Schweitzer and Zaman as well as Nordhaus, productivity increases do not explain the decreases in manufacturing employment.[43, 44] However, Ward claims that 80 % of the job losses in the U.S. economy since 1990 are due to productivity increases;[45] other authors also assert that increased productivity is the major reason for the decreased manufacturing employment

[43] Schweitzer, Mark and Saeed Zaman. "Are we Engineering Ourselves out of Manufacturing Jobs." Federal Reserve Bank of Cleveland. January 2006. <http://www.clevelandfed.org/research/commentary/2006/0101.pdf>

[44] Nordhaus, William. "The Sources of the Productivity Rebound and the Manufacturing Employment Puzzle." NBER Working Paper. May 2005. <http://www.nber.org/papers/w11354>

[45] Ward, William A. "Manufacturing Productivity and the Shifting US, China, and Global Job Scenes—1990 to 2005." Clemson University Center for International Trade Working Paper 052507. August 2005. <http://ageconsearch.umn.edu/bitstream/112948/2/citpaper12.pdf>

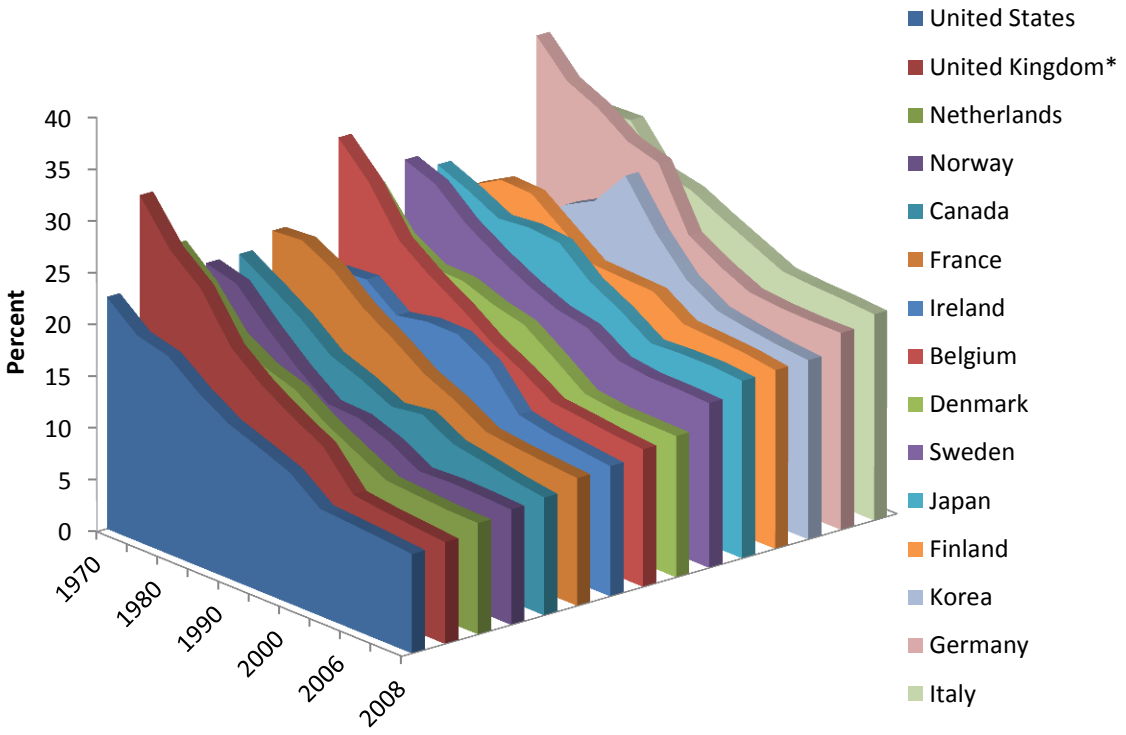


Figure 3.7: Manufacturing Share of Employment (OECD SDBS Business Demography Database)
* The 1970 value for the United Kingdom was estimated using a rolling 10 year average change

numbers.[46, 47, 48] These contrasting views need to be reconciled before any solid conclusions can be drawn concerning the decrease in manufacturing employment.

In addition to employment and production data, OECD also maintains data on the number of businesses started and ending during the year. As seen in Table 3.8, the 2005 U.S. employer enterprise birth rate (number of new enterprises divided by the number of existing enterprises) is less than the death rate; thus, more businesses were eliminated from manufacturing than were created. Seemingly, this trend has left the U.S. manufacturing industry with one of the lowest numbers of active employer enterprises per capita and also having a share of total employment lower than Germany, Italy, Japan, France, Canada, and the United Kingdom (not shown).

[46] Kelley, Charles, Mark Wang, Gordon Bitko, Michael Chase, Aaron Kofner, Julia Lowell, James Mulvenon, David Ortiz, and Kevin Pollpeter. March 2004. "High-Technology Manufacturing and U.S. Competitiveness." RAND Technical Report. <http://www.rand.org/pubs/technical_reports/2004/RAND_TR136.pdf>
[47] Krugman, Paul R. and Robert Z. Lawrence. "Trade, Jobs, and Wages," Scientific American, April 1994: 22-27.
[48] Rowthorn, Robert and Ramana Ramaswamy. "Deindustrialization: Causes and Implications," April 1997. International Monetary Fund Working Paper WP/97/42.

Table 3.8: Employer Enterprises in Manufacturing (OECD SDBS Business Demography Database)

	Employer Enterprise Birth Rate (2005)	Employer Enterprise Death Rate (2005)	2-Year Survival Rate (2006)	Number of Active Employer Enterprises (2005)	Number of Active Employer Enterprises Per Capita (2005) (thousands)	Employment Shares in Total Economy (percent) (2005)
Australia	-	-	-	56 883	2.81	10.65
Austria	4.74	5.62	79.85 ***	22 602	2.76	16.08
Belgium	1.67 **	1.59 **	-	20 903 **	2.01 **	14.24
Brazil	9	6.73	-	241 370	1.30	-
Bulgaria	8.36	4.49	61.90	21 327	2.86	-
Canada	7.32	7.24	73.88	58 580	1.81	12.97
Czech Republic	8.49	-	-	37 850	3.70	27.46
Denmark	6.45	9.28	-	11 549	2.13	14.14
Estonia	8.31	7.16	77.96	5 057	3.79	22.97
Finland	6.54	6.8	68.77	14 424	2.76	18.11
Hungary	7.55	8.97	61.93	39 423	3.92	22.35
Israel	6.3	4.74	68.53 ***	16 447	2.44	13.15
Italy	5.71	7.08	72.28	297 531	5.04	20.45
Latvia	7.77	3.8	77.65 ***	5 815	2.54	-
Lithuania	8.82	-	-	8 054	2.24	-
Luxembourg	6.62	4.5	85.29	755	1.61	11.53
Netherlands	6.2	7.12	47.62	29 898	1.83	11.25
New Zealand	-	-	65.53	-	-	14.92
Norway	4.39	2.96	-	11 030	2.40	11.22
Portugal	12.05	13.79	49.91 ***	99 113	9.38	18.38
Romania	12.42	8.2	75.03	51 108	2.30	-
Slovak Republic	9.93	7.13	74.96	23 237	4.28	24.46
Slovenia	5.68	5.54	80.54 ***	10 487	5.21	26.05
Spain	6.21	6.42	76.38	170 923	3.91	16.12
Sweden	5.61 **	-	-	26 211 **	2.91 **	16.46
United States	7.28	8.32	83.89	352 181	1.19	10.35

* This value is for 2005

** This value is for 2006

*** This value is for 2007

3.2.2 Input-Output Data

OECD STAN Input-Output Data: The STAN input-output data[49] is collected and assembled in a different manner than the STAN data previously discussed; however, the input-output data has within it estimates of value added for various manufacturing subsectors. This data contains estimates for China, Australia, and India whereas previously discussed STAN data did not have them. Input-Output tables describe the sales and purchases of final and intermediate goods and services within an economy.

[49] The STAN input-output data and other input-output data presented in this report are based on a framework developed by Wassily Leontief. Leontief was awarded the Nobel Memorial Prize in Economic Sciences in 1973 for his pioneering work on input-output analysis.

Data in the STAN tables are categorized by industry and are available for the mid-2000's, early 2000's, and the mid-1990's. The mid-2000's data are available for 39 countries representing over 90 % of global GDP while the mid-1990's data is available for 36 countries representing over 70 % of global GDP.[50] These data have been converted to U.S. dollars using the OECD National Accounts Exchange rates.

The input-output data from the STAN database provide an estimate of value added for each two digit ISIC code in manufacturing. Table 3.9 provides the mid-2000's value as well as gross operating surplus per dollar of expenditure. Out of all 39 countries, the U.S. has the largest value added in the mid-2000's for all manufacturing subsectors except ISIC 27, 30, and 31 as seen in the rankings. According to the table, U.S. manufacturing value added is 13.1 % of GDP while China is 34.2 %. In terms of value added per capita, the U.S. ranks 4th in office, accounting, and computing machinery and 11th for all manufacturing. The U.S. does not rank first for any subsector in terms of value added per capita. Gross operating surplus per dollar of expenditure, as seen in Table 3.9, proxies as a measure of the return on investment as gross operating surplus is similar to profit except it does not take into account the depreciation of capital. Expenditures include compensation of employees, taxes, and intermediate goods and services. The gross operating surplus per dollar of expenditure is 0.15 for the whole of U.S. manufacturing. Among the countries shown, India and Mexico have larger ratios at 0.19 and 0.27. The largest ratio among the U.S. subsectors is 0.26 for ISIC 26, which includes the production of glass, ceramics, and other non-metallic mineral products. Table 3.10 breaks value added into three components: compensation, gross operating surplus, and taxes. The sum of these three items is equal to value added. Approximately 58.1 % of U.S. manufacturing value added goes to the compensation of employees, 38.7 % is gross operating surplus, and 3.1 % is taxes. Only 31.2 % of China's value added goes to the compensation of employees while 48.5 % is gross operating surplus and 20.3 % is taxes. Gross operating surplus being nearly 10 percentage points higher in China poses as a continued incentive for manufacturers to establish factories in China rather than in the U.S. In terms of gross operating surplus per dollar of expenditure, the U.S. ranks 14th for total manufacturing and 9th for office, accounting, and computing machinery (not shown).

[50] Yamano, Norihiki and Nadim Ahmad. "The OECD Input-Output Database: 2006 Edition. DSTI/DOC(2006)8. October 2006. STI Working Paper 2006/8. <http://www.oecd.org/dataoecd/46/54/37585924.pdf>

Table 3.9: Value Added from the STAN Input-Output Data

		Food, apparel, wood product, and printing manufacturing	Refined petroleum products and nuclear fuel	Chemicals	Rubber and plastics	Other nonmetallic mineral products	Basic metals	Fabricated metals	Machinery and equipment	Office, accounting and computing machinery	Electrical machinery and apparatus, n.e.c.	Radio, television and communication equipment	Medical, precision and optical instruments	Transport equipment	Other manufacturing	TOTAL
	ISIC	15-22	23	24	25	26	27	28	29	30	31	32	33	34-35	36-37	
Value Added ($billion 2005	United States	481	71	201	67	53	56	124	120	20	38	66	45	179	103	1 624
	Australia	28	2	5	3	3	7	6	4	0	2	0	1	7	3	71
	Canada	61	4	12	9	5	11	12	11	1	3	5	0	22	9	164
	China	222	32	110	24	29	81	29	92	23	42	18	7	48	31	789
	Germany	104	6	59	27	17	26	51	86	5	40	14	25	92	14	566
	India	24	7	14	2	4	10	3	5	4	3	1	1	5	0	83
	Japan	233	54	58	43	27	64	48	117	12	84	17	14	105	21	898
	Mexico	48	4	12	3	8	7	4	3	7	4	0	0	19	4	123
	UK	88	5	30	13	10	6	23	22	5	9	6	10	29	12	269
Gross Operating Surplus Per Dollar of Expenditure	United States	0.15	0.14	0.24	0.15	0.26	0.13	0.16	0.13	0.19	0.22	0.16	0.05	0.06	0.19	0.15
	Australia	0.16	0.09	0.15	0.13	0.15	0.14	0.12	0.10	-	0.10	-	0.10	0.10	0.11	0.14
	Canada	0.17	0.05	0.15	0.15	0.24	0.14	0.14	0.16	0.01	0.10	0.09	-	0.08	0.19	0.13
	China	0.13	0.10	0.13	0.11	0.26	0.12	0.12	0.13	0.08	0.11	0.10	0.13	0.10	0.38	0.13
	Germany	0.13	0.05	0.16	0.14	0.12	0.11	0.13	0.11	0.10	0.06	0.13	0.19	0.05	0.11	0.11
	India	0.18	0.18	0.26	0.15	0.33	0.20	0.36	0.19	0.22	0.13	0.08	0.27	0.11	-	0.19
	Japan	0.18	0.03	0.15	0.12	0.21	0.10	0.15	0.15	0.12	0.14	0.11	0.13	0.07	0.11	0.12
	Mexico	0.37	0.11	0.26	0.21	0.61	0.37	0.23	0.11	0.10	0.16	-	-	0.25	0.25	0.27
	UK	0.12	0.02	0.15	0.08	0.13	0.04	0.12	0.09	0.16	0.10	0.09	0.20	0.05	0.16	0.11
Value Added as a Percent of Total GDP	United States	3.87%	0.57%	1.62%	0.54%	0.43%	0.45%	1.00%	0.97%	0.16%	0.30%	0.53%	0.36%	1.44%	0.83%	13.07%
	Australia	4.67%	0.26%	0.87%	0.43%	0.58%	1.19%	0.96%	0.66%	0.00%	0.41%	0.00%	0.15%	1.09%	0.44%	11.72%
	Canada	5.76%	0.36%	1.14%	0.82%	0.47%	1.00%	1.15%	1.07%	0.05%	0.25%	0.52%	0.00%	2.08%	0.82%	15.50%
	China	9.65%	1.40%	4.79%	1.05%	1.25%	3.52%	1.26%	4.00%	1.00%	1.81%	0.76%	0.31%	2.08%	1.34%	34.21%
	Germany	4.15%	0.23%	2.34%	1.07%	0.67%	1.01%	2.02%	3.41%	0.19%	1.57%	0.57%	0.98%	3.66%	0.57%	22.46%
	India	4.37%	1.20%	2.48%	0.38%	0.78%	1.72%	0.56%	0.89%	0.71%	0.63%	0.27%	0.11%	0.93%	0.00%	15.02%
	Japan	5.15%	1.18%	1.27%	0.96%	0.59%	1.41%	1.06%	2.59%	0.27%	1.86%	0.37%	0.30%	2.32%	0.47%	19.81%
	Mexico	7.16%	0.57%	1.86%	0.52%	1.19%	1.08%	0.56%	0.42%	1.04%	0.58%	0.00%	0.00%	2.83%	0.66%	18.46%
	UK	4.35%	0.22%	1.50%	0.66%	0.47%	0.29%	1.16%	1.10%	0.26%	0.42%	0.28%	0.51%	1.45%	0.59%	13.26%
2005 Rank of Value Added (among 39 countries)	United States	1	1	1	1	1	3	1	1	2	4	1	1	1	1	1
	Australia	14	21	19	16	14	13	13	19	34	15	36	19	14	17	17
	Canada	8	17	15	9	12	7	10	10	17	14	11	36	8	8	9
	China	3	3	2	4	2	1	5	3	1	2	4	7	4	2	3
	Germany	4	11	3	3	5	4	2	4	6	3	6	2	3	5	4
	India	16	8	11	19	13	10	20	16	7	13	19	23	16	39	14
	Japan	2	2	4	2	3	2	3	2	3	1	5	3	2	3	2
	Mexico	11	18	14	12	9	14	19	24	4	12	36	36	9	12	12
	UK	5	13	5	6	8	16	7	7	5	8	10	4	6	6	6
2005 Rank of Value Added per Capita (among 39 countries)	United States	11	5	7	11	14	15	11	12	4	18	7	12	6	2	11
	Australia	15	18	22	21	15	9	19	22	34	19	36	20	14	18	21
	Canada	4	11	16	5	22	10	15	17	16	23	10	36	5	5	13
	China	37	30	31	37	36	29	35	30	15	33	29	32	35	35	36
	Germany	16	20	6	3	11	11	4	1	7	3	9	5	1	12	5
	India	39	35	38	39	38	37	38	38	31	39	35	35	39	39	39
	Japan	6	2	13	2	10	2	16	2	2	1	12	15	3	14	3
	Mexico	29	29	27	32	29	27	33	36	5	32	36	36	22	32	30
	UK	14	19	9	12	19	22	13	14	3	16	17	9	9	9	16

Note: This data was adjusted using the PPI for all manufacturing for ISIC 15-22, 33, and 36-37; NAICS 324 for ISIC 23; NAICS 325 for ISIC 24; NAICS 326 for ISIC 25; NAICS 327 for ISIC 26; NAICS 331 for ISIC 27; NAICS 332 for ISIC 28; NAICS 3332 for ISIC 29; NAICS 3342 for ISIC 30; NAICS 3352 for ISIC 31; NAICS 3342 for ISIC 32; and NAICS 336991 for ISIC 34-35.

Note: The green and red bars represent a visual comparison between countries for each category (listed in the far left column) and subsector (listed in the top row) combination. Higher values have longer bars. Red bars signify instances where a lower value is preferred such as rankings (i.e., being 1st is preferred over 31st).

Table 3.10: Compensation, Gross Operating Surplus, and Taxes as a Percent of Value Added, mid-2000's

		Food, apparel, wood product, and printing manufacturing	Refined petroleum products and nuclear fuel	Chemicals	Rubber and plastics	Other nonmetallic mineral products	Basic metals	Fabricated metals	Machinery and equipment	Office, accounting and computing machinery	Electrical machinery and apparatus, n.e.c.	Radio, television and communication equipment	Medical, precision and optical instruments	Transport equipment	Other manufacturing	TOTAL
		15-22	23	24	25	26	27	28	29	30	31	32	33	34-35	36-37	
Compensation	United States	57.0%	19.8%	41.1%	60.1%	53.0%	55.9%	65.9%	68.0%	48.6%	57.8%	61.2%	86.9%	74.6%	63.9%	58.1%
	Australia	55.3%	28.3%	50.2%	65.0%	61.2%	47.1%	67.9%	72.1%	-	70.2%	-	74.4%	64.4%	66.6%	58.1%
	Canada	59.0%	42.1%	48.4%	61.9%	53.4%	48.9%	68.2%	63.6%	92.8%	72.5%	74.1%	-	62.2%	62.0%	59.6%
	China	31.8%	20.3%	29.5%	36.1%	29.2%	24.0%	35.0%	34.2%	36.2%	38.4%	42.8%	43.0%	34.6%	19.7%	31.2%
	Germany	61.0%	35.8%	57.5%	66.0%	70.1%	60.0%	70.0%	72.7%	65.5%	82.5%	66.8%	65.7%	79.4%	69.9%	68.6%
	India	26.4%	8.1%	20.2%	31.6%	20.5%	28.7%	12.8%	34.3%	31.1%	26.1%	34.2%	48.6%	53.1%	-	26.1%
	Japan	43.9%	5.2%	36.6%	60.8%	49.4%	47.9%	62.1%	56.9%	49.5%	56.2%	53.4%	65.8%	65.5%	60.9%	49.7%
	Mexico	29.0%	42.4%	35.5%	45.4%	28.0%	24.5%	44.6%	71.6%	42.1%	46.8%	-	-	34.8%	45.7%	34.4%
	UK	69.5%	82.7%	58.5%	78.0%	70.6%	80.4%	76.2%	76.2%	59.0%	73.2%	73.3%	64.1%	81.0%	62.9%	71.1%
Gross Operating Surplus	United States	37.3%	77.4%	56.1%	37.1%	44.7%	40.3%	32.4%	30.3%	51.0%	41.5%	37.7%	12.4%	23.4%	34.9%	38.7%
	Australia	41.7%	69.6%	46.7%	31.3%	35.6%	50.6%	29.5%	25.1%	-	25.4%	-	23.0%	32.4%	31.2%	38.9%
	Canada	38.8%	55.4%	49.1%	36.0%	43.9%	48.5%	29.6%	34.5%	5.9%	25.5%	23.4%	-	36.2%	35.6%	38.3%
	China	44.5%	45.8%	50.1%	45.2%	54.8%	52.3%	49.0%	48.0%	59.9%	46.1%	40.7%	42.0%	41.6%	73.7%	48.5%
	Germany	37.5%	60.4%	39.9%	32.1%	28.3%	38.0%	28.1%	25.6%	33.9%	16.4%	32.9%	32.8%	20.1%	28.4%	29.9%
	India	73.6%	91.9%	79.8%	68.4%	79.5%	71.3%	87.2%	65.7%	68.9%	73.9%	65.8%	51.4%	46.9%	-	73.9%
	Japan	38.8%	8.5%	54.1%	31.4%	41.6%	40.2%	30.6%	36.7%	43.0%	39.1%	39.7%	28.8%	28.6%	31.8%	35.7%
	Mexico	70.3%	57.5%	63.0%	53.3%	71.6%	75.1%	54.2%	27.1%	56.9%	52.1%	-	-	64.8%	53.4%	64.8%
	UK	29.0%	15.4%	40.1%	20.0%	27.1%	17.2%	22.1%	22.3%	40.5%	25.1%	25.6%	34.6%	17.7%	34.9%	27.4%
Taxes	United States	5.8%	2.8%	2.8%	2.8%	2.3%	3.7%	1.7%	1.7%	0.4%	0.7%	1.2%	0.7%	2.0%	1.2%	3.1%
	Australia	3.0%	2.1%	3.1%	3.7%	3.2%	2.4%	2.7%	2.8%	-	4.3%	-	2.7%	3.2%	2.2%	3.0%
	Canada	2.2%	2.5%	2.4%	2.1%	2.8%	2.6%	2.2%	1.9%	1.3%	2.0%	2.5%	-	1.6%	2.3%	2.2%
	China	23.7%	33.9%	20.4%	18.6%	16.0%	23.7%	16.0%	17.8%	4.0%	15.5%	16.5%	15.0%	23.9%	6.6%	20.3%
	Germany	1.5%	3.9%	2.5%	1.8%	1.6%	2.0%	2.0%	1.7%	0.5%	1.1%	0.3%	1.5%	0.5%	1.6%	1.5%
	India	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-	0.0%
	Japan	17.4%	86.3%	9.2%	7.7%	9.0%	11.9%	7.4%	6.3%	7.4%	4.7%	6.9%	5.5%	6.0%	7.3%	14.6%
	Mexico	0.6%	0.1%	1.5%	1.3%	0.4%	0.5%	1.2%	1.3%	1.0%	1.1%	-	-	0.5%	0.9%	0.8%
	UK	1.5%	1.9%	1.3%	2.1%	2.2%	2.5%	1.7%	1.5%	0.5%	1.7%	1.1%	1.3%	1.3%	2.2%	1.6%

Note: The green bars represent a visual comparison between countries for each category (listed in the far left column) and subsector (listed in the top row) combination. Higher values have longer bars.

In using OECD data in input-output analysis, economies of scale are ignored; thus, it operates under constant returns to scale. The model also assumes that a sector uses inputs in fixed proportions.[51] Table 3.11 uses this model to estimate the output of the manufacturing industry and the domestically produced goods and services used to produce that output. The U.S. output for electronics was $335 billion with $115 billion of non-manufactured goods and services used domestically in their production. The total impact from electronics is $450 billion or 1.9 % of total output. The total impact from machinery is $1 511 billion or 6.5 % of total output. The whole of the U.S. manufacturing industry impacts $6 446 billion or 27.9 % of total output. This percentage is lower than in other countries such as China, Germany, India, and Japan which have impacts of 62.1 %, 44.9 %, 45.3 %, and 41.2 % respectively. According to these data, the U.S. manufacturing industry uses 18.3 % of total U.S. research and development output (not shown).

[51] Miller, Ronald E. and Peter D. Blair. *Input-Output Analysis: Foundations and Extensions*. (New York: Cambridge University Press, 2009): 16

Table 3.11: Input-Output Analysis using OECD STAN Data, mid-2000's

$Billion 2005

	Electronics (ISIC 30-32)		Machinery (ISIC 29, 33-35)		Other (ISIC 15-28, 36-37)		Total (ISIC 15-37)			
	Output	Non-manufactured Products Used	Output	Non-manufactured Products Used	Output	Non-manufactured Products Used	**Output**	**Non-manufactured Products Used**	**Total Impact**	**Percent of Total Output**
United States	335	115	1 118	393	3 485	1 000	**4 938**	**1 508**	**6 446**	**27.9%**
Australia	7	2	37	14	187	66	**231**	**83**	**314**	**24.7%**
Canada	25	5	136	29	384	110	**544**	**145**	**689**	**33.8%**
China	458	128	648	195	2 337	466	**3 443**	**789**	**4 232**	**62.1%**
Germany	170	40	644	185	955	273	**1 769**	**498**	**2 267**	**44.9%**
India	50	15	45	16	285	94	**380**	**125**	**505**	**45.3%**
Japan	386	136	848	235	1 648	261	**2 882**	**633**	**3 515**	**41.2%**
Mexico	57	9	69	16	252	79	**378**	**103**	**481**	**41.8%**
UK	57	15	187	62	531	164	**775**	**241**	**1 016**	**24.8%**

Note: The green bars represent a visual comparison between each country for each category (listed in the top row). Higher values have longer bars.

3.2.3 Research and Development

Research and Development Expenditures: In addition to data on production, the STAN database provides estimates on research and development expenditures by nation. Similar to production data, national currencies are converted to dollars using the OECD purchasing power parity (PPP) rates for gross domestic product. Research and development data is available for 1999 through 2006.

To maintain a strong manufacturing environment, the U.S. must have a healthy investment in the research and development of new products. Significant concern has been expressed in regards to U.S. research and development expenditures compared to those abroad.[52] This concern is primarily in regards to its proportion of global research and development expenditures.[53] There is also concern that the share of U.S. patents filed by inventors residing in the U.S. has decreased in recent years as have peer-reviewed publications.[54] As previously mentioned, it is important to examine the nation's nominal and real performance relative to its resources. It should be expected that as emerging economies make progress in becoming developed countries that U.S. and other developed nation's proportion of production and research will decline due to the growth of total global production and research activities. That is, it is not to be expected that the U.S. will keep up with the aggregate growth of global research and production as much of these increases are the result of utilizing previously idle or under-utilized resources. A decline of the proportion of U.S. activities, therefore, is not unexpected. A greater concern is its nominal and real performance relative to its population and/or resources. It is in this context that this report will compare U.S. research and development to that of other nations.

[52] Atkinson, Robert D. and David B. Audretsch. "Economic Doctrines and Policy Differences: Has the Washington Policy Debate Been Asking the Wrong Questions?" The Information Technology and Innovation Foundation. September 2008. < http://www.itif.org/files/EconomicDoctrine.pdf>

[53] Tassey Gregory. "Rationales and Mechanisms for Revitalizing U.S. Manufacturing R&D Strategies." *Journal of Technology Transfer*. 35 (2010). 283-333.

[54] National Science Board. "Research and Development: Essential Foundation for U.S. Competitiveness in a Global Economy." 2008. <http://www.nsf.gov/statistics/nsb0803/nsb0803.pdf>

Although data is available on research and development, there have been calls for improvements in statistics on research and development along with innovation. Data on this subject has been identified as insufficient and underutilized.[55] It is also important to note that there are concerns in the linkage of moving innovation into domestic manufacturing. That is, there are occasions where U.S. research and development produces a new technology only for that technology to be utilized in manufacturing overseas. It has been identified that in at least some cases this transfer was not the result of lower production costs, but rather a result of other market factors. The production of Lithium-ion batteries is an example of this type of issue.[56] Concern has been expressed in that as some manufacturing activities move abroad that supporting activities may follow.

According to the adjusted OECD STAN data in Table 3.12, the U.S. has the largest research and development expenditure for ISIC 15-22, 23, 24, 28, 29, 32, 33, 34-35, and for total manufacturing among those countries shown. In per capita terms, the U.S. has the largest research and development expenditures for ISIC 23, 24, 32, and 33. Germany spends nearly as much as the U.S. in per capita research and development for all manufacturing while Japan exceeds the U.S. expenditure by more than 30 %.

As seen in Table 3.13, among all OECD countries for which data are available the U.S. ranks above the 95th percentile for total manufacturing research and development expenditures for all years. From 2001 through 2007, it was above the 90th percentile for all subsectors of manufacturing. In terms of per capita research and development expenditures, 2007 U.S. values rank above the 70th percentile for ISIC codes 15-22, 23, 24, 29, 30, 32, 33, 34-35, 36-37, and total manufacturing (see Table 3.14).

Patents: OECD patent data includes the number of patents filed by the inventor's country of residence for 48 countries including China and India as well as a world estimate. The OECD patent database includes applications to the European Patent Office (EPO) and U.S. Patent and Trademark Office (USPTO) as well as those filed under the Patent Co-operation Treaty (PCT) and Triadic Patent Families. Patents reflect inventive performance and, therefore, are a key measure of innovation. There are, however, some drawbacks in using patents to measure innovation. Many patents have no industrial application. Also, many inventions are not patented either because they are not patentable or the inventor uses other means of intellectual property protection such as secrecy. Finally, patent laws change over time and vary between countries making it difficult to draw solid conclusions from data comparisons.[57] In contrast to these shortcomings, research by de Rassenfosse and van Pottelsberghe has shown a high correlation between patent numbers and R&D performance.[58]

---

[55] National Science Foundation. "Advancing Measures of Innovation." June 2006. <http://www.nsf.gov/statistics/nsf07306/>

[56] Brodd, Ralph J. "Factors Affecting U.S. Production Decisions: Why are There No Volume Lithium-Ion Battery Manufacturers in the United States." ATP Working Paper 05-01. June 2005. <http://www.atp.nist.gov/eao/wp05-01/wp05-01.pdf>

[57] OECD. *OECD Patent Statistics Manual.* OECD 2009. <http://browse.oecdbookshop.org/oecd/pdfs/free/9209021e.pdf>

[58] De Rassenfosse, G. and B. van Pottelsberghe "A Policy Insight into the R&D Patent Relationship." ULB Working Paper. 2008.

According to OECD patent data, as seen in Table 3.15, between 1999 and 2007 the U.S. has ranked above the 90th percentile in terms of total number of patents and above the 80th percentile in terms of patents per capita. During that same period, U.S. patents represented between 30 % and 41 % of total patents worldwide. This data is consistent with a patent analysis conducted by Thomson Reuters, which suggested that approximately 40 % of the top 100 global innovator companies are located in the United States.[59] According to the OECD data, Japan is the only country that occasionally produced more patents than the U.S. while Luxembourg, Switzerland, and Japan produced more patents per capita in 2007.

Table 3.12: Research and Development Expenditures by Country, 2006 (OECD STAN Database)

		Food, Textiles, Leather, Footwear, Wood Products, and Paper Products	Chemical, rubber, plastics and fuel products	Other non-metallic mineral products	Basic metals and fabricated metal products	Machinery and equipment	Machinery and equipment, n.e.c.	Office, accounting and computing machinery	Electrical machinery and apparatus, n.e.c.	Radio, television and communication equipment	Medical, precision and optical instruments	Transport equipment	Motor vehicles, trailers and semi-trailers	Other transport equipment	Manufacturing n.e.c. and recycling	TOTAL Manufacturing
	ISIC	15-22	23	24	26	25	27	28	29	30	31	32	33	34-35	36-37	
R&D ($billion 2006)	United States	4.52	1.44	46.33	1.01	2.25	0.65	1.50	9.85	7.37	2.28	31.18	22.40	37.26	-	172.73
	Australia	0.52	0.07	0.37	0.07	0.05	0.35	0.09	0.17	0.04	0.03	0.16	0.30	0.61	0.02	2.86
	Canada	1.07	0.11	1.22	0.05	0.04	0.21	0.15	0.42	0.30	0.11	2.09	0.19	1.30	-	7.56
	China*	1.33	0.42	2.42	0.47	0.38	1.32	0.30	1.92	0.58	1.48	3.26	0.43	1.73	-	16.16
	Germany	0.78	0.08	8.51	0.32	0.86	0.48	0.59	5.13	0.66	1.50	4.21	3.59	17.70	0.21	44.62
	India	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Japan	1.36	0.47	17.01	1.19	2.55	2.61	0.94	9.36	14.58	9.18	12.62	4.76	19.34	-	99.74
	Mexico	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	UK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Percent of Total R&D	United States	2.6%	0.8%	26.8%	0.6%	1.3%	0.4%	0.9%	5.7%	4.3%	1.3%	18.1%	13.0%	21.6%	-	100.0%
	Australia	18.3%	2.5%	13.1%	2.5%	1.7%	12.3%	3.2%	6.0%	1.3%	1.1%	5.5%	10.5%	21.4%	0.7%	100.0%
	Canada	14.2%	1.5%	16.2%	0.6%	0.6%	2.8%	2.0%	5.5%	3.9%	1.4%	27.6%	2.5%	17.2%	-	100.0%
	China*	8.2%	2.6%	15.0%	2.9%	2.4%	8.2%	1.8%	11.9%	3.6%	9.2%	20.2%	2.6%	10.7%	-	100.1%
	Germany	1.8%	0.2%	19.1%	0.7%	1.9%	1.1%	1.3%	11.5%	1.5%	3.4%	9.4%	8.0%	39.7%	0.5%	100.0%
	India	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Japan	1.4%	0.5%	17.1%	1.2%	2.6%	2.6%	0.9%	9.4%	14.6%	9.2%	12.7%	4.8%	19.4%		100.0%
	Mexico	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	UK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Per Capita R&D (2006)	United States	15.14	4.82	155.16	3.40	7.52	2.18	5.02	32.98	24.68	7.64	104.44	75.01	124.79	-	578.47
	Australia	25.51	3.52	18.21	3.49	2.33	17.11	4.39	8.39	1.76	1.57	7.66	14.61	29.81	1.00	139.36
	Canada	32.74	3.49	37.49	1.39	1.28	6.39	4.58	12.82	9.04	3.22	63.95	5.73	39.80	-	231.37
	China	1.02	0.33	1.86	0.36	0.29	1.01	0.23	1.47	0.44	1.14	2.50	0.33	1.33	-	12.39
	Germany	9.51	0.97	103.29	3.83	10.48	5.77	7.20	62.20	8.01	18.23	51.08	43.53	214.74	2.51	541.35
	India	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Japan	10.70	3.68	133.37	9.30	20.02	20.45	7.38	73.42	114.31	72.01	98.96	37.35	151.66	-	782.21
	Mexico	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	UK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

* R&D data from China was unavailable for 2006. The data shown is adjusted from 2000.
Note: The green bars represent a visual comparison between countries. For example, the U.S. has the largest R&D value for ISIC 15-22; therefore, it also has the longest green bar.

[59] Thomson Reuters. "Top 100 Global Innovators, 2011." <http://www.top100innovators.com/overview>

Table 3.13: U.S. Research and Development Expenditures by Year, Percentile (OECD Structural Analysis Database)

		Food, apparel, wood product, and printing manufacturing	Refined petroleum products and nuclear fuel	Chemicals	Rubber and plastics	Other nonmetallic mineral products	Basic metals	Fabricated metals	Machinery and equipment	Office, accounting and computing machinery	Electrical machinery and apparatus, n.e.c.	Radio, television and communication equipment	Medical, precision and optical instruments	Transport equipment	Other manufacturing	TOTAL
	ISIC	15-22	23	24	25	26	27	28	29	30	31	32	33	34-35	36-37	
U.S. Percentile	2001	95.8	94.1	95.7	95.5	91.7	91.3	95.5	95.7	94.4	91.3	95.5	95.7	95.5	95.5	96.0
	2002	95.8	95.2	95.8	91.3	91.7	91.7	95.5	95.8	94.7	91.7	95.7	95.8	95.7	95.5	96.0
	2003	96.0	94.7	95.8	91.3	92.0	92.0	95.8	91.7	94.7	91.7	95.7	95.8	95.7	95.7	96.3
	2004	96.2	94.4	96.0	91.3	91.7	91.7	95.8	91.7	94.7	92.0	96.0	96.0	95.8	95.7	96.2
	2005	96.2	94.7	95.8	91.3	92.0	92.0	95.8	96.0	94.7	92.0	95.8	96.0	95.8	95.8	96.3
	2006	96.0	94.7	95.8	91.3	92.0	92.0	95.8	95.8	94.7	92.0	95.8	96.0	95.7	95.5	96.0
	2007	96.3	94.7	95.8	91.3	92.6	92.6	96.0	95.8	95.0	92.0	96.0	96.0	95.8	95.7	96.3
	2008	90.5	-	95.2	94.7	85.0	85.0	95.0	90.0	93.3	85.0	95.0	-	94.4	-	95.2
Number of Countries Ranked	2001	24	17	23	22	24	23	22	23	18	23	22	23	22	22	25
	2002	24	21	24	23	24	24	22	24	19	24	23	24	23	22	25
	2003	25	19	24	23	25	25	24	24	19	24	23	24	23	23	27
	2004	26	18	25	23	24	24	24	24	19	25	25	25	24	23	26
	2005	26	19	24	23	25	25	24	25	19	25	24	25	24	24	27
	2006	25	19	24	23	25	25	24	24	19	25	24	25	23	22	25
	2007	27	19	24	23	27	27	25	24	20	25	25	25	24	23	27
	2008	21	14	21	19	20	20	20	20	15	20	20	19	18	17	21

Table 3.14: U.S. Research and Development per Capita by Year, Percentile (OECD Structural Analysis Database)

		Food, apparel, wood product, and printing manufacturing	Refined petroleum products and nuclear fuel	Chemicals	Rubber and plastics	Other nonmetallic mineral products	Basic metals	Fabricated metals	Machinery and equipment	Office, accounting and computing machinery	Electrical machinery and apparatus, n.e.c.	Radio, television and communication equipment	Medical, precision and optical instruments	Transport equipment	Other manufacturing	TOTAL
	ISIC	15-22	23	24	25	26	27	28	29	30	31	32	33	34-35	36-37	
U.S. Percentile	2001	87.5	82.4	73.9	81.8	79.2	39.1	86.4	82.6	83.3	87.0	81.8	91.3	86.4	81.8	92.0
	2002	87.5	90.5	75.0	73.9	41.7	41.7	81.8	75.0	89.5	62.5	73.9	91.7	82.6	90.9	88.0
	2003	88.0	89.5	79.2	73.9	56.0	56.0	70.8	75.0	89.5	58.3	73.9	91.7	91.3	82.6	88.9
	2004	84.6	88.9	92.0	73.9	66.7	50.0	75.0	66.7	89.5	68.0	76.0	92.0	91.7	87.0	88.5
	2005	88.5	84.2	95.8	69.6	60.0	52.0	66.7	80.0	89.5	60.0	75.0	92.0	87.5	87.5	92.6
	2006	88.0	89.5	95.8	69.6	60.0	44.0	70.8	79.2	89.5	56.0	75.0	92.0	87.0	86.4	92.0
	2007	88.9	94.7	95.8	69.6	55.6	51.9	68.0	75.0	85.0	56.0	76.0	92.0	87.5	87.0	92.6
	2008	71.4	-	90.5	78.9	90.0	35.0	75.0	70.0	80.0	60.0	70.0	-	83.3	-	81.0
Number of Countries Ranked	2001	24	17	23	22	24	23	22	23	18	23	22	23	22	22	25
	2002	24	21	24	23	24	24	22	24	19	24	23	24	23	22	25
	2003	25	19	24	23	25	25	24	24	19	24	23	24	23	23	27
	2004	26	18	25	23	24	24	24	24	19	25	25	25	24	23	26
	2005	26	19	24	23	25	25	24	25	19	25	24	25	24	24	27
	2006	25	19	24	23	25	25	24	24	19	25	24	25	23	22	25
	2007	27	19	24	23	27	27	25	24	20	25	25	25	24	23	27
	2008	21	14	21	19	20	20	20	20	15	20	20	19	18	17	21

Table 3.15: U.S. Patents (OECD Patent Database)

Year	Percent of Total Patents	Total Patents Ranked (Percentile)	Patents per Capita Rank (Percentile)	Number of Countries Ranked
1999	32.6%	97.9%	85.1%	47
2000	30.7%	95.8%	83.3%	48
2001	31.3%	95.8%	83.3%	48
2002	32.4%	97.9%	87.2%	47
2003	32.9%	97.9%	87.2%	47
2004	34.3%	97.8%	89.1%	46
2005	37.9%	97.9%	93.8%	48
2006	40.6%	97.7%	93.0%	43
2007	37.6%	94.1%	88.2%	34

3.3 World Bank

The World Bank assists developing countries in financial and technical matters; however, it is not a bank in the traditional use of the term. It constitutes two institutions owned by 187 member countries: the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA). The World Bank provides low-interest loans, interest-free credits, and grants to developing countries to invest in education, health, public administration, infrastructure, financial and private sector development, agriculture, and environmental and natural resource management. It also provides international data on various topics, including science and technology. The sources used to assemble this data includes the UNESCO Institute for Statistics, the U.S. National Science Board, the UN Statistics Division, the International Monetary Fund, and the World Intellectual Property Organization.[60]

As seen in Table 3.16, the U.S. ranks above the 85th percentile for all 2000-2009 science and technology indicators shown with many indicators being above the 95th percentile. The table also shows that the U.S. has the largest number of nonresident patent applications and the 2nd largest number of resident applications (third largest for 2009) during the same time period with Japan having the largest. In per capita terms, the U.S. had the 4th largest number of resident applications in 2000 and the 3rd largest for 2001 to 2009. The U.S. maintains the largest number of scientific and technical journal articles[61] between 2000 and 2007; however, it ranks between 12th and 15th in per capita terms. Although these statistics do not directly measure research and development or innovation performance, it provides a proxy for comparing the U.S. to nations abroad.

[60] World Bank. *World Development Indicators.* Washington DC, World Bank, 2011. <http://www.worldbank.org/>

[61] Scientific and technical journal articles are from journals classified by the Institute for Scientific Information. Specifically, it is from their Science Citation Index and Social Science Citation Index. Articles with authors from different countries are allocated proportionately. World Bank. *World Development Indicators.* Washington DC, World Bank, 2011. 314-317.

Table 3.16: U.S. Science and Technology Indicators, Percentile (World Bank)

	Indicator Name	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Percentile	Patent applications, nonresidents	98.9	98.9	98.8	98.8	98.9	98.9	98.8	98.7	98.7	98.1
	Patent applications, residents	97.8	97.5	97.6	97.5	97.5	97.7	97.5	97.3	97.2	94.3
	Patent applications per capita, nonresidents	87.8	88.8	88.2	88.1	87.8	88.8	87.1	88.5	86.7	90.7
	Patent applications per capita, residents	95.5	96.3	96.4	96.3	96.3	96.5	96.3	95.9	95.8	94.3
	Research and development expenditure (% of GDP)	94.5	92.8	94.6	93.3	92.2	92.0	91.0	91.9	88.2	-
	Researchers in R&D (per million people)	94.2	91.4	93.7	91.0	90.9	87.0	87.3	-	-	-
	Royalty and license fees, payments (BoP, current US$)	98.2	98.3	98.4	98.4	98.4	98.5	98.4	98.5	97.7	97.4
	Royalty and license fees, receipts (BoP, current US$)	98.9	98.9	99.0	99.0	99.0	99.0	99.0	99.1	99.1	98.9
	Scientific and technical journal articles	99.4	99.4	99.4	99.4	99.4	99.4	99.5	99.5	-	-
	Scientific and technical journal articles per capita	93.0	93.1	92.4	92.0	92.1	91.4	92.2	92.0	-	-
Total Number of Countries Ranked	Patent applications, nonresidents	90	89	85	84	90	89	85	78	75	54
	Patent applications, residents	89	81	83	81	81	86	81	74	72	53
	Patent applications per capita, nonresidents	90	89	85	84	90	89	85	78	75	54
	Patent applications per capita, residents	89	81	83	81	81	86	81	74	72	53
	Research and development expenditure (% of GDP)	73	83	93	90	90	88	78	74	34	0
	Researchers in R&D (per million people)	52	58	63	67	66	69	63	57	30	0
	Royalty and license fees, payments (BoP, current US$)	114	115	124	126	129	131	129	131	133	115
	Royalty and license fees, receipts (BoP, current US$)	90	91	97	97	98	98	105	107	107	94
	Scientific and technical journal articles	178	178	179	179	181	179	186	182	0	0
	Scientific and technical journal articles per capita	172	173	172	175	177	174	179	176	0	0

3.4 International Comparative Indices

A number of organizations assemble and publish comparative indices on national economies and manufacturing activities. These include UNIDO, the World Economic Forum, and the World Bank to name a few. These indices can be used to gain additional insight into the U.S. economy and the manufacturing industry. Data from some of the primary indices are discussed below. Many of the issues covered by these indices bleed into the category of the environment in which the manufacturing industry must operate rather than the trends and current state of manufacturing. However, these indices provide an international comparison of industry performance, labor productivity, and innovation among other things, providing a quantitative depiction of items related to the U.S. manufacturing industry.

UNIDO's Competitive Industrial Performance Index (CIP): The CIP index uses four variables to benchmark industrial activity at the country level. These variables include manufacturing value added per capita, manufacturing exports per capita, industrialization intensity (simple average of the share of manufacturing value added in gross domestic product and the share of medium and high-technology activities in manufacturing value added), and export quality (simple average of the share of manufactured exports in total exports and the share of medium and high-technology activities in manufactured exports).[62]

[62] UNIDO. "Industrial Development Scoreboard: Technical Notes." <http://www.unido.org/index.php?id=5058>

In 2003, Singapore was ranked number one in the Competitive Industrial Performance Index followed by Ireland, Switzerland, Japan, Belgium, Sweden, Finland, Germany, Korea, Taiwan Province, and France. The United States was ranked 12th or around the 90th percentile, as seen in Table 3.17. In terms of manufactured value added per capita, the U.S. ranked just below the 90th percentile in 2003. The lowest ranking for the U.S. is its rank in the share of manufacturing value added in gross domestic product (GDP), which was below the 60th percentile in 2003. With the exception of this category, the U.S. ranked above the 70th percentile for all categories for all years.

Table 3.17: U.S. Competitive Industrial Performance Index Rankings (121 countries ranked)

	Percentile			Number of Countries Ranked		
	1993	1998	2003	1993	1998	2003
Industrial Performance Index	91.0	91.5	90.0	100	118	120
Manufactured Value Added per Capita	90.9	90.1	89.3	121	121	121
Share of Manufacturing Value Added in GDP (Percentage)	55.4	59.5	53.7	121	121	121
Industrialization Intensity Indicator	92.6	93.4	90.1	121	121	121
Share of Medium- and High-tech Value Added in Total Manufacturing Value Added (Percentage)	93.3	96.6	94.1	120	119	119

World Economic Forum's Global Competitiveness Report: The Global Competitiveness Report is a yearly report published by the World Economic Forum that ranks the world's nations according to the Global Competitiveness Index. This report is commonly cited inreference to competitiveness issues. The ranking uses a weighted average of multiple components, which are categorized into 12 pillars of economic competitiveness: institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labor market efficiency, financial market development, technological readiness, market size, business sophistication, and innovation.[63] Each pillar includes subcategories and the most recent ranking included 139 countries. Although this index measures the economy as a whole, it does provide insight into areas related to manufacturing.

The overall 2010-2011 Global Competitiveness Index rank for the U.S. was 4th out of 139 countries. This is down from 2nd in 2009-2010 and 1st in 2008-2009. Figure 3.8 illustrates the rankings of the U.S. among the twelve pillars and the overall rank. The outer edge of the wheel represents a high ranking such as 1st or 2nd while the inner part represents a low ranking. Each spoke on the wheel has four tick marks representing 1st, 47th, 93rd, and 139th. Also included in this figure are nations that are the same countries listed in Table 3.2. These countries represent major U.S. trading partners, countries that are often considered competitors with the U.S., and nations that are similar to the U.S. Figure 3.8 is organized so that the overall rank is at the top followed by the 12 pillars in order from the highest ranking items for the U.S. to the lowest ranking items going in a clockwise fashion. The lowest ranking item is the macroeconomic environment and the highest ranking item is market size. The U.S. ranks 4th in innovation, 4th in labor market efficiency, and 17th in technological readiness.

[63] World Economic Forum. *The Global Competitiveness Report*. 2010-2011. <http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2010-11.pdf>

A more comprehensive table of the rankings is available in Appendix A. This table is organized into the twelve pillars and their subcategories ordered from highest ranking to lowest ranking. Subcategories ranking below the 70th percentile are highlighted in yellow and subcategories ranking below the 50th percentile are highlighted in red.

IMD World Competitiveness Center's World Competitiveness Yearbook: The International Institute for Management Development (IMD) is a non-profit business school in Switzerland that has gained international recognition. The World Competitiveness Yearbook is a product of IMD's World Competitiveness Center. The Yearbook is a ranking of nations based on their ability to create and maintain an environment where enterprises can compete. This environment is broken into 4 factors: economic performance, government efficiency, business efficiency, and infrastructure. Each of these factors is broken into 5 sub-factors for a total of 20, which are given equal weight in determining overall rank among the 59 countries evaluated. There are over 300 criteria used to determine the sub-factors. According to the Yearbook, the U.S. ranked 1st in overall competitiveness in 2011. It also ranked 1st in domestic economy and scientific infrastructure. Its ranking for technology infrastructure was 2nd. A complete ranking of the U.S. and a selection of nations is available in Appendix B.

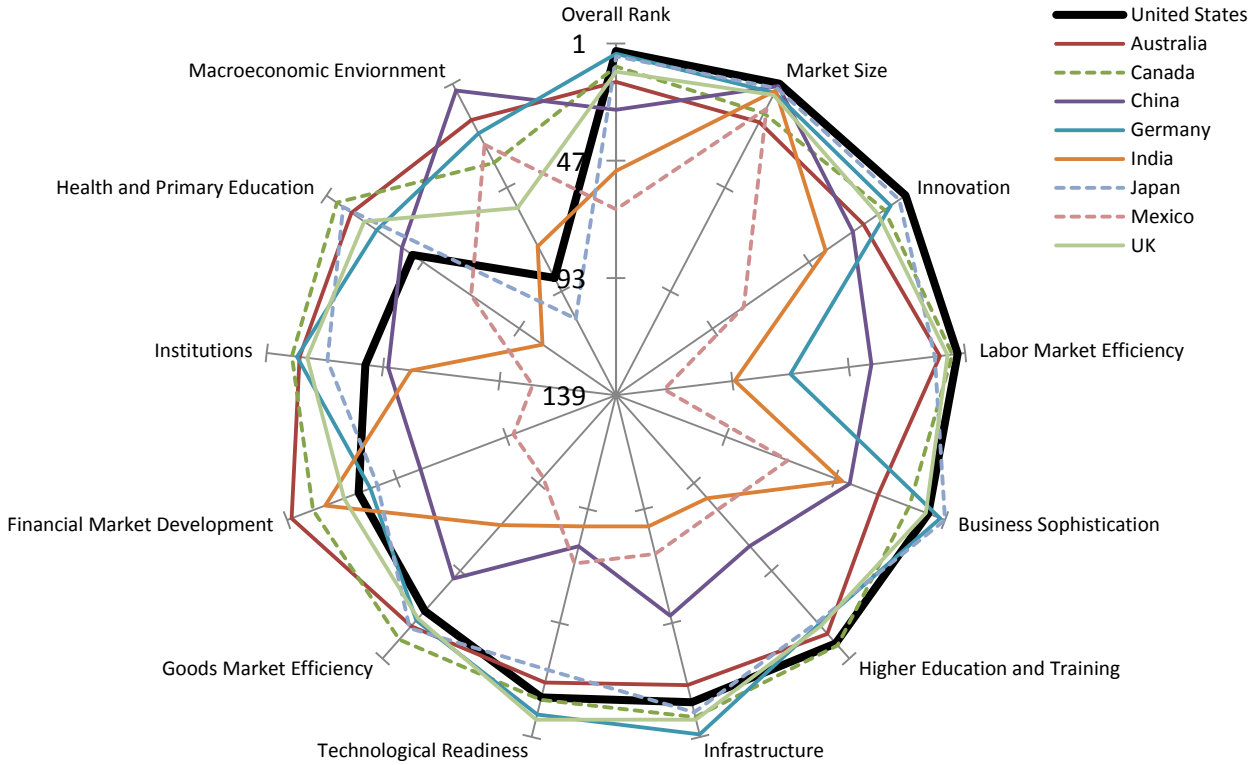


Figure 3.8: Global Competitiveness Index Ranking (139 countries) by Category, 2010-2011
Note: The outer edge of the wheel represents a high ranking such as 1st or 2nd while the inner part represents a low ranking. Each spoke on the wheel has four tick marks representing 1st, 47th, 93rd, and 139th.

4 Domestic Data

This chapter presents data on the domestic U.S. manufacturing industry. The international data provided valuable context to the U.S. industry; however, more exhaustive data is available on the U.S. industry alone. These details include goods and services used by the industry; trends in subsector value added, net income, employment, and compensation; and subsector research and development expenditures. These items each contribute to depicting the U.S. manufacturing industry by providing more detailed information than is provided through international data.

As previously discussed, a successful industry might be considered one that has a suitable magnitude of production that results in competitive net benefits for its stakeholders. It is on this basis, to examine net benefits of U.S. stakeholders, that data was selected to be incorporated into this chapter. The data includes the total manufacturing value added, net income, compensation, and employment among other things. Although there are a number of sources for data, a few of them provide considerably more detail than others. The sources of data to be examined in this chapter include the Census Bureau; Bureau of Economic Analysis; Bureau of Labor Statistics; and the National Science Foundation. These are some of the most cited sources of domestic manufacturing data available. The Annual Survey of Manufactures from the Census Bureau provides detailed subsector data on value added, shipments, net income, depreciation of assets, compensation, and goods and services purchased by the manufacturing industry. It is among the most comprehensive datasets on the industry. The Census Bureau also provides shipment data through its Manufacturers' Shipments, Inventories, and Orders Survey. The Bureau of Economic Analysis provides a detailed accounting of manufacturing activity through its Annual Industry Accounts, including value added by industry and input-output data. This data provides a detailed account of the intermediate goods and services used by each subsector of the manufacturing industry. The Bureau of Labor Statistics provides data related to the compensation of employees, including employment, productivity, and wages. Finally, the National Science Foundation provides data on research and development expenditures, which reflects the advancement of the manufacturing industry. Each dataset in this chapter provides indispensable data relating to the net benefits received by manufacturing stakeholders.

4.1 Census Bureau

The Census Bureau has played a central role in tracking U.S. economic and demographic information since 1902 when it officially "opened its doors." The mission of the organization is "to serve as the leading source of quality data about the nation's people and economy." The Bureau provides three datasets relating to manufacturing activity: the Annual Survey of Manufactures, Economic Census, and the Manufacturers' Shipments, Inventories, and Orders Survey.

4.1.1 Annual Survey of Manufactures and the Economic Census

The Annual Survey of Manufactures (ASM) is conducted every year except for years ending in 2 or 7 when the Economic Census is conducted. The ASM provides statistics on employment, payroll, supplemental labor costs, cost of materials consumed, operating expenses, value of shipments, value added, fuels and energy used, and inventories. It uses a sample survey of approximately 50 000 establishments with new samples selected at 5-year intervals. The ASM data allows the examination of multiple factors (value added, payroll, energy use, and more) of manufacturing at a detailed subsector level. The Economic Census, used for years ending in 2 or 7, is a survey of all employer establishments in the U.S. that has been taken as an integrated program at 5-year intervals since 1967. Both the ASM and the Economic Census use NAICS classification; however, prior to NAICS the Standard Industrial Classification system was used.[64]

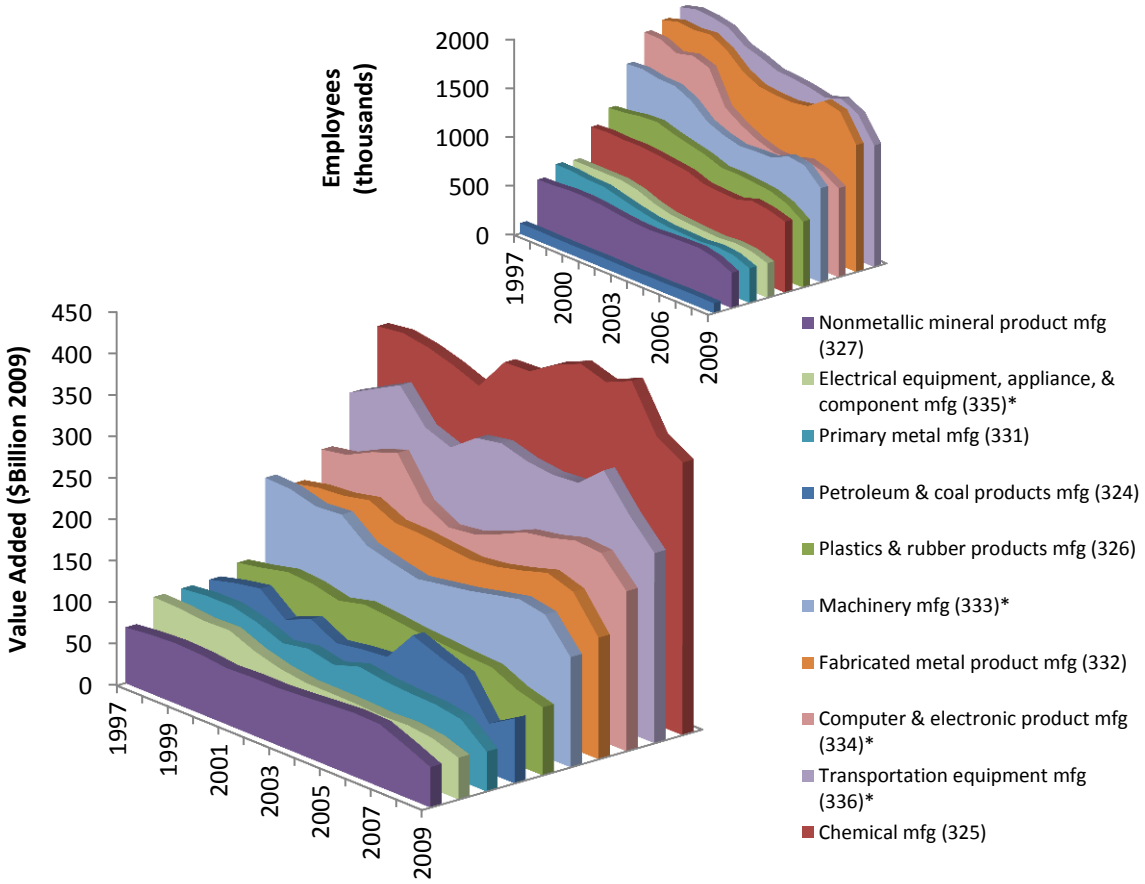
In 2009, the total value of shipments in manufacturing was $4.44 trillion. This figure represents the net selling value of products sold, transferred, or shipped on consignment. These products were made by or for an establishment (an establishment is a single physical location where manufacturing is conducted; this should not be confused with an enterprise or company) from material owned by the establishment. The figure for shipments requires careful interpretation as it includes the sale of intermediate as well as finished goods, which results in counting the value of some products twice. For instance, the value of an alternator for a car may be counted once when it is shipped to an auto assembly plant and once when the finished car is sold. The total value added is the best measure available for comparing the relative economic importance of manufacturing among other industries. Value added is equal to the value of shipments less the cost of materials, supplies, containers, fuel, purchased electricity, and contract work. It is adjusted by the addition of value added by merchandising operations plus the net change in finished goods and work-in-process goods. Value added avoids the duplication caused from the use of products of some establishments as materials. It is important to note that the BEA and the ASM calculate value added differently. The BEA calculates value added as "gross output (sales or receipts and other operating income, plus inventory change) less intermediate inputs (consumption of goods and services purchased from other industries or imported)."[65] Moreover, the difference is that ASM's calculation of value added includes purchases from other industries such as mining and construction while BEA's does not include it.

The ASM value added for all manufacturing was $1 978.0 billion in 2009. Approximately 9.8 % of this value is computer and electronic product manufacturing as can be calculated from the data in Table 4.1. This sector increased 15.5 % from $214.3 billion in 1997 to $247.6 billion in 2000. During the early 2000's recession it declined to a low of $182.9 billion in 2002, but increased until the late 2000's recession as illustrated in Figure 4.1. It is important to note that the values in this figure were adjusted using the producer price index for each industry (sectors 333, 334, 335, and 336 were estimated for

[64] Census Bureau. "Annual Survey of Manufactures." < http://www.census.gov/manufacturing/asm/>
[65] Horowitz, Karen J. and Mark A. Planting. *Concepts and Methods of the U.S. Input-Output Accounts.* Bureau of Economic Analysis. 2006.

1997 to 2002 using an average rate of change between 2003 and 2009). The selection of a price index is particularly important for sector 334 as the prices of computer and electronic products have declined while most other prices have increased. This sector is considered to be the high-tech manufacturing sector.[66] If an increasing price index were used to adjust sector 334, it would appear as though the industry were in a constant decline. This is also the case for the semiconductor and related device manufacturing sector in Figure 4.2. This issue is complicated by uncertainty in the accuracy of the price

Figure 4.1: Value Added and Employment for Select Manufacturing Subsectors, Annual Survey of Manufactures (adjusted using industry specific PPI)



* The 1997 to 2002 PPI was estimated using the average annual price change between 2002 and 2009
Note: NAICS 311-323 (food, beverage, textile, apparel, paper, and printing), 337 (furniture and related products), and 339 (miscellaneous manufacturing) were omitted in order to allow a more detailed view of sectors related to medium- and high-tech manufacturing

[66] Kelley, Charles, Mark Wang, Gordon Bitko, Michael Chase, Aaron Kofner, Julia Lowell, James Mulvenon, David Ortiz, and Kevin Pollpeter. "High-Technology Manufacturing and U.S. Competitiveness." RAND Technical Report. March 2004. <http://www.rand.org/pubs/technical_reports/2004/RAND_TR136.pdf>

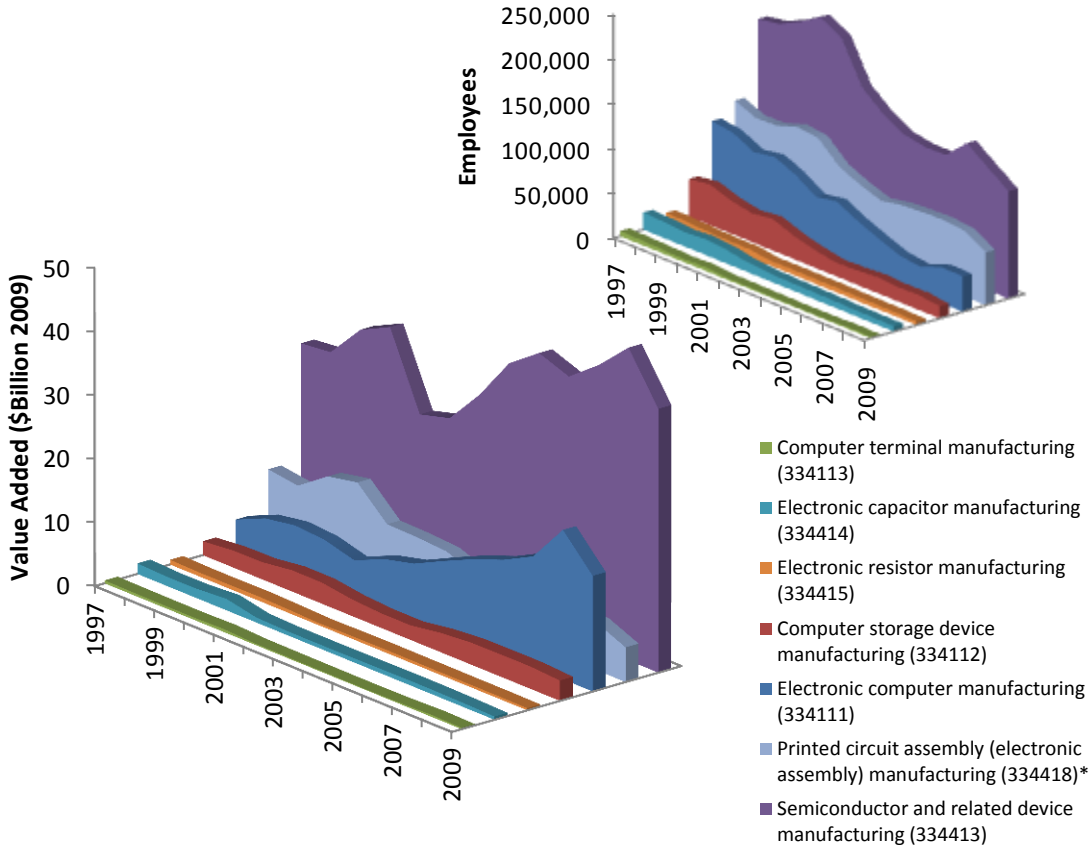
Table 4.1: Subsectors of Manufacturing, Annual Survey of Manufactures 2009

NAICS		Number of Employees	Compensation, Payroll and Benefits ($1000)	Value Added ($1000)	Net Income ($1000)	Compensation per Employee ($1000)	Value Added per Employee ($1000)	Net Income per Employee ($1000)	Net Income per Expenditure Dollar
311-323	Food, beverages, textiles, apparel, paper, and printing mfg	3 124 186	156 465 345	511 953 541	213 288 376	50.1	163.9	68.3	0.24
324	Petroleum & coal products mfg	101 559	11 218 562	78 558 603	23 661 442	110.5	773.5	233.0	0.05
325	Chemical mfg	724 683	62 223 691	328 870 852	181 231 086	85.9	453.8	250.1	0.43
326	Plastics & rubber products mfg	672 794	35 422 443	82 294 714	17 425 905	52.6	122.3	25.9	0.12
327	Nonmetallic mineral product mfg	360 426	20 716 516	48 899 753	8 520 169	57.5	135.7	23.6	0.11
331	Primary metal mfg	354 831	24 746 316	48 169 964	-4 420 471	69.7	135.8	-12.5	-0.03
332	Fabricated metal product mfg	1 296 600	73 269 815	146 876 281	28 875 280	56.5	113.3	22.3	0.12
333	Machinery mfg	962 083	63 539 945	133 056 578	24 575 525	66.0	138.3	25.5	0.10
334	Computer & electronic product mfg	908 299	76 790 501	193 242 334	51 326 615	84.5	212.8	56.5	0.19
335	Electrical equipment, appliance, & component mfg	352 940	21 800 021	50 498 178	13 768 429	61.8	143.1	39.0	0.16
336	Transportation equipment mfg	1 240 320	97 895 792	229 642 082	65 962 477	78.9	185.1	53.2	0.14
337	Furniture & related product mfg	360 210	15 968 585	32 235 361	5 710 641	44.3	89.5	15.9	0.11
339	Miscellaneous mfg	592 410	35 502 295	93 719 105	29 925 935	59.9	158.2	50.5	0.27
31-33	TOTAL Manufacturing	11 051 341	695 559 827	1 978 017 346	659 851 409	62.9	179.0	59.7	0.18

NAICS		Total Value of Shipments ($1000)	Value of Production ($1000)	Total Cost of Materials ($1000)	Cost of Buildings and Structures ($1000)	Cost of Machinery and Equipment ($1000)	Other Costs ($1000)	Net Inventories ($1000)	Total Depreciation of Assets ($1000)
311-323	Food, beverages, textiles, apparel, paper, and printing mfg	1 126 141 857	881 701 643	610 779 377	10 066 479	25 426 153	78 964 289	-3 180 432	27 971 406
324	Petroleum & coal products mfg	497 875 474	467 291 734	419 743 225	2 110 750	16 212 310	18 006 887	480 910	7 403 208
325	Chemical mfg	628 945 803	425 708 250	296 725 926	5 527 042	17 979 903	43 251 688	-3 383 289	18 623 178
326	Plastics & rubber products mfg	171 185 548	145 963 337	87 355 685	2 176 701	5 144 301	15 864 207	-1 561 292	6 235 014
327	Nonmetallic mineral product mfg	90 395 938	75 662 944	40 196 667	1 012 045	3 871 031	9 866 685	-1 272 312	4 940 513
331	Primary metal mfg	168 297 912	162 676 210	115 973 007	1 476 227	6 917 667	13 562 993	-4 190 486	5 851 687
332	Fabricated metal product mfg	281 316 544	240 771 991	130 624 569	4 069 076	7 307 373	25 501 158	-3 833 336	7 835 937
333	Machinery mfg	287 634 198	253 369 592	151 115 284	3 244 628	6 531 819	28 937 916	-3 345 367	6 343 714
334	Computer & electronic product mfg	327 991 364	264 672 505	133 896 248	5 625 231	9 830 986	38 529 539	-719 347	11 272 897
335	Electrical equipment, appliance, & component mfg	106 650 713	88 655 438	54 562 019	1 108 437	2 473 749	8 711 212	-1 584 368	2 642 478
336	Transportation equipment mfg	545 018 370	469 077 710	319 871 616	3 795 734	11 197 690	36 316 878	4 167 802	14 145 985
337	Furniture & related product mfg	60 826 897	53 375 231	27 927 766	939 685	859 572	7 679 623	-596 674	1 144 351
339	Miscellaneous mfg	143 915 487	110 124 550	49 655 914	2 183 976	3 255 938	19 526 427	-562 405	3 302 597
31-33	TOTAL Manufacturing	4 436 196 105	3 639 051 135	2 438 427 303	43 336 011	117 008 492	344 719 502	-19 580 596	117 712 965

Note: The green bars represent a visual comparison between subsectors (listed in the left column) for each category (listed in the top row). Higher values have longer bars.

Figure 4.2: Value Added and Employment for Semiconductor and Other Computer Component Manufacturing



* The 1997 to 2002 PPI was estimated using the average annual price change between 2002 and 2009

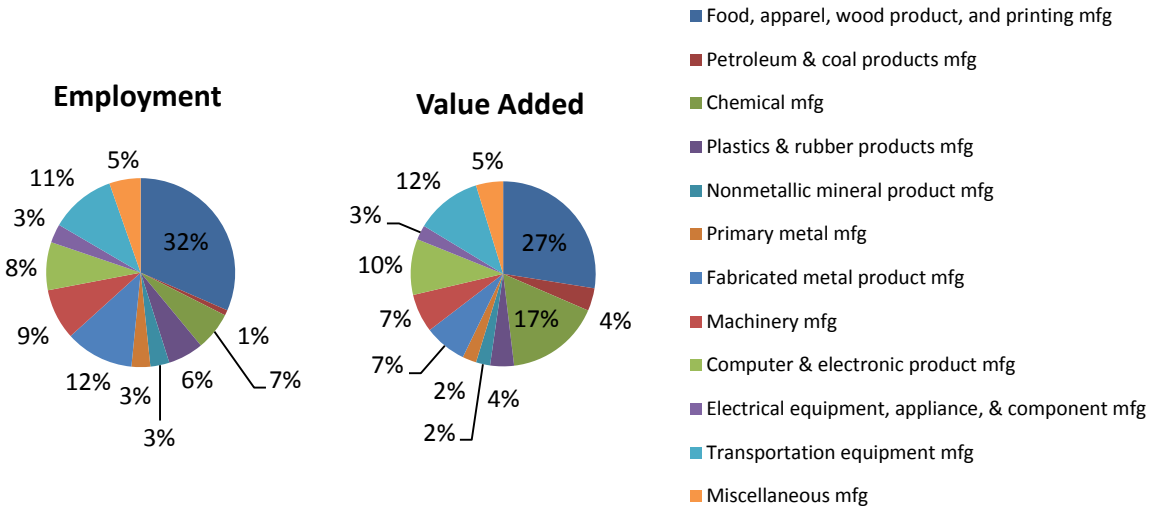
indices available. Research by Houseman et al[67] as well as Byrne et al[68] has brought into question the accuracy of price measurement and its effect on measuring value added. For the time being, the BLS price indices are the best available for broad examination of the manufacturing industry.

Employment in semiconductor and related device manufacturing, as seen in Figure 4.2, has experienced a significant decline as have a number of other sectors. During the 1997 to 2009 period employment declined for all sectors shown in Figure 4.1: petroleum and coal products declined 6 %; chemicals 18 %; plastics and rubber 34 %; nonmetallic mineral products 28 %; primary metals 41 %; fabricated metal 26 %; machinery 32 %; computer and electronic products 46 %; electrical equipment, appliance, and components 41 %; and transportation 33 %. As seen in Figure 4.3, each subsector's 2009 proportion

[67] Houseman, Susan, Christopher Kurz, Paul Lengermann, and Benjamin Mandel. "Offshoring and the State of American manufacturing." W.E. Upjohn Institute for Employment Research. June 2010 <http://www.upjohn.org/publications/wp/10-166.pdf>

[68] Byrne, David, Brian K. Kovak, and Bryan Michaels, "Offshoring and Price Measurement in the Semiconductor Industry." In Susan N. Houseman and Kenneth F. Ryder, eds., *Measurement Issues Arising from the Growth of Globalization*. (Washington, DC: National Academy of Public Administration, 2010): 169-194.

Figure 4.3: Manufacturing Employment and Valued Added, 2009



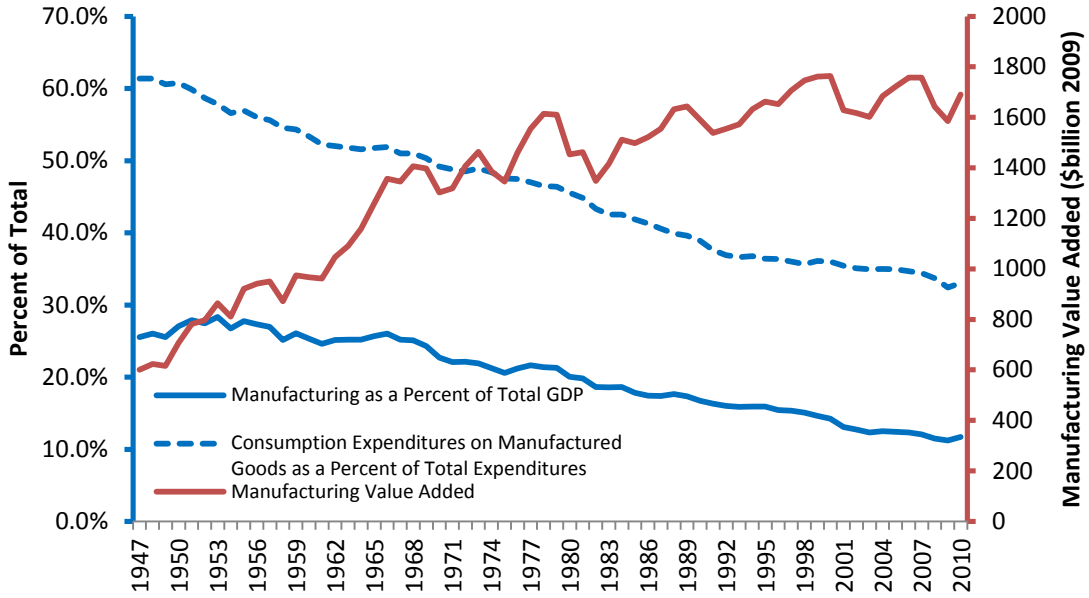
of employment and value added vary considerably. Computer and electronic manufacturing, for example, represents 8 % of employment but 10 % of value added. Chemical manufacturing represents 7 % of employment and 17 % of value added.

There has been some concern regarding the decline of manufacturing's share of GDP; however, this downward trend seems to pervade as far back as BEA data is available in 1947 through the manufacturing golden era of the 1950's and 1960's,[69] as seen in Figure 4.4. During the same time period, expenditures on manufactured goods as a share of total expenditures declined. These downward trends suggest that the recent decline in manufacturing's share of GDP is not the sole result of recent trends in offshoring manufacturing activity. During the same time period, manufacturing value added has had an upward trend. As discussed later in this report, employment as a share of total employment has also had a downward trend (with the exception of the World War II era) going back as far as 1919.

Broad data covering the entire manufacturing industry is shown in Table 4.1 while detailed 2009 data is available in Appendix C, which contains the number of employees, value added, total value of shipments, net income, and other metrics for chemical manufacturing (NAICS 325); machinery manufacturing (NAICS 333); computer and electronic products manufacturing (NAICS 334); electrical equipment, appliance, and component manufacturing (NAICS 335); and transportation equipment manufacturing (NAICS 336) along with all the subsectors. According to this data, semiconductor and other electronic components manufacturing (NAICS 3344) is 3.0 % of the manufacturing industry and has a net income per expenditure dollar ratio of 0.173. Net income is the total value of shipments less all costs, depreciation, and compensation. Similar to previous tables, the green colored bars in Table 4.1 provide a visual comparison between industries. Chemical manufacturing represents a large proportion of manufacturing net

[69] Hopp, Wallace J. and Mark L. Spearman *Factory Physics*. Third Edition. (Long Grove, IL: Waveland Press, 2011): 37-38.

Figure 4.4: Manufacturing as a Percent of GDP (BEA)



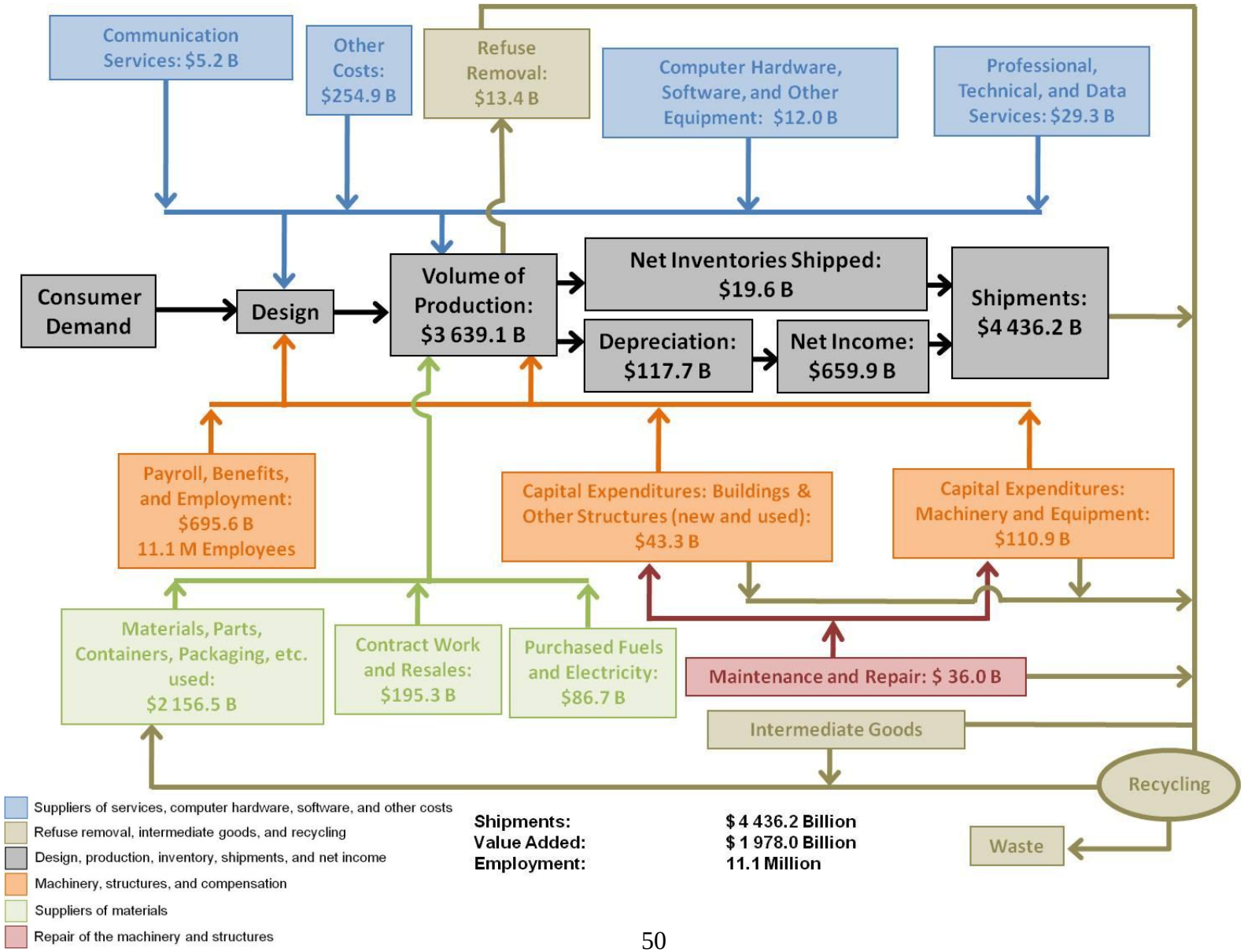
income and value added when compared to other manufacturing sectors. It also maintains the highest net income per expenditure dollar. Petroleum and coal products manufacturing has the highest compensation per employee as well as the highest value added per employee. The value of production is the sum of all costs, including compensation. Sectors 311-323 have the largest value of production followed by transportation (336) and petroleum and coal (324). Net inventories is the sum of all end of year inventories less the sum of all the beginning of year inventories. Inventories need to be accounted for, as some sales are due to products produced in previous years.

Figure 4.5 brings together manufacturing data in a diagram of the manufacturing industry supply chain. The net income for all manufacturing is $777.6 billion. The total value of production is $3 639.1 billion with $43.4 billion for buildings. The items in blue represent purchased services, computer hardware, software, and other costs. Gold represents refuse removal, intermediate goods, and recycling while orange represents machinery, structures, and compensation with red being the repair of the machinery and structures. Green represents the total cost of materials. These items all feed into the design and production of goods that are inventoried and/or shipped. Purchased objects such as structures and computer equipment depreciate as shown in grey.

4.1.2 Manufacturers' Shipments, Inventories, and Orders Survey

The Manufacturers' Shipments, Inventories, and Orders survey provides monthly statistical data on current economic conditions and future production commitments in manufacturing. It includes establishments with $500 million or more in annual shipments. The survey has been conducted monthly since 1957. Data in NAICS format are only available from 1992 onwards. Data between 1958 and 2000 is available in SIC format. Although these data provide information on inventories and orders, this report focuses on

Figure 4.5: Manufacturing Industry Supply Chain, 2009

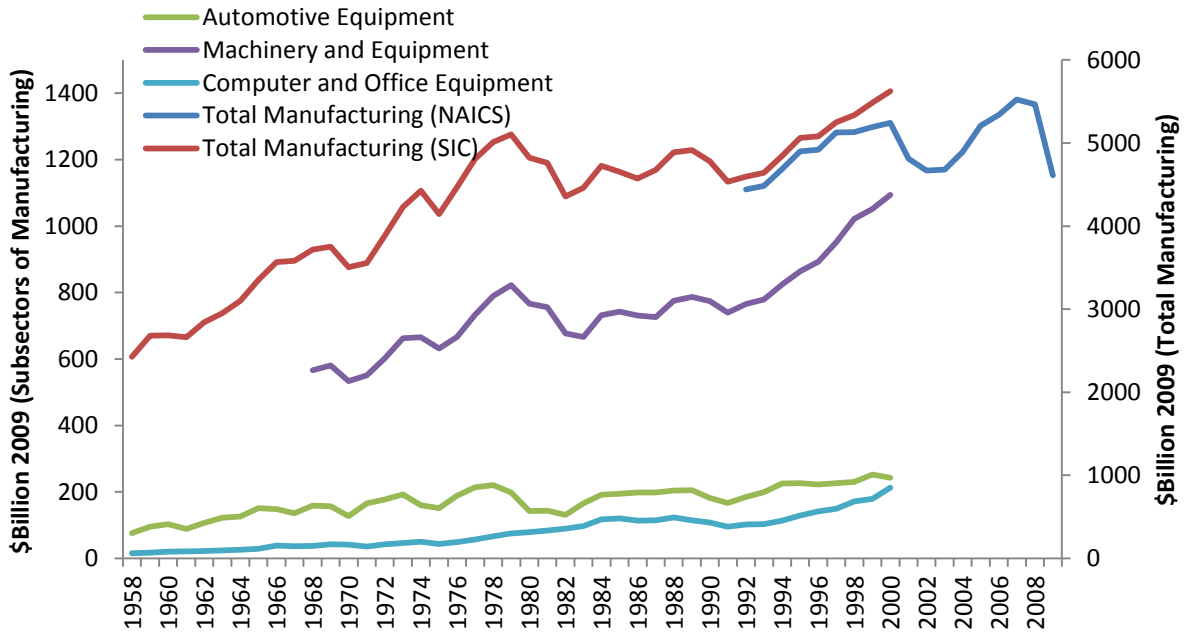


shipments. These data are more consistent with the annual survey of manufactures and BEA data, which also track shipments.[70]

As seen in Figure 4.6, manufacturing shipments have varied between 1958 and 2000; however, these have a general upward trend. Machinery and equipment as well as computer and office equipment manufacturing also appears to have a general upward trend as well. Automotive equipment seems to be increasing slightly. Although this figure is adjusted using the CPI for all goods and therefore does not accurately represent changes in the physical volume of production, it is the best representation possible since the PPI is not available for the same time span. The consumer price index has a strong upward trend with the exception of the 2008-2009 period where it decreased slightly. As mentioned previously, some products have decreased in price; these include computer and electronic products. It is possible, therefore, that shipments of computer and office equipment in Figure 4.6 have increased more rapidly than otherwise shown.

As seen in Figure 4.7, food, apparel, wood product, and printing manufacturing represents a significant proportion of the manufacturing industry, which is consistent with previous data sets discussed. In 2009, it represented 26 % of manufacturing (see pie charts in Figure 4.7); this is down from 31 % in 1992. With the exception of food, apparel, wood product, and printing manufacturing, data was adjusted using sector specific PPI. As noted in the figure, sectors 333, 334, 335, 336 were adjusted using related subsectors. These PPI values were used because the PPI for the listed sector is available only for 2003 onwards. The pie charts were generated using unadjusted data so

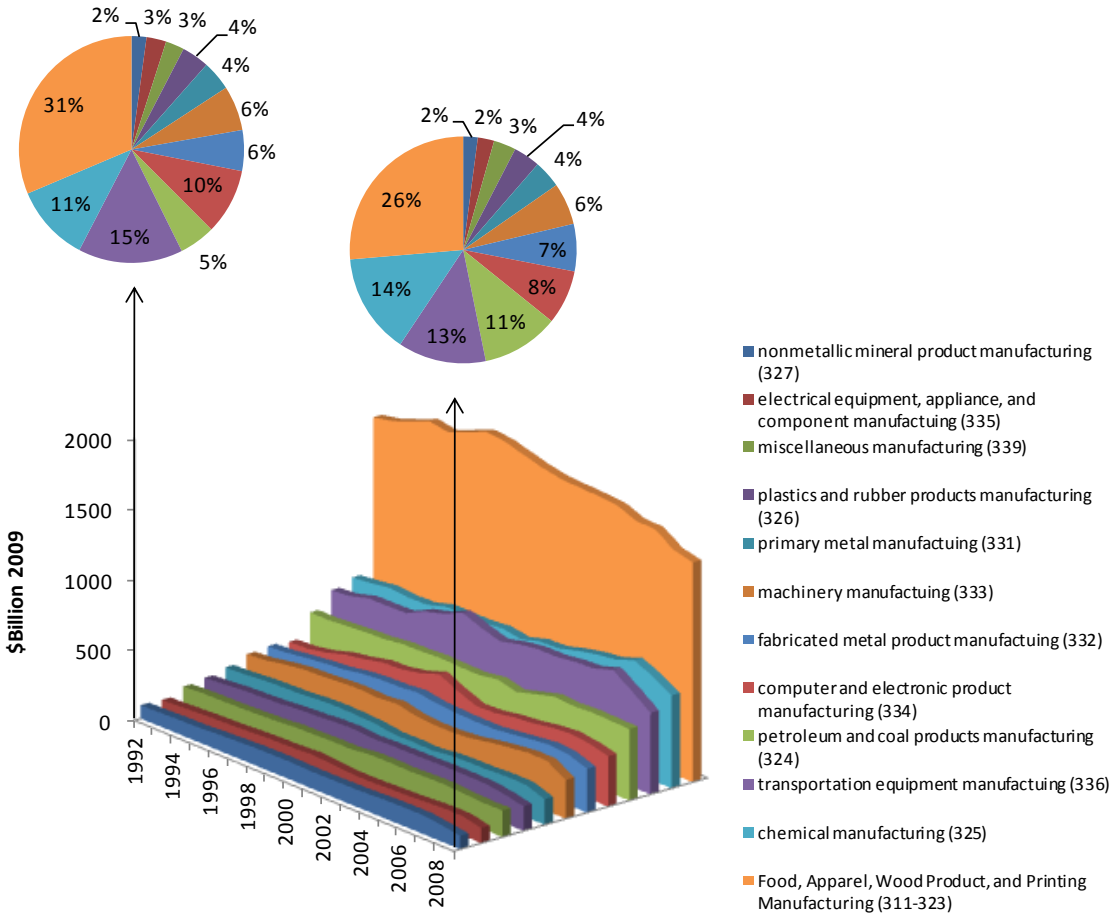
Figure 4.6: Manufacturing Shipments, 1958-2000 (Manufacturers' Shipments, Inventories, and Orders Survey)



Note: Adjusted using the Consumer Price Index.

[70] Census Bureau. "Manufacturers' Shipments, Inventories, and Orders." <http://www.census.gov/manufacturing/m3/>

Figure 4.7: Manufacturing Shipments, 1992-2009 (Manufacturers' Shipments, Inventories, and Orders Survey)



* Sectors 333, 334, 335, and 336 were adjusted using the PPI for sectors 3332, 3342, 3352, and 336991
Note: Pie charts were created using unadjusted data

as to maintain proportional relationships. Computer and electronic product manufacturing represents 8 % of manufacturing shipments down from 10 % in 1992. This decline may be due to changes in the price of computer and electronic product manufacturing and not due to a decline in the volume of physical production. This industry grew by 47 % between 1992 and 2009, faster than any other industry shown in Figure 4.7. Transportation equipment manufacturing; machinery manufacturing; and electrical equipment, appliances, and component manufacturing represent 13 % (down from 15 % in 1992), 6 % (the same as 1992), and 2 % (down from 3 % in 1992), respectively. These industries grew 10.5 %, 14.0 %, and 19.4 %, respectively.

4.2 Bureau of Economic Analysis

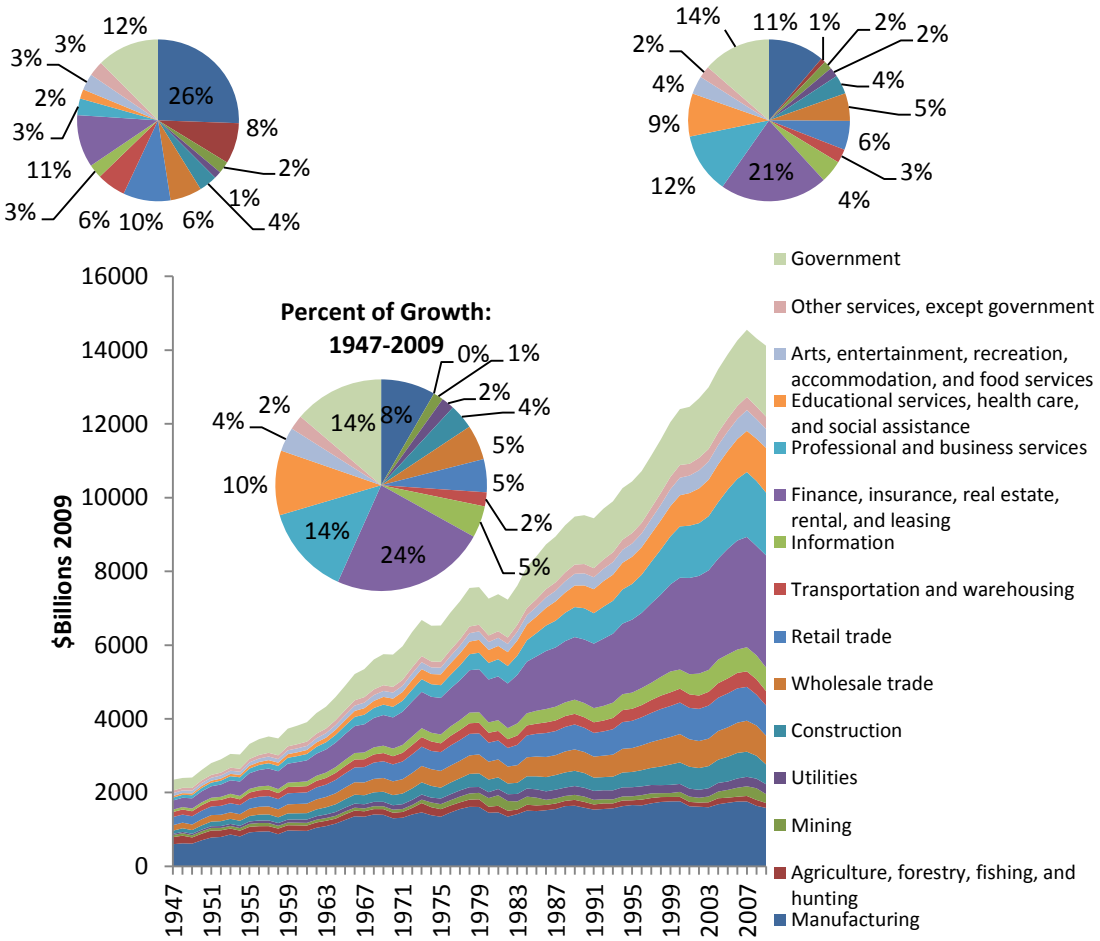
The Bureau of Economic Analysis (BEA) is an entity of the Department of Commerce that produces national, regional, and industry data that depict economic growth and

interindustry relationships.[71] This report utilizes two BEA data sets: gross domestic product by industry and the input-output accounts. The GDP by industry accounts provide estimates of value added by industry, which is defined as gross sales (sales or receipts and other operating income, commodity taxes, and inventory change) less intermediate inputs (energy, raw materials, semi-finished goods, and purchased services). The BEA input-output data provides data on the interrelationships between industries. It provides data on how industries provide inputs and use outputs from each other to produce final goods and services to the end user. The Leontief input-output model provides a framework for utilizing BEA's input-output data; however, the data must be modified to be used in this type of analysis.

4.2.1 Production

BEA GDP by industry is available from 1947 to 2009; however, as discussed previously the producer price index is not available prior to 1985. Therefore, the consumer price index is used to adjust the values in Figure 4.8. As illustrated in this figure, U.S. GDP

Figure 4.8: U.S. GDP by Industry ($billions 2009), BEA

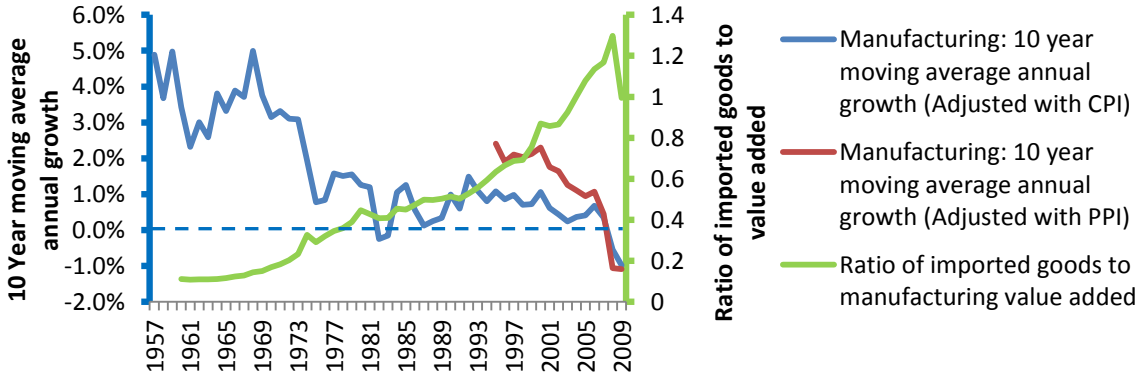


[71] Bureau of Economic Analysis. "U.S. Economic Accounts." <http://www.bea.gov/>

grew 501 % between 1947 and 2009 while manufacturing grew 164 %. As seen in Figure 4.9, manufacturing's average annual ten year growth (10 year moving average) has declined from around 5 % in 1957 to -1 % in 2009. During nearly the same period, the ratio of imported goods to manufacturing value added has increased from 0.11 in 1960 to 0.99 in 2009. Since manufacturing grew slower than the whole of the U.S. economy, it went from representing 26 % of GDP to 11 % of GDP (see Figure 4.8). Manufacturing represented 8 % of growth while the largest growth sector was the finance, insurance, real estate, rental, and leasing sector with real estate representing the majority of this growth. The fastest growing sector was the educational services, health care, and social assistance sector followed by the professional and business services sector, growing 2641 % and 2083 %. Approximately 63 % of the professional and business services sector is professional, scientific, and technical services such as computer system design. Although the finance, insurance, real estate, rental, and leasing sector accounted for a larger percent of growth, it was the third fastest growing sector at 1134 %. With other industries growing faster and the real estate industry having grown to be larger than the whole of the manufacturing industry, it is important to note that in a world of limited and scarce resources that the growth of one industry may result in a decline in another industry. That is, resources might be diverted from one industry to be invested into another industry.[72] It is also interesting to note that although real estate has grown by 148 % between 1977 and 2009, construction has only grown by 64 %. That is, the real estate industry is growing at a rapid rate while the constructed part of real estate seems to be changing a bit slower. Manufacturing value added as a ratio of shipments, as seen in Figure 4.10, provides a proxy for tracking U.S. activities involved in producing manufactured goods. As seen in the figure, this ratio has varied somewhat over time dipping during or near times of recession. Note that there was a recession in 1973-1975, 1980, 2001, and 2007-2009 during which times the ratio dips and recovers.

Food, apparel, wood product, and printing manufacturing made up 29 % of manufacturing in 1977, as seen in Figure 4.11. It is important to note that this figure was adjusted using the consumer price index; therefore, it maintains proportional relationships

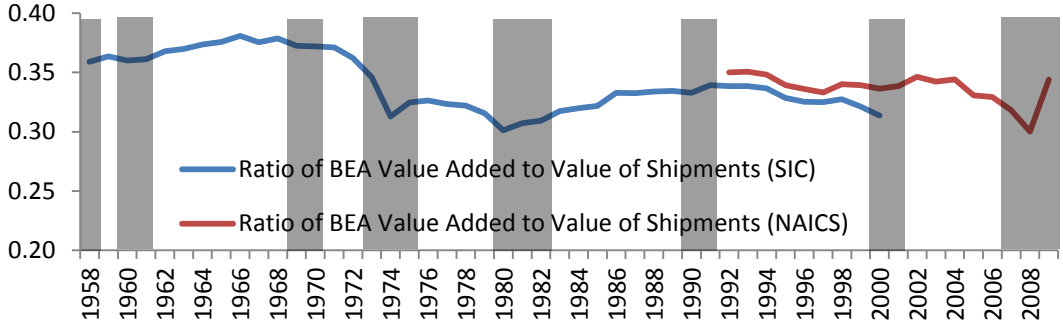
Figure 4.9: 10 Year Moving Average of Annual Growth in the Manufacturing Industry and Ratio of Imported Goods to Manufacturing Value Added



[72] National Public Radio. "Stopping the 'Brain Drain' of the U.S. Economy." February 6, 2012. <http://www.npr.org/2012/02/05/146434854/stopping-the-brain-drain-of-the-u-s-economy?ft=1&f=100>

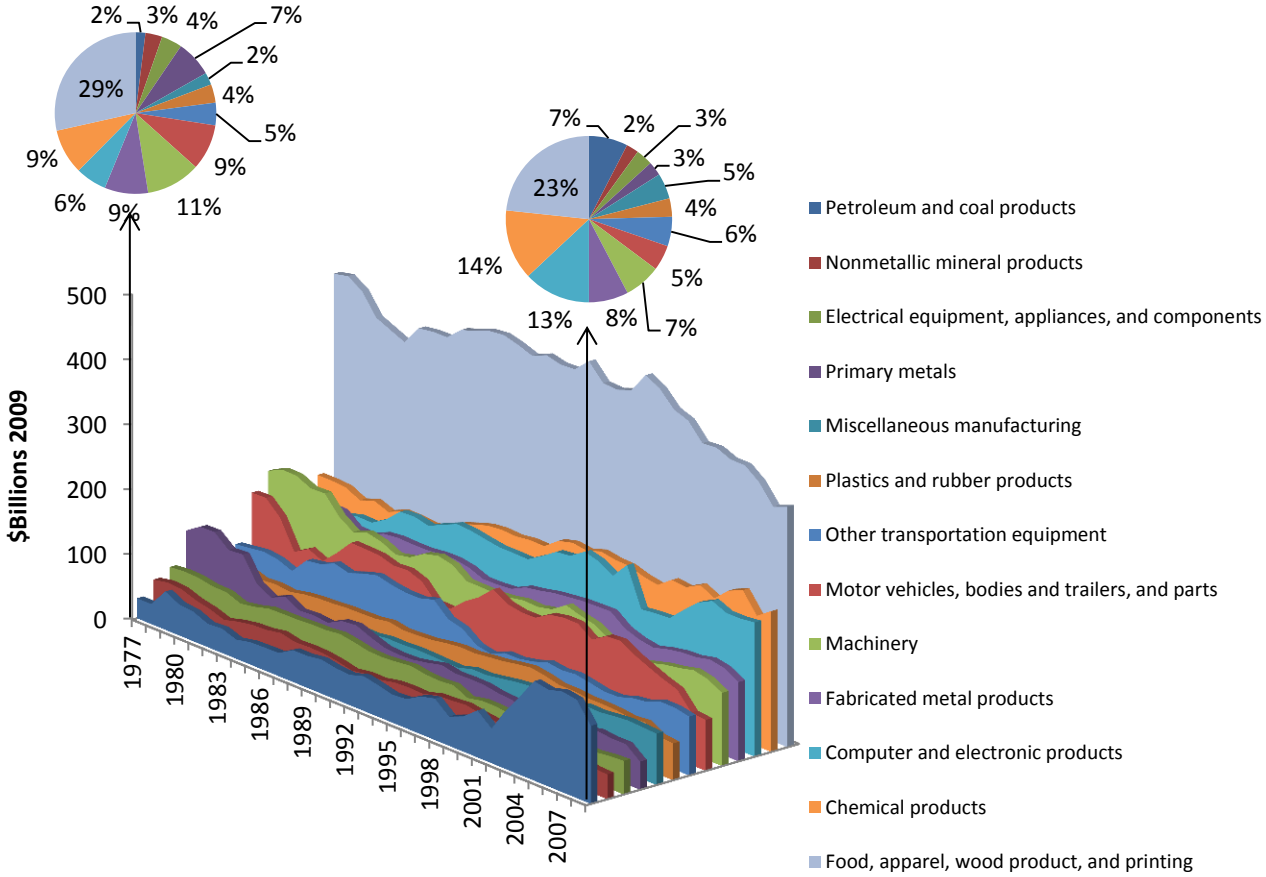
but does not reflect changes in the physical volume of production over time. For example, comparing computer and electronic products manufacturing in Figure 4.11 with that of Figure 4.12, which uses the PPI for each industry, reveals that using the CPI for all items makes it appear that this industry declined 3.7 % between 2000 and 2009. According to

Figure 4.10: Ratio of BEA Value Added to Shipments from the Manufacturers' Shipments, Inventories, and Orders Survey



Note: Periods of recession are shown in grey.

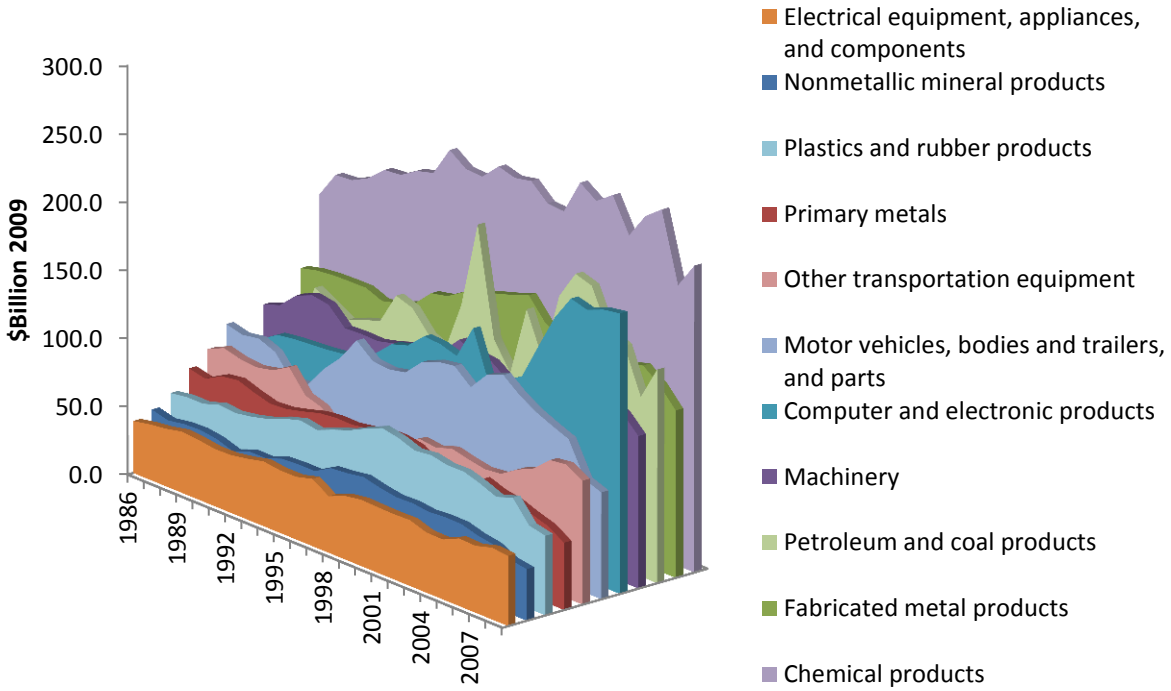
Figure 4.11: Manufacturing GDP (BEA), 1977-2009



Note: Adjusted using the CPI for All Items

Figure 4.12, however, the industry grew by 36.2 % because of enhanced productivity. There is also a marked difference in petroleum and coal product manufacturing. Computer and electronic products represented 13 % of manufacturing in 2009 up from 6 % in 1977 and 12 % in 2000 (not shown in Figure 4.11). Machinery was 7 % in 2009, down from 11 % in 1977 and 8 % in 2000 (not shown in Figure 4.11). The manufacturing of motor vehicles, bodies and trailers, and parts was 5 % in 2009 down from 9 % in 1977 and 8 % in 2000 (not shown in Figure 4.11). As discussed in the next section, according to Figure 4.12, which contains data adjusted using the PPI by industry, the computer and electronic product manufacturing industry grew by 36.2 % between 2000 and 2009. During this period, only the petroleum and coal products industry grew faster at 41.9 %. Between 1986 and 2009 computer and electronic products manufacturing grew 182.5 %, the largest growth of all manufacturing industries shown. Petroleum and coal were the second largest at 101.8 %. During this same period, motor vehicle, bodies and trailers, and parts manufacturing declined 12.7 %; however, most of this decline occurred between its peak in 2003 and 2009 where it declined 42.1 %.

Figure 4.12: Selected Manufacturing Industries GDP by Industry (BEA), 1986-2009



Note: Adjusted using the PPI by subsector

4.2.2 Input-Output Accounts

Annual input-output data is available from the BEA for the years 1998 through 2009. Prior to 1998, the data is available for every fifth year starting in 1967. There is also data available for the years 1947, 1958, and 1963. More detailed data is available for years ending in two or seven. The input-output accounts provide data to analyze inter-industry relationships.

BEA input-output data is provided in the form of make and use tables. Make tables show the production of commodities (products) by industry. Use tables show the components required for producing the output of each industry. There are two types of make and use tables: "standard" and "supplementary." Standard tables closely follow NAICS and are consistent with other economic accounts and industry statistics, which classify data based on establishment. Note that an "establishment" is a single physical location where business is conducted. This should not be confused with an "enterprise" such as a company, corporation, or institution. Establishments are classified into industries based on the primary activity within the NAICS code definitions. Establishments often have multiple activities. For example, a hotel with a restaurant has income from lodging, a primary activity, and from food sales, a secondary activity. An establishment is classified based on its primary activity. Data for an industry reflects all the products made by the establishments within that industry; therefore, secondary products are included.

Supplementary make-use tables reassign secondary products to the industry in which they are primary products. The data in this report utilizes supplementary make-use tables.[73, 74] The make-use tables are used for input-output analysis as developed by Wassily Leontief. Within this model, economies of scale are ignored; thus, it operates under constant returns to scale. The model also assumes that a sector uses inputs in fixed proportions.[75] This report uses an industry-by-commodity format as outlined in Horowitz and Planting. This accounts for the fact that an industry may produce more than one commodity or product such as secondary and by-products. This calculation, however, does not take into account the fact that competitive imports are included in the make-use tables; therefore, to analyze the domestic manufacturing industry's interindustry relationships imports must be removed. This is done by subtracting imports proportionally throughout the use matrix.

Each manufacturing sector has two impacts: there are the goods and services purchased for use in the specified sector and then there are the goods and services that use products of the specified sector. The primary measure of output in the input-output accounts is gross output, which is similar to shipments from the Annual Survey of Manufactures. In general, gross output includes the value of both intermediate product and final product measured using market value (revenues received) for goods and services. With much of the data being from the Economic Census, the basic measure used for each industry varies, but is often referred to as "receipts." It is identified as shipments for mining and manufacturing, revenue for utilities, sales for merchant wholesale trade and retail trade, receipts for most services, and commissions for commodity brokerage. For the purpose of this report, it will simply be called output.

[73] Over the years BEA has made improvements to its methods. This includes redefining secondary products. The data discussed in this section utilizes the data BEA refers to as "after redefinitions."
[74] Horowitz, Karen J. and Mark A. Planting "Concepts and Methods of the U.S. Input-Output Accounts." 2009. <http://www.bea.gov/papers/pdf/IOmanual_092906.pdf>
[75] Miller, Ronald E. and Peter D. Blair. *Input-Output Analysis: Foundations and Extensions*. (New York: Cambridge University Press, 2009): 16.

As seen in Table 4.2, the total impact of computer and electronic product manufacturing is $457.9 billion or 1.9 % of total output. That is, if all domestic computer and electronic manufacturing ceased to exist, total output would be 1.9 % less. Food, beverage, and tobacco products have the largest impact with $1 319.7 billion or 5.3 % of total output. Chemical product manufacturing is the second largest and petroleum and coal products are the third largest. Manufacturing's total impact on output is $5 705.2 billion or 23 % of total output. It is important to note that the last entry of the column labeled "manufacturing products used" is left blank because this value is already accounted for in the column labeled "products used in the manufacturing industry." That is, the column labeled "B" has both the products an industry uses from other manufacturing industries as well as the products an industry uses from itself; thus, the sum of column "D" would represent the products an industry uses from itself, which is already accounted for in column "B." The item that is similar to shipments from the ASM is the total industry output, which is $4 476 billion. Table 4.3 provides a more detailed account of products used by the manufacturing industry; thus, the sum of the last row of the table (excluding the last column labeled manufacturing products, which is blank) equals the total in the column labeled "non-manufacturing products used" in Table 4.2. The last column is exactly the same as the column labeled "manufacturing products used" in Table 4.2. As seen in Table 4.3, the computer and electronic products sector used $975.8 million of construction products, $1 487.2 million of non-manufactured materials, $14 339.5 million wholesale and retail trade services, $4 875.5 million in utilities, $45 426.3 million of professional services, $4 291.5 million of transportation and warehousing, $12 271.7 million of other non-manufacturing, and $35 169.4 million of manufacturing products (excluding computer and electronic products). The green colored bars in the table visually compare the value of the goods and services consumed by each manufacturing sector. For example, the computer and electronic products sector consumed more professional services than any other good or service; therefore, it has the longest bar. Table 4.4 has similar information for manufacturing products used by other industries. As seen in this table, professional services used $15 542.7 million of computer and electronic products in 2009 and the manufacturing industry used $276 061.9 million of computer and electronic products (including those products purchased from the computer and electronic industry for itself). As seen in Table 4.5, the manufacturing industry impacts 16.2 % of value added with computer and electronic products impacting 1.8 %.[76]

It is important to note, that there are additional services that support manufactured products in the marketplace. That is, technology support such as software and computer system design services purchased directly in the market place are not accounted for in Tables 4.2 through 4.5 because these purchases are not related to the manufacturing industry. These goods and services support both domestically produced goods and overseas produced goods. The computer systems design and related services sector (NAICS 5415) produced $340 488.2 million in output associated with non-manufacturing

[76] The value added calculation assumes that the ratio of value added to output is constant for each subsector

Table 4.2: Manufacturing Industry Impact on Output, 2009

		A	*W*	B	*X*	=A+B	*=W+X*	C	*Y*	D	*Z*	=A+B+C+D	*=W+X+Y+Z*
NAICS	**Industry**	**Product Used in Non-Manufacturing Industries ($million)**	*As a Percent of Total Output*	**Product Used in the Manufacturing Industry ($millions)***	*As a Percent of Total Output*	**Total Industry Output ($millions)**	*As a Percent of Total Output*	**Non-Manufacturing Products Used ($million)**	*As a Percent of Total Output*	**Manufacturing Products Used ($million)****	*As a Percent of Total Output*	**Total Impact on Output ($million)**	*As a Percent of Total Output*
321	**Wood products**	56 252	*0.23%*	22 500	*0.09%*	78 751	*0.32%*	5 690	*0.02%*	1 677	*0.01%*	86 117	*0.35%*
327	**Nonmetallic mineral products**	63 338	*0.26%*	28 212	*0.11%*	91 549	*0.37%*	8 548	*0.03%*	2 808	*0.01%*	102 905	*0.41%*
331	**Primary metals**	61 153	*0.25%*	117 747	*0.47%*	178 901	*0.72%*	9 036	*0.04%*	3 323	*0.01%*	191 260	*0.77%*
332	**Fabricated metal products**	144 349	*0.58%*	155 972	*0.63%*	300 321	*1.21%*	21 739	*0.09%*	16 342	*0.07%*	338 403	*1.36%*
333	**Machinery**	42 356	*0.17%*	213 675	*0.86%*	256 031	*1.03%*	82 030	*0.33%*	85 909	*0.35%*	423 971	*1.71%*
334	**Computer and electronic products**	63 024	*0.25%*	276 062	*1.11%*	339 086	*1.37%*	83 665	*0.34%*	35 169	*0.14%*	457 920	*1.85%*
335	**Electrical equipment, appliances, and components**	30 215	*0.12%*	71 481	*0.29%*	101 696	*0.41%*	20 821	*0.08%*	23 231	*0.09%*	145 749	*0.59%*
3361MV	**Motor vehicles, bodies and trailers, and parts**	53 069	*0.21%*	294 474	*1.19%*	347 543	*1.40%*	104 039	*0.42%*	106 156	*0.43%*	557 738	*2.25%*
3364OT	**Other transportation equipment**	48 256	*0.19%*	195 052	*0.79%*	243 308	*0.98%*	80 977	*0.33%*	53 282	*0.21%*	377 567	*1.52%*
337	**Furniture and related products**	13 754	*0.06%*	46 211	*0.19%*	59 966	*0.24%*	24 047	*0.10%*	18 666	*0.08%*	102 679	*0.41%*
339	**Miscellaneous manufacturing**	33 335	*0.13%*	116 073	*0.47%*	149 408	*0.60%*	44 217	*0.18%*	34 472	*0.14%*	228 096	*0.92%*
311FT	**Food and beverage and tobacco products**	146 379	*0.59%*	629 686	*2.54%*	776 065	*3.13%*	431 574	*1.74%*	112 025	*0.45%*	1 319 664	*5.32%*
313TT	**Textile mills and textile product mills**	8 771	*0.04%*	36 306	*0.15%*	45 077	*0.18%*	10 497	*0.04%*	10 288	*0.04%*	65 863	*0.27%*
315AL	**Apparel and leather and allied products**	1 177	*0.00%*	15 818	*0.06%*	16 995	*0.07%*	4 295	*0.02%*	3 143	*0.01%*	24 433	*0.10%*
322	**Paper products**	68 506	*0.28%*	89 693	*0.36%*	158 200	*0.64%*	20 875	*0.08%*	10 808	*0.04%*	189 882	*0.77%*
323	**Printing and related support activities**	76 632	*0.31%*	15 374	*0.06%*	92 006	*0.37%*	4 929	*0.02%*	2 728	*0.01%*	99 663	*0.40%*
324	**Petroleum and coal products**	219 928	*0.89%*	253 656	*1.02%*	473 583	*1.91%*	95 416	*0.38%*	10 440	*0.04%*	579 439	*2.34%*
325	**Chemical products**	154 278	*0.62%*	446 413	*1.80%*	600 691	*2.42%*	156 909	*0.63%*	68 586	*0.28%*	826 185	*3.33%*
326	**Plastics and rubber products**	75 908	*0.31%*	91 754	*0.37%*	167 662	*0.68%*	19 061	*0.08%*	21 391	*0.09%*	208 113	*0.84%*
32-33	**TOTAL Manufacturing**	1 360 680	*5.49%*	3 116 159	*12.56%*	4 476 839	*18.05%*	1 228 364	*4.95%*	-	-	5 705 203	*23.00%*

* Including the specified industry

** Excluding specified industry

Table 4.3: Products Used by Manufacturing Subsectors ($millions 2009)

NAICS	Industry	Construction	Non-Manufactured Materials	Wholesale and Retail Trade	Utilities	Professional Services	Transportation and Warehousing	Other Non-Manufacturing	Manufacturing Products ($million)*
321	Wood products	122.5	1 188.5	786.1	444.1	2 043.2	597.7	507.4	1 676.7
327	Nonmetallic mineral products	208.8	1 316.9	681.0	967.1	3 311.3	1 310.1	752.5	2 807.7
331	Primary metals	280.4	1 338.4	1 010.6	1 041.4	3 398.3	1 173.9	793.1	3 323.0
332	Fabricated metal products	498.2	1 039.2	2 607.6	2 049.2	11 609.7	1 910.8	2 024.7	16 342.3
333	Machinery	1 586.7	3 039.2	14 507.9	6 342.7	42 695.2	6 790.0	7 068.6	85 909.1
334	Computer and electronic products	975.8	1 487.2	14 339.5	4 875.5	45 423.3	4 291.5	12 271.7	35 169.4
335	Electrical equipment, appliances, and components	420.6	1 157.7	4 182.1	1 735.0	9 746.0	1 848.1	1 732.0	23 231.2
3361MV	Motor vehicles, bodies and trailers, and parts	1 944.2	5 466.4	21 291.1	8 088.4	49 360.4	9 719.6	8 169.0	106 156.4
3364OT	Other transportation equipment	1 129.8	2 011.2	9 136.1	5 182.1	51 006.0	5 491.3	7 020.1	53 281.9
337	Furniture and related products	510.8	1 169.2	3 800.1	2 032.8	11 828.5	2 499.1	2 206.2	18 666.1
339	Miscellaneous manufacturing	762.0	1 591.9	6 236.3	3 442.0	24 485.2	3 746.0	3 953.1	34 472.2
311FT	Food and beverage and tobacco products	5 875.5	158 251.2	54 359.0	25 882.6	131 437.5	33 487.8	22 280.5	112 025.2
313TT	Textile mills and textile product mills	207.0	1 053.8	1 921.6	1 173.8	4 211.5	1 048.2	881.6	10 288.0
315AL	Apparel and leather and allied products	55.2	248.1	859.1	326.2	2 134.8	361.5	309.8	3 143.3
322	Paper products	590.3	1 877.4	3 218.1	2 877.1	7 906.7	2 379.7	2 025.4	10 808.1
323	Printing and related support activities	113.4	146.1	535.7	453.9	2 726.3	405.6	547.9	2 727.6
324	Petroleum and coal products	3 229.5	63 007.6	7 604.4	2 593.6	13 072.8	3 864.6	2 043.5	10 439.9
325	Chemical products	3 281.5	18 048.1	21 600.3	15 435.9	74 999.9	11 794.7	11 748.1	68 585.6
326	Plastics and rubber products	466.9	1 284.1	2 693.2	2 080.2	9 033.0	1 688.7	1 814.8	21 390.6
32-33	TOTAL Manufacturing	22 259.1	264 722.3	171 369.9	87 023.7	500 429.6	94 408.8	88 150.1	-

* Excluding specified industry

Note: For the purposes of this Table, construction is NAICS 23; non-manufactured materials is 111CA, 113FF, 211, 212, and 213; wholesale and retail trade is 42 and44RT; utilities is 22, 513, and 562; professional services is 514, 521CI, 523, 524, 525, 531, 532RL, 5411, 5415, 5412OP, 55, 561, 61, 621, and 622HO; transportation and warehousing is 481, 482, 483, 484, 485, 486, 487OS, and 493; and other includes 511, 512, 624, 711AS, 713, 721, 722, 81, and government entities

Note: The green bars represent a visual comparison within each subsector (e.g., wood products) between categories (e.g., construction). Higher values have longer bars (e.g., the wood products sector uses more professional services than any other category; therefore, it has the longest green bar).

Table 4.4: Manufacturing Products Used by Other Industries ($million 2009)

NAICS	Industry	Construction	Non-Manufactured Materials	Wholesale and Retail Trade	Utilities	Professional Services	Transportation and Warehousing	Other Non-Manufacturing	Manufacturing Products ($million)*
321	Wood products	29 210.2	712.9	2 531.5	1 168.3	9 409.5	598.1	12 621.0	22 499.7
327	Nonmetallic mineral products	38 067.5	1 623.9	1 664.0	1 881.7	7 431.3	566.8	12 102.5	28 211.7
331	Primary metals	21 009.6	4 514.7	2 433.8	2 268.7	9 720.4	1 846.7	19 359.4	117 747.5
332	Fabricated metal products	60 866.6	4 055.3	5 733.1	6 021.2	20 695.6	4 858.9	42 118.8	155 971.9
333	Machinery	14 802.6	2 620.7	1 710.9	1 655.4	7 191.6	854.5	13 520.2	213 675.3
334	Computer and electronic products	5 109.1	555.1	3 827.8	4 208.0	15 542.7	725.0	33 056.5	276 061.9
335	Electrical equipment, appliances, and components	13 305.4	430.8	1 082.8	1 536.9	4 457.1	532.5	8 869.7	71 480.9
3361MV	Motor vehicles, bodies and trailers, and parts	6 248.8	1 013.4	4 751.4	1 145.4	7 153.5	3 070.5	29 685.6	294 474.5
3364OT	Other transportation equipment	861.4	170.0	330.7	266.7	1 012.1	3 310.0	42 305.6	195 051.6
337	Furniture and related products	6 605.7	66.3	794.5	267.9	3 560.8	81.0	2 377.8	46 211.5
339	Miscellaneous manufacturing	1 651.1	373.0	1 218.9	472.8	20 969.5	166.9	8 482.3	116 072.9
311FT	Food and beverage and tobacco products	1 476.9	12 171.4	2 104.0	796.3	33 705.7	507.3	95 617.4	629 685.9
313TT	Textile mills and textile product mills	1 616.6	199.5	1 897.3	139.8	1 912.8	123.0	2 882.2	36 306.0
315AL	Apparel and leather and allied products	46.3	7.3	146.3	16.6	192.7	6.8	760.7	15 818.2
322	Paper products	6 729.4	1 617.9	5 888.4	1 374.0	17 759.2	780.9	34 356.5	89 693.4
323	Printing and related support activities	3 082.7	476.7	8 020.2	1 521.4	24 577.4	549.0	38 404.7	15 374.1
324	Petroleum and coal products	38 566.2	8 784.7	11 317.5	7 009.9	35 770.8	37 255.0	81 223.5	253 655.9
325	Chemical products	19 610.3	11 431.9	6 331.4	2 855.7	61 919.7	2 377.7	49 751.6	446 412.8
326	Plastics and rubber products	17 566.6	1 888.1	7 073.3	2 228.3	19 603.3	1 535.0	26 013.5	91 753.7
32-33	TOTAL Manufacturing	286 433.1	52 713.5	68 857.7	36 835.1	302 585.6	59 745.7	553 509.4	3 116 159.2

* Including specified industry

Note: For the purposes of this Table, construction is NAICS 23; non-manufactured materials is 111CA, 113FF, 211, 212, and 213; wholesale and retail trade is 42 and44RT; utilities is 22, 513, and 562; professional services is 514, 521CI, 523, 524, 525, 531, 532RL, 5411, 5415, 5412OP, 55, 561, 61, 621, and 622HO; transportation and warehousing is 481, 482, 483, 484, 485, 486, 487OS, and 493; and other includes 511, 512, 624, 711AS, 713, 721, 722, 81, and government entities

Note: The green bars represent a visual comparison within each subsector (e.g., wood products) between categories (e.g., construction). Higher values have longer bars.

Table 4.5: Manufacturing Industry Impact on Value Added, 2009

NAICS	Industry	A **Product Used in Non-Manufacturing Industries ($million)**	*W* *As a Percent of Total Value Added*	B **Product Used in the Manufacturing Industry ($millions)***	*X* *As a Percent of Total Value Added*	=A+B **Total Industry Value Added ($millions)**	*=W+X* *As a Percent of Total Value Added*	C **Non-Manufacturing Products Used ($million)**	*Y* *As a Percent of Total Value Added*	D **Manufacturing Products Used ($million)****	*Z* *As a Percent of Total Value Added*	=A+B+C+D **Total Impact on Value Added ($million)**	*=W+X+Y+Z* *As a Percent of Total Value Added*
321	**Wood products**	14 581	*0.10%*	5 832	*0.04%*	20 413	*0.14%*	3 661	*0.03%*	594	*0.00%*	24 668	*0.17%*
327	**Nonmetallic mineral products**	25 771	*0.18%*	11 479	*0.08%*	37 250	*0.26%*	5 303	*0.04%*	965	*0.01%*	43 517	*0.31%*
331	**Primary metals**	14 522	*0.10%*	27 961	*0.20%*	42 483	*0.30%*	5 618	*0.04%*	1 264	*0.01%*	49 365	*0.35%*
332	**Fabricated metal products**	56 910	*0.40%*	61 493	*0.44%*	118 403	*0.84%*	13 646	*0.10%*	4 872	*0.03%*	136 921	*0.97%*
333	**Machinery**	17 685	*0.13%*	89 217	*0.63%*	106 902	*0.76%*	52 410	*0.37%*	30 103	*0.21%*	189 415	*1.34%*
334	**Computer and electronic products**	36 187	*0.26%*	158 506	*1.12%*	194 693	*1.38%*	53 354	*0.38%*	12 125	*0.09%*	260 172	*1.84%*
335	**Electrical equipment, appliances, and components**	14 811	*0.10%*	35 039	*0.25%*	49 850	*0.35%*	13 408	*0.09%*	7 875	*0.06%*	71 132	*0.50%*
3361MV	**Motor vehicles, bodies and trailers, and parts**	11 747	*0.08%*	65 183	*0.46%*	76 930	*0.54%*	66 964	*0.47%*	37 541	*0.27%*	181 435	*1.29%*
3364OT	**Other transportation equipment**	16 966	*0.12%*	68 576	*0.49%*	85 542	*0.61%*	51 314	*0.36%*	21 174	*0.15%*	158 030	*1.12%*
337	**Furniture and related products**	5 321	*0.04%*	17 878	*0.13%*	23 199	*0.16%*	15 246	*0.11%*	6 084	*0.04%*	44 528	*0.32%*
339	**Miscellaneous manufacturing**	17 557	*0.12%*	61 135	*0.43%*	78 692	*0.56%*	27 994	*0.20%*	12 089	*0.09%*	118 775	*0.84%*
311FT	**Food and beverage and tobacco products**	39 048	*0.28%*	167 973	*1.19%*	207 021	*1.47%*	235 885	*1.67%*	37 652	*0.27%*	480 558	*3.40%*
313TT	**Textile mills and textile product mills**	3 303	*0.02%*	13 671	*0.10%*	16 974	*0.12%*	6 617	*0.05%*	3 678	*0.03%*	27 270	*0.19%*
315AL	**Apparel and leather and allied products**	713	*0.01%*	9 587	*0.07%*	10 300	*0.07%*	2 752	*0.02%*	1 089	*0.01%*	14 140	*0.10%*
322	**Paper products**	24 073	*0.17%*	31 519	*0.22%*	55 592	*0.39%*	13 323	*0.09%*	3 642	*0.03%*	72 557	*0.51%*
323	**Printing and related support activities**	27 730	*0.20%*	5 563	*0.04%*	33 293	*0.24%*	3 119	*0.02%*	959	*0.01%*	37 372	*0.26%*
324	**Petroleum and coal products**	54 454	*0.39%*	62 805	*0.44%*	117 259	*0.83%*	68 769	*0.49%*	3 658	*0.03%*	189 686	*1.34%*
325	**Chemical products**	51 712	*0.37%*	149 633	*1.06%*	201 345	*1.43%*	100 991	*0.72%*	21 659	*0.15%*	323 996	*2.29%*
326	**Plastics and rubber products**	24 667	*0.17%*	29 817	*0.21%*	54 484	*0.39%*	12 154	*0.09%*	7 380	*0.05%*	74 019	*0.52%*
32-33	**TOTAL Manufacturing**	457 758	*3.24%*	1 072 865	*7.60%*	1 530 624	*10.84%*	752 528	*5.33%*	-	-	2 283 152	*16.17%*

* Including the specified industry

** Excluding specified industry

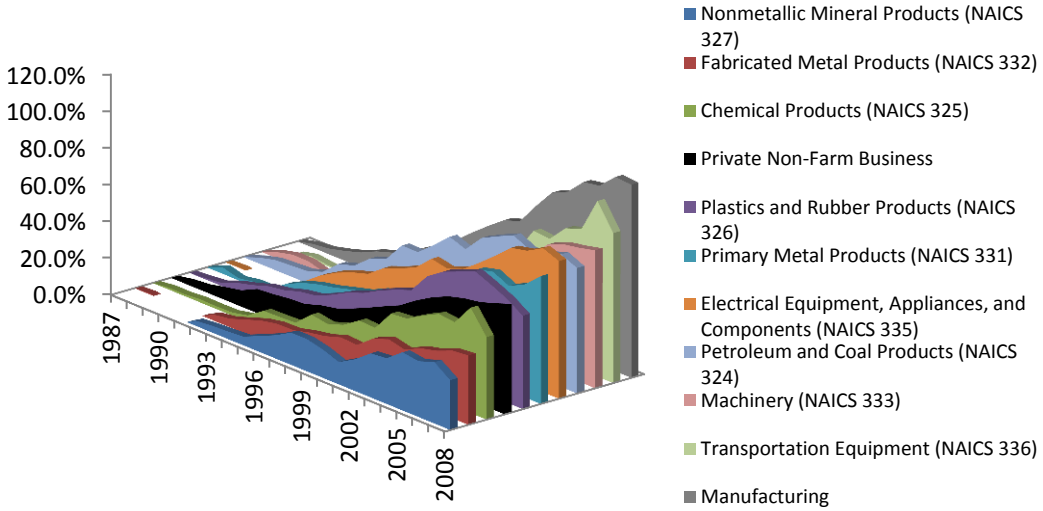
activity while the software publishing sector (NAICS 511200) produced $128 380.1 million.[77]

4.3 Bureau of Labor Statistics: Labor and Productivity

The Bureau of Labor Statistics (BLS), an agency within the Department of Labor, measures labor market activity, working conditions, and price changes in the economy. There are two measures provided by the BLS that measure productivity: labor productivity and multifactor productivity. Labor productivity relates output to labor hours used to produce output while multifactor productivity relates output to a combined set of inputs such as labor and capital. The BLS also tracks employment through two surveys: Current Employment Statistics (CES) program and the Current Population Survey (CPS). The CES surveys approximately 140 000 businesses and government agencies to provide data on employment, hours, and earnings. The CPS is a monthly survey of households conducted by the Bureau of the Census.[78]

Productivity: Manufacturing labor productivity has increased significantly in recent decades. As seen in Figure 4.13, labor productivity in manufacturing increased 105.1 % between 1987 and 2008 while private non-farm business increased 64.9 %; thus, manufacturing labor productivity is increasing faster than the whole of the U.S. economy. The industry with the largest productivity gains is the computer and electronics sector (NAICS 334) which increased 1009.3 % (not shown), more than 10 times larger than any other manufacturing subsector shown in Figure 4.13. Between 1987 and 2009, multifactor productivity (not shown) increased 26.3 % for all manufacturing and 661.2 %

Figure 4.13: Output per Unit of Labor (aggregate percent increase of BLS Index)



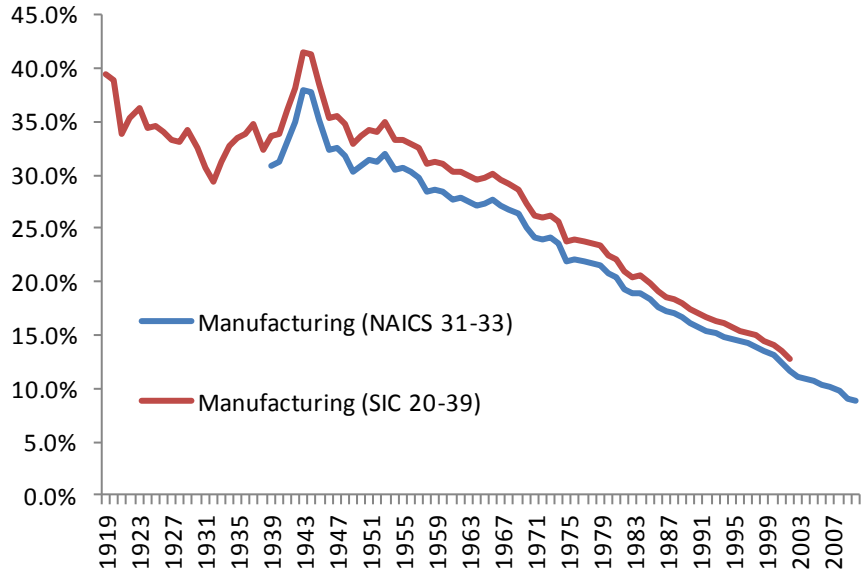
[77] Software publishing was estimated as the 2002 ratio of the value of software publishing industry output (NAICS 511200) to the value of the publishing industry output (NAICS 511) multiplied by the value of the publishing industry output for non-manufacturing industries in 2009.
[78] Bureau of Labor Statistics. "BLS Productivity Statistics." <http://www.bls.gov/bls/productivity.htm>

for computer and electronic products. During the same period machinery (NAICS 333); electrical equipment, appliances, and components (NAICS 335); and transportation equipment (NAICS 336) declined 7.2 %, 18.2 %, and 3.3 % respectively. It is important to note that the source of productivity gains in manufacturing have been questioned somewhat. It has been suggested that the source of at least some of these gains are due to outsourcing.[79]

Employment: Employment levels for manufacturing have fluctuated somewhat in recent decades and have recently declined significantly. As seen in Figure 4.14, manufacturing as a percent of total non-farm employment has had a downward trend since 1919 with the exception of a period during World War II when the U.S. was manufacturing military supplies. According to NAICS CES data, 15.0 million workers were employed in manufacturing in 1961. Employment peaked in 1979 to 19.4 million and declined 41 % to 11.5 million in 2010, as seen in Figure 4.15. Many of the subsectors shown in the figure trend upwards until some point between the mid-70's and mid-80's where they plateau somewhat or trend downwards. According to CPS data, there were 14.1 million employed persons in the manufacturing industry in 2010. Of these, 97 % is private industry workers, 2 % is self employed, and less than one percent is government and unpaid family workers. The 2010 estimate of the number of employees is down 17 % from 16.9 million in 2003.

Wages: Wages in the U.S. manufacturing industry had a general upward trend from 1919 until the early 70's where they began to plateau or even trend downwards, as seen in Figure 4.16. This trend however, is similar to the trend for the wages for all those in

Figure 4.14: Manufacturing Employment as a Percent of Total Non-Farm Employment (CES)



[79] Houseman, Susan. "Outsourcing, Offshoring, and Productivity Measurement in U.S. Manufacturing." Upjohn Institute Staff Working Paper No. 06-130. June 2006. <http://www.upjohninst.org/publications/wp/06-130.pdf>

Figure 4.15: Employment in Manufacturing and Select Subsectors, 1919-2010 (Current Employment Survey)

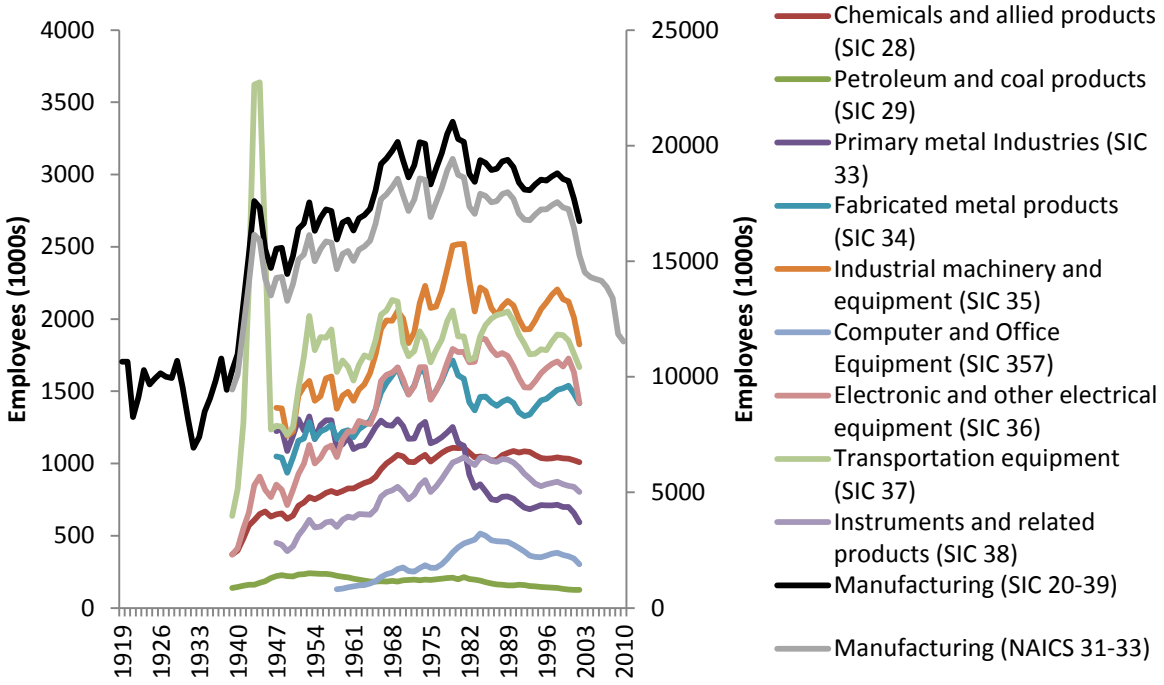
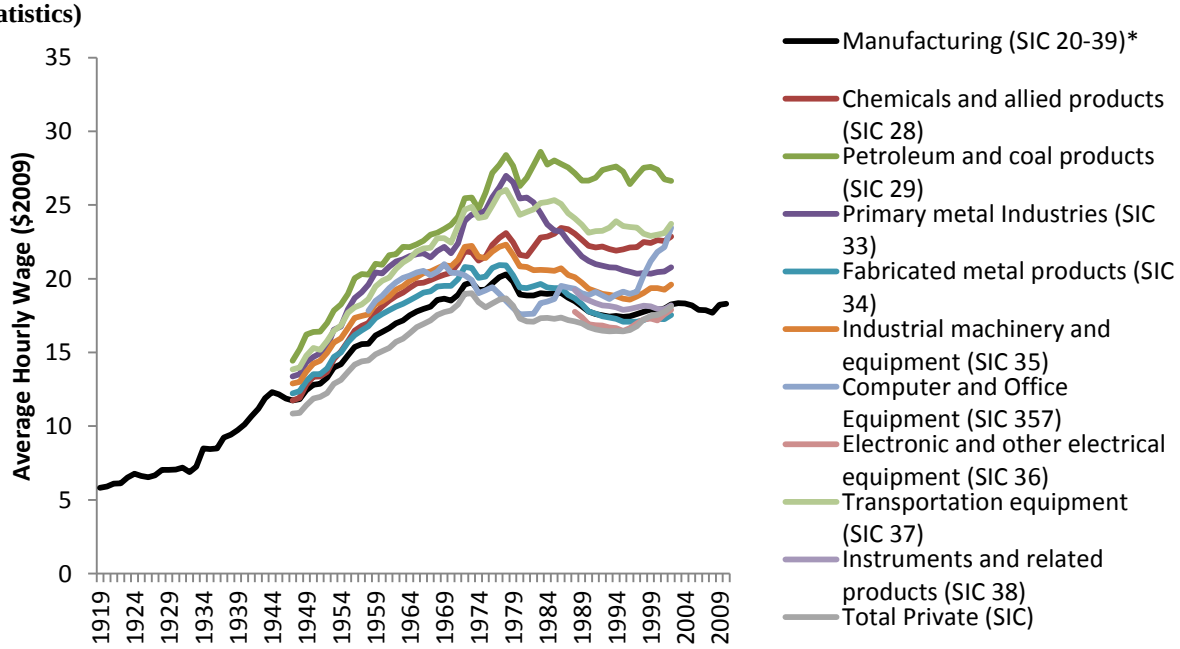


Figure 4.16: Wages in Manufacturing and Select Subsectors, 1919-2010 (Current Employment Statistics)



* 2003 to 2010 is NAICS 31-33

private industry. The average hourly earnings for all private workers using the NAICS format from the CES was $22.21 in 2009 while it was $23.04 for manufacturing workers.

4.4 National Science Foundation: Research and Development

The National Science Foundation (NSF) is an independent federal agency created by Congress in 1950. As stated by the NSF, it was created "to promote the progress of science; to advance the national health, prosperity, and welfare; [and] to secure the national defense…" The agency collects data on research and development expenditures and provides them through its National Center for Science and Engineering Statistics (NCSES).[80] The data is broken into categories by funding sources, industry, and by type of research. Since federally funded research represents less than 10 % of total funding, this report will focus on non-federally funded expenditures, which reflects trends in the private industry. Total federal research funding, however, is briefly discussed. It is important to note that the funds for research and development discussed in this section, including federal funds, is activity performed within company owned or company operated facilities.

As mentioned previously, significant concern has been expressed in regards to U.S. research and development expenditures compared to those abroad. This concern is primarily in regards to its proportion of global research and development expenditures;[81] however, a decline of the proportion of these activities is not unexpected and is not by itself considered a decline in the U.S. manufacturing industry. A greater concern is its nominal and real performance relative to its population and/or resources. It is in this context that this report examines research and development.

Research and development expenditures in the manufacturing industry accounted for 69.5 % of the total for the U.S. Expenditures have increased significantly for the chemical industry as seen in Figure 4.17. Between 2000 and 2006 it increased 89.7 %. Pharmaceuticals and medicines, which increased 159.2 % during the same period (see Figure 4.18), represented 84.2 % of chemical research in 2006. During the 2000 to 2006 period, computer and electronic product research expenditures decreased 7.4 %; however, a number of this industry's subsectors increased significantly: semiconductor and other electronic component research was up 23.8 %, computers and peripheral equipment were up 20.6 %, and other computer and electronic products were up 199.0 % (see Figure 4.18). As illustrated in Figure 4.17, machinery and transportation equipment research increased 27.3 % and 11.9 % respectively.

Approximately 39 % of total research and development expenditures in 1953 were funded by the Federal government with the remainder being from company and other sources, as illustrated in Figure 4.19. This percentage did not drop below 30 % until 1989 where it began a downward trend until 2002 where it represented 8.5 %. Between 2002 and 2007 it increased to 9.9 %. Overall, total expenditures have had a general upward

[80] National Science Foundation. "Business and Industrial R&D." <http://www.nsf.gov/statistics/industry/>
[81] Tassey Gregory. "Rationales and Mechanisms for Revitalizing U.S. Manufacturing R&D Strategies." *Journal of Technology Transfer*. 35 (2010): 283-333.

trend between 1953 and 2007 with the exception of a few years. Approximately 4 % of nonfederal research expenditures was basic research, 20 % applied, and 76 % was development in 2007. This has changed only slightly since 1953 where it was 6 %, 20 %, and 74 % respectively. Federal funding for defense related research and development represented 16.2 % of total 2007 research and development (not shown). Space, civilian, and nonfederal related expenditures are 1.4 %, 9.3 %, and 73.9 % respectively (not shown).

Figure 4.17: Company and Other Research and Development by Industry

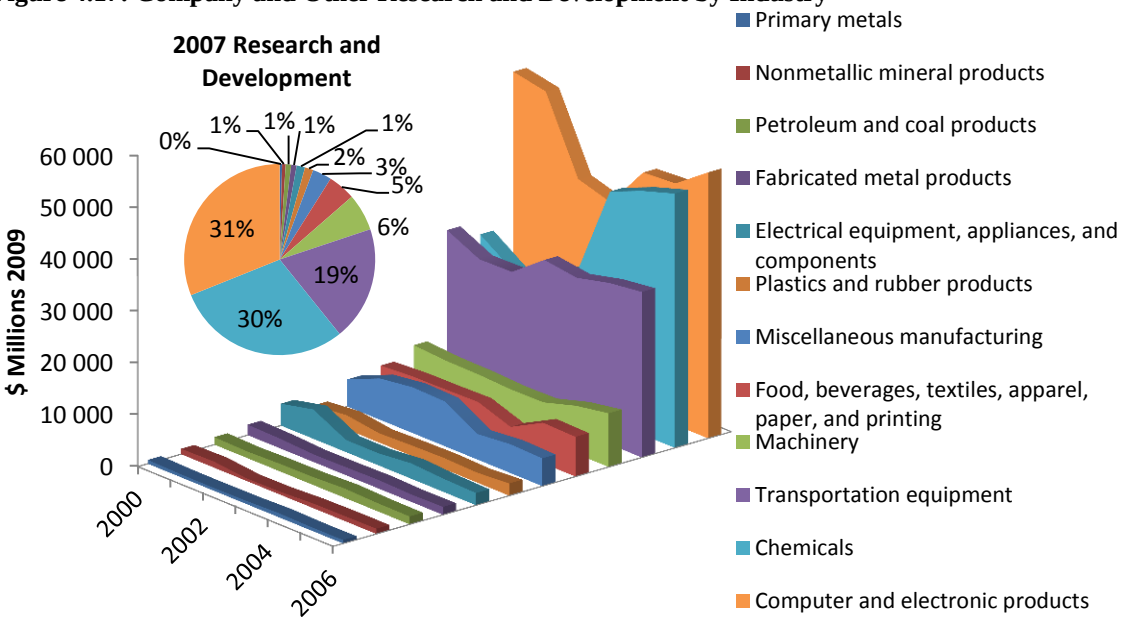
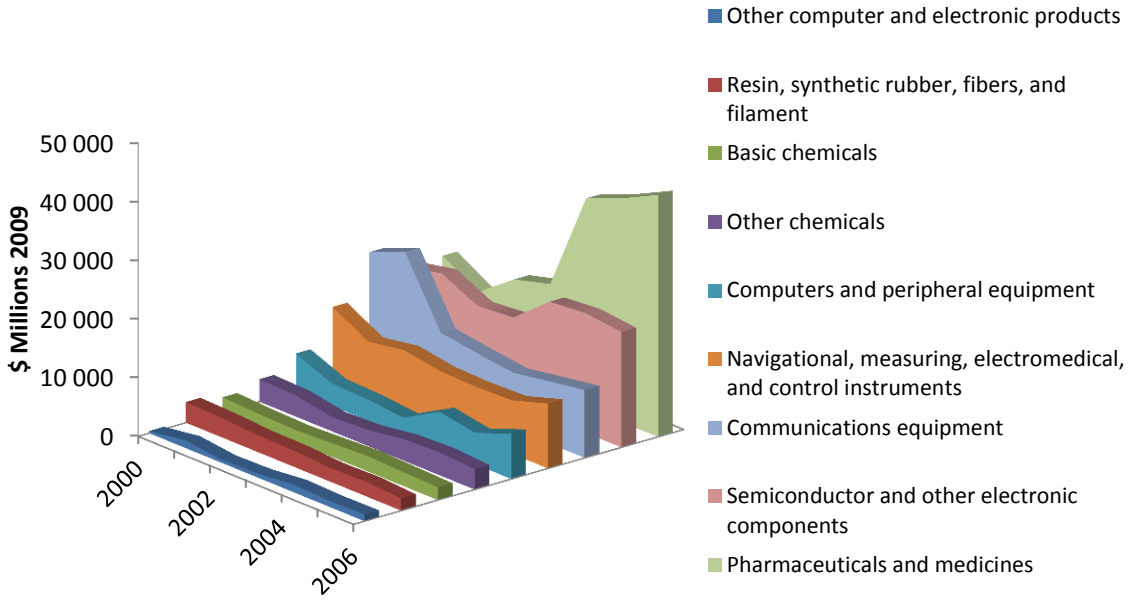
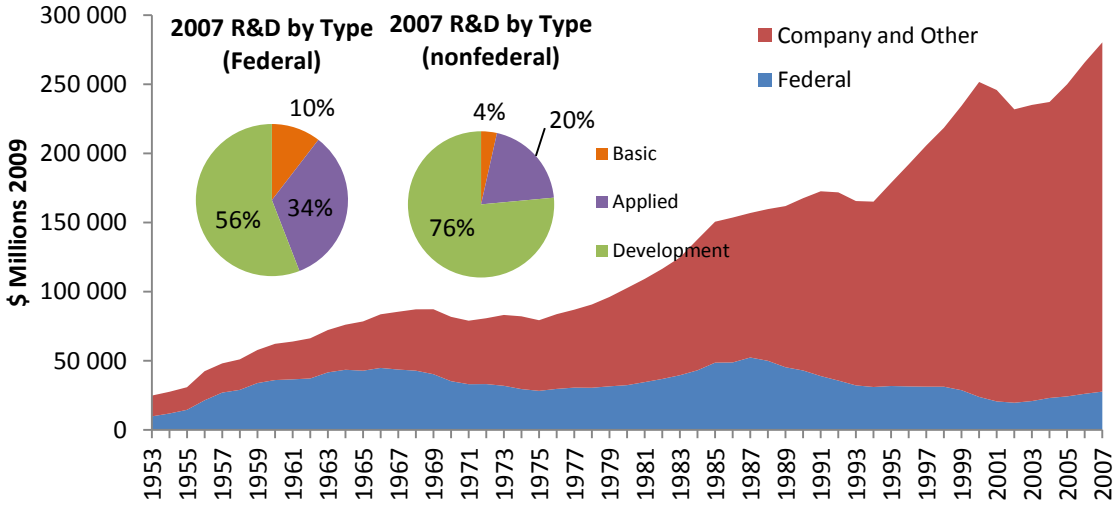


Figure 4.18: Company and Other Research and Development by Industry (subsectors of the chemical industry and computer and electronic industry)



NOTE: Adjusted using the CPI

Figure 4.19: Research and Development by Source of Funds



5 Characterizing the U.S. Manufacturing Industry

5.1 Production

According to UNSD data, U.S. manufacturing growth lags behind that of many countries and is growing slower than the whole of the U.S. economy. Compound annual growth is below the 20th percentile of 180 nations. While manufacturing value added is larger in the U.S. than in any other country, U.S. manufacturing per capita has lagged slightly behind some industrialized nations, such as Germany and Japan. Out of 199 countries, at least 20 other nations have a higher manufacturing value added per capita than the U.S. in 2008, according to UNSD data. Manufacturing as a percent of total Gross Domestic Product (GDP) has declined in the U.S. as it has declined in many industrialized nations.

Among all OECD countries for which data is available in 2009, the U.S. ranks above the 70th percentile in value added per capita (see Table 3.4) in food, apparel, wood product, and printing; refined petroleum products and nuclear fuel; chemicals; office, accounting, and computing machinery; radio, television and communications equipment; medical, precision, and optical instruments; transport equipment; and other manufacturing. That is, in per capita terms the U.S. produces more than at least 70 % of those ranked. Among those OECD countries for which data is available, the U.S. is above the 70th percentile in terms of the gross operating surplus per expenditure dollar for at least four sectors of manufacturing in 2009: refined petroleum products and nuclear fuel; chemicals; machinery and equipment; electrical machinery and apparatus; and total manufacturing. Manufacturing's share of employment has declined for all OECD countries including the U.S.

According to OECD input-output data for 39 countries, the U.S. has the largest value added in the mid-2000's for all manufacturing subsectors except basic metals; office, accounting, and computing machinery; and electrical machinery and apparatus as seen in the rankings in Table 3.9. In terms of value added per capita, the U.S. ranks 4th in office, accounting, and computing machinery, 11th for all manufacturing, and does not rank first for any subsector in terms of value added per capita. According to these data, the whole of the U.S. manufacturing industry impacts $6 446 billion or 27.9 % of total output (see Table 3.11), slightly more than is estimated using BEA data. This percentage is lower than other countries such as China, Germany, India, and Japan which have impacts of 62.1 %, 44.9 %, 45.3 %, and 41.2 % respectively.

In 2009, the total value of shipments in manufacturing was $4.44 trillion, according to the ASM. Value added for all manufacturing was $1 978.2 billion in 2009. Approximately 9.8 % of this value is computer and electronic product manufacturing as illustrated in Table 4.1. This sector increased 15.5 % from $214.3 billion in 1997 to $247.6 billion in 2000. During the early 2000's recession it declined to a low of $182.9 billion in 2002, but increased until the late 2000's recession as illustrated in Figure 4.1. Semiconductor and other electronic components manufacturing (NAICS 3344) is 3.0 % of the manufacturing industry and has a net income per expenditure dollar ratio of 0.173. During the 1997 to

2009 period, employment declined for all sectors shown in Figure 4.1: petroleum and coal products declined 6 %; chemicals 18 %; plastics and rubber 34 %; nonmetallic mineral products 28 %; primary metals 41 %; fabricated metal 26 %; machinery 32 %; computer and electronic products 46 %; electrical equipment, appliance, and components 41 %; and transportation 33 %. Each subsector's proportion of employment and value added is shown in Figure 4.3. The net income for all manufacturing in 2009 was $659.9 billion.

The Manufacturer's Shipments, Inventories, and Orders Survey indicates that computer and electronic product manufacturing represents 8 % of manufacturing shipments down from 10 % in 1992. This decline is likely due to changes in the price of computer and electronic product manufacturing and not due to a decline in the volume of physical production. This industry grew by 47 % between 1992 and 2009, faster than any other industry shown in Figure 4.7.

BEA GDP by industry shows manufacturing as 8 % of U.S. growth between 1947 and 2009 while the largest growth sector was the finance, insurance, real estate, rental, and leasing sector with real estate representing the majority of this growth. GDP grew 501 % between 1947 and 2009 while manufacturing grew 164 %. The slower growth in manufacturing has resulted in a downward trend in manufacturing's share of GDP. This trend seems to pervade as far back as 1947 when data was first collected. This sentiment is supported by manufacturing's share of total employment, which also has a pervading downward trend with the exception of the World War II era (see Figure 4.14). As seen in Table 4.2, the total impact of computer and electronic product manufacturing is $457.9 billion or 1.9 % of total output. Food, beverage, and tobacco products is the largest with $1 319.7 billion or 5.3 % of total output. Chemical products is the second largest and petroleum and coal products is the third largest. Other industries such as machinery; electrical equipment, appliances, and components; motor vehicles, bodies, trailers, and parts; and other transportation represented 1.7 %, 0.6 %, 2.3 %, and 1.5 % respectively. Manufacturing's total impact on output is $5 705.2 billion or 23 % of total output.

Manufacturing labor productivity has increased significantly in recent decades, as indicated by BLS data. As seen in Figure 4.13, labor productivity in manufacturing increased 105.1 % between 1987 and 2008 while private non-farm business increased 64.9 %; thus, manufacturing labor productivity is increasing faster than the whole of the U.S. economy. Employment levels for manufacturing have fluctuated somewhat in recent decades and have recently declined significantly. According to CES data, 15.0 million workers were employed in manufacturing in 1961. Employment peaked in 1979 to 19.4 million and declined 41 % to 11.5 million in 2010. Wages in the U.S. manufacturing industry had a general upward trend from 1919 until the early 70's where they began to plateau or even trend downwards, as seen in Figure 4.16.

5.2 Research, Development, and Technology

Among all OECD countries for which data is available, the U.S. ranks above the 85th percentile during the 2001 to 2008 period for total research and development

expenditures for all subsectors, as seen in Table 3.13. From 2001 through 2007, it was above the 90th percentile for all subsectors of manufacturing and above the 95th percentile for total manufacturing. In terms of per capita research and development expenditures, 2007 U.S. values rank above the 70th percentile for a number of subsectors and total manufacturing (see Table 3.14). According to OECD patent data, as seen in Table 3.15, between 1999 and 2007 the U.S. has ranked above the 90th percentile in terms of total number of patents and above the 80th percentile in terms of patents per capita. During that same period, U.S. patents represented between 30 % and 41 % of total patents worldwide.

As indicated by World Bank data, the U.S. ranks above the 90th percentile for 2009 patent applications (resident and nonresident), patent applications per capita (resident and nonresident), and royalty license fees (payments and receipts). Researchers per million people were above the 85th percentile in 2006, the latest data available. Scientific and technical journal articles authored by U.S. residents were above the 95th percentile and articles per capita were above the 90th percentile in 2007, the latest available data. Research and development expenditures as a percent of GDP was above the 85th percentile in 2008 and above the 90th percentile in 2007. The Global Competitiveness Index ranked the U.S. as 4th in innovation and 17th in technological readiness among 139 countries. The IMD World Competitiveness Yearbook ranks the U.S. as 1st for scientific infrastructure and 2nd for technological infrastructure out of 59 countries. The 2003 Competitive Industrial Performance Index puts the U.S. above the 90th percentile for its share of medium- and high-tech value added as a percent of total manufacturing value added; however, it puts the U.S. just above the 55th percentile for its share of manufacturing value added as a percent of total GDP (see Table 3.17).

Between 1953 and 2007 total research and development expenditures has increased 1031 %, according to NSF data; however, during the 2000 to 2007 period it only increased 11 %. During the 2000 to 2006 period, computer and electronic product research expenditures decreased 7.4 %; however, a number of this industry's subsectors increased significantly: semiconductor and other electronic component research was up 23.8 %, computers and peripheral equipment were up 20.6 %, and other computer and electronic products were up 199.0 % (see Figure 4.18). As illustrated in Figure 4.17, machinery and transportation equipment research increased 27.3 % and 11.9 % respectively. Overall, total expenditures have had a general upward trend between 1953 and 2007 with the exception of a few years.

5.3 Stakeholder's Perspective

Owners and Finance Services: The owners of U.S. manufacturing firms invest land, capital goods, and financial capital with the expectation of receiving a profit from the sales of manufactured goods. The primary variable available to examine and compare the returns for owners and financiers internationally is gross operating surplus per dollar of expenditure. Gross operating surplus is gross output less a subset of costs (i.e., intermediate expenditures, compensation, and taxes less subsidies) and does not take into account the depreciation of capital; therefore, it does not fully represent a return on

investment. However, it is the best variable available. OECD data for 2004 through 2009 put the U.S. manufacturing industry as a whole above the 75th percentile for gross operating surplus per dollar of expenditure (see Table 3.5). This data also shows that the 2005 U.S. employer enterprise birth rate (number of new enterprises divided by the number of existing enterprises) is less than the death rate; thus, more businesses were eliminated from manufacturing than were created (see Table 3.8). According to OECD input-output data for the mid-2000's, the U.S. ranks 14th out of 39 countries or just above the 60th percentile in terms of gross operating surplus per dollar of expenditure. The office, accounting and computing machinery subsector ranked 9th or just above the 75th percentile.

The Annual Survey of Manufactures provides an opportunity to examine the net income (also known as net profit or simply profit) of the U.S. manufacturing industry. Net income is different from gross operating surplus in that it accounts for depreciation of assets or capital. In 2009, the total net income from the manufacturing industry in 2009 was $659.9 billion. Approximately 32.3 % of the net income was from the production of food, beverages, textiles, apparel, paper, and printing (NAICS 311-323). Another 27.5 % is from chemical manufacturing while computer and electronic product manufacturing represented 7.8 % as calculated from the data in Table 4.1. Net income represented 14.9 % of the total value of shipments. The net income per expenditure dollar was 0.18 for the whole of manufacturing while computer and electronic product manufacturing was slightly higher at 0.19. Stated another way, the return on investment for manufacturing is 18 % while computer and electronic product manufacturing was 19 %. Even with the highest costs for materials, buildings, and machinery, the return on investment for semiconductor and other electronic component manufacturing was 17 % (see Appendix C).

Employees: Employees exchange their time for compensation or income. The manufacturing industry employed 12.5 million people or 4.2 % of the population in the U.S. according to 2006 UNIDO data. Canada, China, Germany, India, Japan, Mexico, and the UK employ 1.9 million (6 %), 72.3 million (6 %), 6.9 million (8.4 %), 8.8 million (0.8 %), 7.5 million (5.9 %), 4.3 million (4.0 %), and 3.1 million (5.2 %) respectively. In the U.S., approximately 101 thousand employees work in the office, accounting, and computing machinery sector. The wages for manufacturing workers is $47.2 thousand annually in the U.S. while Canada, China, Germany, India, Japan, Mexico, and the UK are $30.8 thousand, $2.9 thousand, $47.7 thousand, $1.8 thousand, $30.5 thousand, $4.8 thousand, and $41.9 thousand respectively. OECD STAN data puts U.S. manufacturing wages above the 90th percentile between 2001 and 2008 with its subsectors mostly ranking above the 80th percentile. Manufacturing's share of total employment has declined in the U.S. as it has for many nations.

According to the Annual Survey of Manufactures there were 11.1 million manufacturing employees in 2009 with 908 thousand or 8 % being in the computer and electronic product manufacturing sector. The average compensation for the industry as a whole was $62.9 thousand annually with the computer and electronic product sector being

$84.5 thousand. The 294 thousand individuals working in the semiconductor and related device sector made $71.9 thousand annually.

Resellers, Transportation and Warehousing, Industry Suppliers, and Professional Services: Companies and organizations provide products and services to the manufacturing industry in exchange for compensation that results in a profit. Tracking these profits is difficult since there does not exist readily available data on the profit gained through domestic manufacturing alone; therefore, this report has largely focused on the purchases of non-manufacturing products and services rather than the profit gained from the purchases. According to OECD input-output data, electronics manufacturing (ISIC 30-32), machinery manufacturing (ISIC 29, 33-35), and other manufacturing (ISIC 15-28, 36-37) used $115 billion, $393 billion, and $1000 billion of non-manufactured products and services for a total of $1508 billion or 6.5 % of total output. The total impact of the manufacturing industry is $6446 billion or 27.9 % of output. The total impact of the manufacturing industry in other nations such as Australia, Canada, China, Germany, India, Japan, Mexico and the UK is 24.7 %, 33.8 %, 62.1 %, 44.9 %, 45.3 %, 41.2 %, 41.8 %, and 24.8 % of total output respectively.

According to BEA data, the manufacturing industry uses $1228 billion of non-manufactured goods and services and impacts 23.0 % of total output or $5705 billion. Computer and electronic products impacts 1.9 % of output. The whole of the manufacturing industry uses $22.3 billion of construction products, $264.7 billion of non-manufactured materials, $171.4 billion of wholesale and retail trade, $87.0 billion of utilities, $500.4 billion of professional services, $94.4 billion of transportation and warehousing, and $88.2 billion of other non-manufactured products and services.

Consumers: Data on the utility that consumers gain by purchasing domestically produced manufacturing products is not readily available. Additional research is needed to gain further knowledge in this area.

Standards and Codes Organizations, Public Vested Interests, and Professional Societies: There are many organizations and individuals that have interests in the economic success of the manufacturing industry. This interest hinges on the primary stakeholders (owners, finance services, and employees), the technology produced, as well as the size of the industry. The primary stakeholders were discussed above in both the terms of domestic and international data. Assessing the technology produced by the industry must be measured in an indirect manner using research and development expenditure data, patent data, and journal publication data as there is not a direct measurement available. According to OECD STAN data, 2006 research and development expenditures in the U.S. amounted to $172.7 billion with $1.5 billion being in office, accounting, and computing machinery. The U.S. expenditure is often above the 90^{th} percentile while expenditure per capita is commonly above the 80^{th} percentile.

Using the OECD Patent Database for 1999 through 2007, the U.S. accounts for more than 30 % of the total number of patents registered while ranking above the 90^{th} percentile in the number of patents and above the 80^{th} percentile in the number of patents per capita.

Using World Bank data for 2000 through 2009, the U.S. ranks above the 90th percentile in the number of patent applications per capita for residents and above the 80th percentile for nonresidents. Research and development expenditures as a percent of GDP ranks above the 90th percentile with the exception of 2008. In terms of the number of researchers per million people, the U.S. ranks above the 90th percentile between 2000 and 2004 and above the 85th percentile in 2005 and 2006. In terms of the number of scientific and technical journal articles published per capita, the U.S. ranks above the 90th percentile.

According to 2007 National Science Foundation data on research and development funded by companies, 31 % of expenditures are in computer and electronic products, 30 % in chemicals, and 19 % in transportation. A large percentage of the computer and electronic research is in semiconductor and other electronic components. Approximately 76 % of total nonfederal research is in development, 20 % in applied research, and 4 % in basic research.

Three international comparative indices were discussed that ranked national competitiveness: (1) UNIDO's Competitive Industrial Performance Index; (2) the World Economic Forum's Global Competitiveness Report; and (3) the IMD World Competitiveness Center's World Competitiveness Yearbook. These indices do not specifically address the manufacturing industry, but provide an overall comparison of economic activity. Among 121 nations, the Competitive Industrial performance Index ranked the U.S. as 9th, 10th, and 12th in 1993, 1998, and 2003. The Global Competitiveness Report ranked the U.S. as 4th in 2010-2011, 2nd in 2009-2010, and 1st in 2008-2009. The World Competitiveness Yearbook ranked the U.S. as 1st out of 59 countries in 2011.

5.4 Characteristics of the U.S. Manufacturing Industry

As seen in the manufacturing supply chain in Figure 4.5, there are many suppliers of goods and services that also have a stake in the industry; these include resellers, providers of transportation and warehousing, raw material suppliers, suppliers of intermediate goods, and suppliers of professional services. The manufacturing industry shipped $4 436.2 billion of goods in 2009 according to the industry supply chain in Figure 4.5. The value of communications; computer hardware, software, and other equipment; professional, technical, and data services; and other items used by the industry were $5.2 billion, $12.0 billion, and $29.3 billion, and $254.9 billion, respectively. These items, represented in blue in the supply chain, represent 6.8 % of the total value of manufacturing shipments. Capital expenditures on buildings and structures ($43.3 billion), machinery and equipment ($110.9 billion), and maintenance and repair were 4.3 %. Compensation ($695.6 billion) was 15.7 % while materials and energy (shown in green in the supply chain) were 55.0 %. The expenditures just mentioned, account for 82.0 % of total shipments, net income accounted for 14.9 %, and net inventories and depreciation accounted for 3.1 %.

6 Discussion and Research Needs

6.1 Discussion

There are many theories that speculate the future of the U.S. manufacturing industry. These theories must take into account and be consistent with the data available on the industry. Frequently, anecdotal observations are used to depict the industry; however, the insight from these types of observations is limited, as the manufacturing industry includes hundreds of thousands of establishments with millions of employees making trillions of dollars worth of goods. Additionally, national economies are often compared to companies competing for market share; unfortunately, this is somewhat misleading. This report brings together data on the current state of the U.S. manufacturing industry as it relates to its stakeholders and, to the extent possible, compares this data internationally to develop a quantitative depiction of the industry. This provides a structured approach to characterizing the industry and its subsectors.

There is a general concern that the U.S. manufacturing industry has lost competitiveness with Asian manufacturing, particularly China. With over 1.3 billion people (more than the combined 2009 population of the U.S., Canada, Australia, Japan, and the whole of Europe), the Chinese economy has the potential to far exceed the size of the U.S. economy. However, China's rise is recent, rapid, and has come with some costs. Many of the policies and activities to attract manufacturing have short term gains for long term losses. Air and water pollution are becoming a significant concern[82] as is waste disposal, which is inadequate as significant amounts of China's waste ends up in unlicensed dumps in the countryside.[83] A looming housing bubble, harsh conditions for some workers, low wages, gender imbalance in the population, and remnants of a command economy may pose challenges to China's social and economic future.[84, 85, 86] Thus, the sustainability of China's current economic situation is unknown and may face the prospects of a slowdown in growth as many emerging economies have experienced.[87, 88] Therefore, it is also important to bear in mind that U.S. economic concerns regarding China are not unique. The U.S. has had similar concerns regarding Japan, Mexico, Thailand, and India.[89] It is important to examine U.S. manufacturing in a way that considers the entirety of the industry and its subsectors while considering the various aspects of the industry.

---

[82] BBC. "China Pollution 'Threatens Growth'." February 28, 2011. <http://www.bbc.co.uk/news/world-asia-pacific-12595872>

[83] CBS News. "As Economy Grows, So Do China's Garbage Woes." October 11, 2009. <http://www.cbsnews.com/stories/2009/10/11/ap/asia/main5377158.shtml>

[84] Davis, Bob. "The Great Property Bubble of China May be Popping." June 9, 2011. <http://online.wsj.com/article/SB10001424052702304906004576367121835831168.html>

[85] Shepherd, Robert J. "The People's Dynasty: Culture and Society in Modern China." Modern Scholar. Lecture Series. 2010.

[86] Harney, Alexandra. The China Price. (London, England: The Penguin Press, 2008).

[87] Economist. "Converging Economies: One-Track Bind." September 24, 2011. <http://www.economist.com/node/21528985>

[88] Zhang, Kevin Honglin. "Is China the World Factory." In *China as the World Factory*. (New York: Routeledge, 2006).

[89] Harney, Alexandra. The China Price. (London, England: The Penguin Press, 2008).

China's manufacturing industry is rapidly approaching the size of the U.S. manufacturing industry; however, China's industry is far smaller than the U.S. industry on a per capita basis.

All this is not to say that the U.S. manufacturing industry does not have deficiencies, but the U.S. produced more manufactured goods per capita than 92.6 % of OECD reporting countries in 2007 and produced more than any other country in the world. Industry growth, however, has been somewhat stagnant in the U.S. when compared internationally. UNSD data suggests that U.S. manufacturing growth is below the 20th percentile of 180 countries. Manufacturing as a percent of GDP has declined in the U.S.; however, this percentage has declined globally. As demonstrated in this report, there are many aspects involved in tracking the current state and recent trends in the U.S. manufacturing industry and no single metric provides an accurate depiction.

6.2 Recommendations for Further Research

Tracking manufacturing activity provides significant challenges. For example, the components of one product may be produced in several different countries; the iPod is one example. Between the design and production of the iPod there are a number of countries involved: England, Germany, France, Italy, Japan, Korea, and the United States.[90] Further research is needed to understand the role the U.S. has in developing and manufacturing intermediate and finished parts.

This report has focused on the trends and current state of the U.S. manufacturing industry and, therefore, largely excludes the environment in which the manufacturing industry operates. This includes taxes, regulations, infrastructure, the labor market, and current economic conditions among other things. These are the factors that are often driving the trends in the industry and exploring these items might reveal means for improving U.S. manufacturing competitiveness.

This report primarily used gross operating surplus as a proxy to compare manufacturing industry profits or net income from various countries; however, there was little discussion on how closely these two items correlate. Further investigation might confirm the use of gross operating surplus as a proxy for profit; alternatively, further investigation might reveal additional data sets detailing international profits.

There are a number of expected returns that were not comprehensively examined due to data constraints: capital gains for financiers, profit from markup for retailers, and final product utilization. Further examination of these factors could provide further insight into the manufacturing industry. As discussed previously, there are also issues regarding price indices. Investigating this issue might ensure that time series data accurately reflects changes in the manufacturing industry.

[90] Bhide, Amar. *The Venturesome Economy*. (New Jersey: Princeton University Press, 2008): 21-23.

With continuing concern about the loss of manufacturing competitiveness, it would be advantageous to compare professional, scientific, and technical services related to the U.S. manufacturing industry to those abroad. In recent years there has been considerable concern regarding the hollowing out of U.S. manufacturing. An examination of professional, scientific, and technical services in the U.S. and abroad might reveal the extent of this hollowing out trend. Related to this topic is the extent to which supply chain goods and services are imported versus those that are domestically provided. This issue could be examined more closely using the detailed input-output data provided by the BEA. The input-output data used in this report breaks the U.S. economy into a little over 60 sectors with 19 of them being manufacturing. The detailed input-output data breaks the economy into over 400 sectors with over 250 being manufacturing. Examination of these data could reveal important details about inter-industry activity as well as details about the import of manufactured goods. For example, the use of these data could quantify the value of the data and information services used by the manufacturing industry and each of its 250 subsectors.

Although this report depicts the manufacturing industry with a focus on medium- and high-tech industry, the sectors included in these categories are only generally identified. Although the OECD definition of high-tech is commonly used, it seems that there is not a well-established criteria for identifying what types of manufacturing are high-tech, medium-tech, or low-tech. It is often the case that authors refer to medium- and high-tech manufacturing and simply specify the industries to which they are referring. Additionally, those things that are considered high-tech today may not be considered high-tech in the future; that is, the industries in this category change over time. Thus, high-tech cannot be defined by specifying a set of subsectors; rather, it must be defined by a set of criteria. This improved clarity would provide a better understanding of those sectors that might be more advantageous to invest additional research and development.

This report has brought together multiple data sources of aggregate manufacturing industry data and industry subsector data to develop a quantitative depiction of the U.S. manufacturing industry as it relates to industry stakeholders. It then compared the industry to its international counterparts. This approach has not comprehensively explored all issues within the manufacturing industry; however, it has provided an evidence-based characterization that avoids using anecdotal data.

Literature Cited

Atkinson, Robert D. and David B. Audretsch. "Economic Doctrines and Policy Differences: Has the Washington Policy Debate Been Asking the Wrong Questions?" The Information Technology and Innovation Foundation. September 2008. < http://www.itif.org/files/EconomicDoctrine.pdf>

Banister, Judith. "Manufacturing Employment and Compensation in China." November 2005. <http://www.bls.gov/fls/chinareport.pdf>

BBC. "China Pollution 'Threatens Growth'." February 28, 2011. <http://www.bbc.co.uk/news/world-asia-pacific-12595872>

Beck, Robin. "Hydraulic Fracturing: The Fuss, The Facts, The Future." *Journal of Petroleum Technology.* December (2010): 34-41.

Brodd, Ralph J. "Factors Affecting U.S. Production Decisions: Why are There No Volume Lithium-Ion Battery Manufacturers in the United States." ATP Working Paper 05-01. June 2005. <http://www.atp.nist.gov/eao/wp05-01/wp05-01.pdf>

Bhatnagar, Rohit and Amrik S. Sohal. "Supply Chain Competitiveness: Measuring the Impact of Location Factors, Uncertainty and Manufacturing Practices." *Technovation.* 25 (2005): 443-456.

Bhide, Amar. *The Venturesome Economy*. (New Jersey: Princeton University Press, 2008): 21-23.

Bureau of Economic Analysis. "U.S. Economic Accounts." <http://www.bea.gov/>

Bureau of Labor Statistics. "Producer Price Indexes: How Does the Producer Price Index Differ from the Consumer Price Index." <http://www.bls.gov/ppi/ppicpippi.htm>

Bureau of Labor Statistics. "BLS Productivity Statistics." <http://www.bls.gov/bls/productivity.htm>

Byrne, David, Brian K. Kovak, and Bryan Michaels, "Offshoring and Price Measurement in the Semiconductor Industry." In Susan N. Houseman and Kenneth F. Ryder, eds., *Measurement Issues Arising from the Growth of Globalization*. (Washington, DC: National Academy of Public Administration, 2010): 169-194.

Carbaugh, Robert J. *International Economics*. (Mason, OH, South Western Cengage Learning, 2011):78.

CBS News. "As Economy Grows, So Do China's Garbage Woes." October 11, 2009. <http://www.cbsnews.com/stories/2009/10/11/ap/asia/main5377158.shtml>

Census Bureau. "Annual Survey of Manufactures." < http://www.census.gov/manufacturing/asm/>

Census Bureau. "Manufacturers' Shipments, Inventories, and Orders." <http://www.census.gov/manufacturing/m3/>

Center for Public Policy Innovation. "The Decline in Semiconductor Manufacturing in the United States." June 2010. <http://cppionline.org/docs/The-Decline-of-Semiconductor-Manufacturing.pdf>

Committee on Prospering in the Global Economy of the 21st Century: An Agenda for American Science and Technology, National Academy of Sciences, National Academy of Engineering, Institute of Medicine. "Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future." National Academies Press. <http://www.nap.edu/catalog.php?record_id=11463>

Congressional Budget Office. “Factors Underlying the Decline in Manufacturing Employment Since 2000.” December 23, 2008. <http://www.cbo.gov/ftpdocs/97xx/doc9749/12-23-Manufacturing.pdf>

Congressional Budget Office. “Taxing Capital Income: Effective Rates and Approaches to Reform.” 2005. <http://www.cbo.gov/ftpdocs/67xx/doc6792/10-18-Tax.pdf>

Davidson, Adam. “Making It in America.” *The Atlantic*. January/February 2012. <http://www.theatlantic.com/magazine/archive/2012/01/making-it-in-america/8844/?single_page=true>

Davidson, Adam. “The Transformation of American Factory Jobs, In One Company.” NPR. January 13, 2012. <http://www.npr.org/blogs/money/2012/01/13/145039131/the-transformation-of-american-factory-jobs-in-one-company?ft=1&f=100>

Davis, Bob. “The Great Property Bubble of China May be Popping.” June 9, 2011. <http://online.wsj.com/article/SB10001424052702304906004576367121835831168.html>

De Rassenfosse, G. and B. van Pottelsberghe. “A Policy Insight into the R&D Patent Relationship.” ULB Working Paper. 2008.

Economist. “Converging Economies: One-Track Bind.” September 24, 2011. <http://www.economist.com/node/21528985>

Economist. “The Dwindling Allure of Building Factories Offshore.” May 12, 2011. <http://www.economist.com/node/18682182?fsrc=rss&story_id=18682182>

Engardio, Pete. “Can the Future Be Built in America.” Bloomberg Businessweek. April 26, 2009. <http://www.businessweek.com/magazine/content/09_38/b4147046115750.htm>

Greenwald, Bruce C.N. and Judd Kahn. *Globalization: The Irrational Fear that Someone in China will Take Your Job*. (Hoboken, NJ: John Wiley & Sons, 2009).

Hopp, Wallace J. and Mark L. Spearman. *Factory Physics*. Third Edition. (Long Grove, IL: Waveland Press, 2011). 37-38.

Harney, Alexandra. The China Price. (London, England: The Penguin Press, 2008).

Horowitz, Karen J. and Mark A. Planting. *Concepts and Methods of the U.S. Input-Output Accounts.* Bureau of Economic Analysis. 2009. <http://www.bea.gov/papers/pdf/IOmanual_092906.pdf>

Houseman, Susan. “Outsourcing, Offshoring, and Productivity Measurement in U.S. Manufacturing.” Upjohn Institute Staff Working Paper No. 06-130. June 2006. <http://www.upjohninst.org/publications/wp/06-130.pdf>

Houseman, Susan, Christopher Kurz, Paul Lengermann, and Benjamin Mandel. “Offshoring and the State of American manufacturing.” W.E. Upjohn Institute for Employment Research. June 2010. <http://www.upjohn.org/publications/wp/10-166.pdf>

IC Insights. Research Bulletin. April 21, 2011. <http://www.icinsights.com/data/articles/documents/263.pdf>

Kelley, Charles, Mark Wang, Gordon Bitko, Michael Chase, Aaron Kofner, Julia Lowell, James Mulvenon, David Ortiz, and Kevin Pollpeter. “High-Technology Manufacturing and U.S. Competitiveness.” RAND Technical Report. March 2004. <http://www.rand.org/pubs/technical_reports/2004/RAND_TR136.pdf>

Krugman, Paul. “Competitiveness, A Dangerous Obsession.” *Foreign Affairs*. Vol 73. Num 2. March/April (1994): 28-44.

Krugman, Paul. “Making Sense of the Competitiveness Debate.” *Oxford Review of Economic Policy*. Vol. 12 no. 3 (1996): 17-25.

Krugman, Paul R. and Robert Z. Lawrence. “Trade, Jobs, and Wages,” Scientific American, April (1994): 22-27.

Mandel, Benjamin R. “Why is the U.S. Share of World Merchandise Exports Shrinking.” Federal Reserve Bank of New York: Current Issues. Vol. 18, No. 1. 2012. <http://www.newyorkfed.org/research/current_issues/ci18-1.pdf>

Miller, Ronald E. and Peter D. Blair. *Input-Output Analysis: Foundations and Extensions*. (New York: Cambridge University Press, 2009). 16.

National Public Radio. “Stopping the ‘Brain Drain’ of the U.S. Economy.” February 6, 2012. <http://www.npr.org/2012/02/05/146434854/stopping-the-brain-drain-of-the-u-s-economy?ft=1&f=100>

National Science Board. “Research and Development: Essential Foundation for U.S. Competitiveness in a Global Economy.” 2008. <http://www.nsf.gov/statistics/nsb0803/nsb0803.pdf>

National Science Foundation. “Advancing Measures of Innovation.” June 2006. <http://www.nsf.gov/statistics/nsf07306/>

National Science Foundation. “Asia’s Rising Science and Technology Strength.” May 2007. <http://www.nsf.gov/statistics/nsf07319/>

National Science Foundation. “Business and Industrial R&D.” <http://www.nsf.gov/statistics/industry/>

Neary, J. Peter. “Measuring Competitiveness.” IMF Working Paper WP/06/209. September 2006. <http://www.imf.org/external/pubs/ft/wp/2006/wp06209.pdf>

Nordhaus, William. “The Sources of the Productivity Rebound and the Manufacturing Employment Puzzle.” NBER Working Paper. May 2005. <http://www.nber.org/papers/w11354>

OECD. “Measuring Globalisation: OECD Handbook on Economic Globalisation Indicators.” May 2005. <http://www.oecd-ilibrary.org/economics/measuring-globalisation-oecd-handbook-on-economic-globalisation-indicators-2005_9789264108103-en >

OECD. *OECD Patent Statistics Manual*. 2009. <http://browse.oecdbookshop.org/oecd/pdfs/free/9209021e.pdf>

OECD. “StatExtracts.” <http://stats.oecd.org/Index.aspx>

Pisano, Gary P. and Willy C. Shih. Restoring American Competitiveness. *Harvard Business Review*. July-August (2009).

Porter, Michael E. “Building the Microeconomic Foundations of Prosperity: Findings from the Business Competitiveness Index.” In Porter, Michael E., Klaus Schwab, Xavier Sala-i-Martin, and Augusta Lopez-Claros. The Global Competitiveness Report 2003-2004. (New York: Oxford University Press, 2004).

Porter, Michael E. *The Competitive Advantage of Nations*. 1st ed. (New York: The Free Press, 1990).

Rowthorn, Robert and Ramana Ramaswamy. “Deindustrialization: Causes and Implications,” International Monetary Fund Working Paper WP/97/42. April 1997.

Schweitzer, Mark and Saeed Zaman. “Are we Engineering Ourselves out of Manufacturing Jobs.” Federal Reserve Bank of Cleveland. January 2006.
<http://www.clevelandfed.org/research/commentary/2006/0101.pdf>

SEMI. Semiconductor, LED, and MEMS Fabs and Foundries. <http://www.semi.org/en/>

Shepherd, Robert J. “The People’s Dynasty: Culture and Society in Modern China.” Modern Scholar. Lecture Series. 2010.

Sirkin, Harold L. “Made in the USA Still Means Something.” Bloomberg Businessweek. April 10, 2009.
<http://www.businessweek.com/managing/content/apr2009/ca20090410_054122.htm>

Slaughter, Matthew J. “How U.S. Multinational Companies Strengthen the U.S. Economy.” United States Council for International Business. March 2010.
<http://www.uscib.org/docs/foundation_multinationals.pdf>

Tassey Gregory. “Rationales and Mechanisms for Revitalizing U.S. Manufacturing R&D Strategies.” *Journal of Technology Transfer*. 35 (2010). 283-333.

Toder, Eric. “International Competitiveness: Who Competes Against Whom and for What?” Tax Policy Center: Urban Institute and Brookings Institution. January 2012.
<http://www.taxpolicycenter.org/UploadedPDF/412477-international-competitiveness.pdf>

United Nations Statistics Division. “National Accounts Main Aggregates Database.”
<http://unstats.un.org/unsd/snaama/Introduction.asp>

UNIDO. “Statistical Country Briefs.” <http://www.unido.org/index.php?id=1000313>

UNIDO Strategic Research Database. Competitive Industrial Performance Index. 2003.
<http://www.unido.org/index.php?id=5058>

UNIDO. “Industrial Development Scoreboard: Technical Notes.”
<http://www.unido.org/index.php?id=5058>

US-China Business Council. “US Manufacturing: Dying… Or Still Going Strong?” 2006.
<https://www.uschina.org/public/documents/2006/09/us-manufacturing.pdf>

Ward, William A. “Manufacturing Productivity and the Shifting US, China, and Global Job Scenes—1990 to 2005.” Clemson University Center for International Trade Working Paper 052507. August 2005.
<http://ageconsearch.umn.edu/bitstream/112948/2/citpaper12.pdf>

World Bank. *World Development Indicators.* Washington DC, World Bank, 2011. 314-317.

World Economic Forum. *The Global Competitiveness Report*. 2010-2011.
<http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2010-11.pdf>

Yamano, Norihiki and Nadim Ahmad. “The OECD Input-Output Database: 2006 Edition.
DSTI/DOC(2006)8. STI Working Paper 2006/8. October 2006.
<http://www.oecd.org/dataoecd/46/54/37585924.pdf>

Zhang, Kevin Honglin. “Is China the World Factory.” In *China as the World Factory*. (New York: Routeledge, 2006).

Appendix A: Global Competitiveness Index Rankings (World Economic Forum)

Table A.1 below represents the Global Competitiveness Index Rankings for the United States and 8 other countries. The Global Competitiveness Report is a yearly report published by the World Economic Forum that ranks the world's nations according to the Global Competitiveness Index. This report is commonly cited in reference to competitiveness issues. The ranking uses a weighted average of multiple components, which are categorized into 12 pillars of economic competitiveness highlighted in grey: institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labor market efficiency, financial market development, technological readiness, market size, business sophistication, and innovation.[91] The ranking from each pillar was used to create Figure 3.8. In Table A.1, the pillars include subcategories. Although this index measures the economy as a whole, it does provide insight into areas related to manufacturing. Note that the red bars are a visual comparison between countries; the shorter the bar the higher the ranking is when compared to the countries shown. Subcategories are highlighted in yellow if the U.S. ranks below the 70th percentile (ranks at or below 42nd) and red if it is below the 50th percentile (ranks at or below 70th). The overall rank for the U.S. was 4th while Switzerland, Sweden, and Singapore were ranked 1st, 2nd, and 3rd respectively.

[91] World Economic Forum. *The Global Competitiveness Report*. 2010-2011. <http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2010-11.pdf>

Table A.1: Global Competitiveness Index Rankings among 139 countries (World Economic Forum), 2010-2011

	United States	Australia	Canada	China	Germany	India	Japan	Mexico	UK
Overall Rank	**4**	**16**	**10**	**27**	**5**	**51**	**6**	**66**	**12**
	United States	Australia	Canada	China	Germany	India	Japan	Mexico	UK
Market size	**1**	**18**	**14**	**2**	**5**	**4**	**3**	**12**	**6**
Domestic market size index	1	17	14	2	5	4	3	11	6
foreign market size index	2	30	18	1	3	4	9	15	5
	United States	Australia	Canada	China	Germany	India	Japan	Mexico	UK
Innovation	**4**	**21**	**11**	**26**	**8**	**39**	**4**	**78**	**14**
University-industry collaboration in R&D	1	13	7	25	9	58	19	59	4
Utility patents per million population	3	17	10	51	9	59	2	60	20
Quality of scientific research institutions	4	10	8	39	6	30	15	60	3
Availability of scientists and engineers	4	45	6	35	27	15	2	89	29
Gov't procurement of advanced tech products	5	37	26	12	32	76	41	96	53
Capacity for innovation	6	23	19	21	1	33	2	86	15
Company spending on R&D	6	23	20	22	4	37	3	90	14
	United States	Australia	Canada	China	Germany	India	Japan	Mexico	UK
Labor Market Efficiency	**4**	**11**	**6**	**38**	**70**	**92**	**13**	**120**	**8**
Rigidity of employment	1	1	8	78	108	77	36	104	18
Redundancy costs	1	6	55	114	98	89	6	81	40
Brain drain	3	22	9	37	31	34	26	74	10
Hiring and firing practices	6	79	15	62	133	89	121	120	49
Pay and productivity	9	53	30	15	43	61	12	98	25
Reliance on professional management	15	8	5	50	14	49	16	102	7
Cooperation in labor-employer relations	33	43	28	58	18	49	7	74	26
Flexibility of wage determination	34	110	33	56	136	61	15	92	20
Female participation in labor force	49	51	24	23	44	128	88	117	47

	United States	Australia	Canada	China	Germany	India	Japan	Mexico	UK
Business sophistication	**8**	**29**	**16**	**41**	**3**	**44**	**1**	**67**	**9**
Extent of marketing	1	16	10	49	7	57	9	72	4
State of cluster development	6	35	11	17	12	29	2	50	10
Control of international distribution	8	31	36	42	2	64	1	76	19
Willingness to delegate authority	8	12	7	68	9	48	13	86	16
Local supplier quantity	11	37	20	19	3	7	1	71	23
Production process sophistication	11	24	15	55	2	43	1	61	17
Local supplier quality	14	16	7	54	3	60	4	55	30
Value chain breadth	15	78	33	41	1	42	2	49	11
Nature of competititive advantage	19	59	56	48	3	61	1	85	9
	United States	Australia	Canada	China	Germany	India	Japan	Mexico	UK
Higher education and training	**9**	**14**	**8**	**60**	**19**	**85**	**20**	**79**	**18**
Tertiary education enrollment rate	6	13	27	88	52	101	34	80	35
Local availability of research and training services	10	20	11	50	2	51	13	55	12
Extent of staff training	10	20	12	57	8	59	6	84	28
Quality of management schools	11	17	3	63	31	23	65	52	10
Internet access in schools	14	28	13	22	39	70	40	89	18
Quality of the educational system	26	12	5	53	18	39	35	120	28
Secondary education enrollment rate	45	1	19	92	18	108	21	61	28
Quality of math and science education	52	24	10	33	39	38	28	128	55
	United States	Australia	Canada	China	Germany	India	Japan	Mexico	UK
Infrastructure	**15**	**22**	**9**	**50**	**2**	**86**	**11**	**75**	**8**
Available airline seat kilometers	1	6	10	2	5	12	4	20	3
Fixed telephone lines	16	23	12	57	5	110	34	72	11
Quality of railroad infrastructure	18	26	16	27	5	23	3	76	19
Quality of roads	19	30	17	53	5	90	22	62	35
Quality of port infrastructure	22	46	14	67	5	83	37	89	23
Quality of overall infrastructure	23	34	13	72	9	91	15	79	33
Quality of electricity supply	23	33	14	52	6	110	5	91	15
Quality of air transport infrastructure	32	30	23	79	3	71	54	65	34
Mobile telephone subscriptions	71	42	100	111	26	118	75	93	24

	United States	Australia	Canada	China	Germany	India	Japan	Mexico	UK
Technological readiness	**17**	**23**	**16**	**78**	**10**	**86**	**28**	**71**	**8**
Availability of latest technologies	7	22	14	94	17	41	18	74	15
Firm-level technology absorption	11	19	22	61	14	39	3	87	21
Broadband Internet subscriptions	16	18	12	56	10	100	20	51	11
Internet users	17	20	15	77	14	118	21	85	9
Internet bandwidth	29	40	18	80	12	119	39	89	6
Foreign Direct Investment and technology transfer	55	22	29	80	85	28	68	32	17
	United States	Australia	Canada	China	Germany	India	Japan	Mexico	UK
Goods Market Efficiency	**26**	**18**	**11**	**43**	**21**	**71**	**17**	**96**	**22**
Extent of market dominance	9	11	13	23	1	26	2	127	10
Time required to start a business	13	2	9	108	65	93	77	45	45
Buyer sophistication	13	16	6	7	18	43	1	79	8
Intesity of local competition	16	11	20	19	2	30	7	98	8
Effectiveness of anti-monopoy policy	17	15	14	50	3	29	7	116	8
Degree of customer orientation	22	20	13	70	11	64	1	68	44
Trade tariffs	32	55	38	122	4	124	36	92	4
Number of procedures required to start a business	34	3	1	126	88	121	73	73	34
Prevalence of foreign ownership	47	19	11	103	36	81	97	22	7
Burden of customs procedures	48	24	27	46	21	81	41	87	31
Agricultural policy costs	58	9	28	5	85	81	133	126	53
Prevalence of trade barriers	67	24	45	69	36	96	85	55	21
Extent and effect of taxation	71	66	48	29	90	36	102	113	95
Business impact of rules on FDI	77	57	48	18	63	46	91	64	14
Total tax rate	89	94	79	122	84	123	111	104	54
	United States	Australia	Canada	China	Germany	India	Japan	Mexico	UK
Financial market development	**31**	**3**	**12**	**57**	**36**	**17**	**39**	**96**	**25**
Venture capital availability	13	12	19	27	52	31	49	96	38
Availability of financial services	15	14	2	71	8	45	41	79	5
Legal rights index	20	6	60	60	39	20	39	86	6
Affordability of financial services	21	25	14	44	18	38	33	105	10
Ease of access to loans	34	16	24	51	69	39	46	96	74
Financing through local equity market	36	15	8	52	49	10	24	94	32
Regulation of securities exchanges	64	10	22	61	35	15	40	91	42
Restriction on capital flows	69	32	39	123	15	75	51	42	10
Soundness of banks	111	3	1	60	112	25	77	42	133

	United States	Australia	Canada	China	Germany	India	Japan	Mexico	UK
Instititutions	**40**	**14**	**11**	**49**	**13**	**58**	**25**	**106**	**17**
Strength of investor protection	5	45	5	77	77	33	16	33	10
Intellectual property protection	24	14	13	49	9	66	21	85	17
Reliability of police services	26	19	7	51	12	68	22	132	31
Efficacy of corporate boards	28	7	4	85	15	76	19	112	16
Ethical behavior of firms	30	10	8	55	13	70	18	93	14
Efficiency of legal framework in settling disputes	33	12	14	44	15	47	27	102	8
Diversion of public funds	34	13	16	55	14	71	27	98	11
Judicial independence	35	9	11	62	5	41	20	92	8
Efficiency of legal framework in challenging regulations	35	13	18	51	8	37	33	77	16
Property rights	40	14	10	38	8	61	23	88	17
Irregular Payments and bribes	40	16	12	63	20	83	11	91	21
Protection of minority shareholders' interests	40	15	8	66	13	55	27	81	17
Transparency of government policymaking	41	19	11	38	13	42	48	79	34
Burden of government regulation	49	60	41	21	92	95	70	116	89
Public trust of politicians	54	17	23	22	29	88	58	94	55
favoritism in decisions of government officials	55	19	20	37	16	72	14	83	23
Strength of auditing and reporting standards	55	14	6	61	21	45	33	68	22
Wastefulness of government spending	68	21	32	35	33	57	91	81	72
Business costs of crime and violence	84	45	49	47	23	67	53	132	55
Organized crime	86	32	50	76	28	73	71	136	39
Business costs of terrorism	125	80	96	79	56	127	95	112	99

	United States	Australia	Canada	China	Germany	India	Japan	Mexico	UK
Health and Primary Education	**42**	**13**	**6**	**37**	**25**	**104**	**9**	**70**	**19**
Business impact of malaria	1	1	1	90	1	102	1	74	1
Malaria incidence	1	1	1	80	1	108	1	81	1
Tuberculosis incidence	6	20	8	86	9	101	45	42	32
Life expectancy	34	7	11	70	19	109	1	51	21
Quality of primary education	34	14	9	35	36	98	20	120	27
Infant mortality	41	28	35	75	20	111	6	70	28
Business impact of tuberculosis	53	35	9	74	11	87	50	44	36
Primary education enrollment rate	79	42	8	7	27	95	2	29	6
Business impact of HIV/AIDS	80	53	25	56	12	99	42	78	54
HIV prevalence	89	55	77	22	22	71	1	71	55

	United States	Australia	Canada	China	Germany	India	Japan	Mexico	UK
Macroeconomic Environment	**87**	**17**	**36**	**4**	**23**	**73**	**105**	**28**	**56**
Country credit rating	11	14	4	32	6	50	16	45	18
Inflation	15	49	24	10	20	123	4	96	54
Interest rate spread	26	35	20	33	28	65	7	62	2
Government budget balance	118	67	34	35	26	81	134	19	117
Government debt	122	23	120	18	114	115	137	50	108
National savings rate	130	46	80	3	56	9	51	59	107

Appendix B: IMD World Competitiveness Yearbook, 2011

The World Competitiveness Yearbook is a product of the International Institute for Management Development's (IMD) World Competitiveness Center. The Yearbook is a ranking of nations based on their ability to create and maintain an environment where enterprises can compete. This environment is broken into 4 factors: economic performance, government efficiency, business efficiency, and infrastructure. Each of these factors is broken into 5 sub-factors for a total of 20, which are given equal weight in determining overall rank among the 59 countries evaluated. There are over 300 criteria used to determine the sub-factors. The rankings for the U.S. and a selection of other nations are shown below. Note that the red bars are a visual comparison between countries; the shorter the bar the higher the ranking is when compared to the countries shown. Subcategories are highlighted in yellow if the U.S. ranks below the 70th percentile and red if it is below the 50th percentile.

Table B.1: IMD World Competitiveness Yearbook

	United States	Australia	Canada	China	Germany	India	Japan	Mexico	UK
Overall Rank (out of 59 countries)	1	9	7	19	10	32	26	38	20
Domestic Economy	1	14	11	4	6	8	7	29	21
Scientific Infrastructure	1	13	11	10	3	28	2	38	9
International Investment	2	17	12	20	6	24	54	27	5
Tech. Infrastructure	2	25	9	20	13	22	26	55	17
Productivity and Efficiency	5	25	17	19	11	34	28	39	23
Business Legislation	9	4	8	47	22	48	27	53	16
Basic Infrastructure	9	17	2	7	5	50	20	49	26
Prices	10	36	16	32	14	39	45	11	20
International Trade	12	14	35	7	11	30	45	43	36
Institutional Framework	12	28	14	6	11	18	24	39	10
Finance	13	5	3	35	15	18	20	44	24
Management Practices	14	5	7	37	15	33	24	42	39
Societal Framework	18	9	11	42	5	40	35	52	19
Labor Market	18	12	23	4	30	13	26	32	35
Health and Environment	18	9	10	53	8	58	11	44	21
Education	18	8	7	43	16	59	34	54	17
Attitudes and Values	22	2	6	28	27	9	36	46	30
Employment	26	8	18	1	16	8	13	15	31
Fiscal Policy	26	19	17	52	54	14	36	27	35
Public Finance	53	17	36	12	43	40	58	21	54

Appendix C: Annual Survey of Manufactures, Medium- and High-Tech Sectors (2009)

The Annual Survey of Manufactures (ASM) is conducted every year except for years ending in 2 or 7 when the Economic Census is conducted. The ASM provides statistics on employment, payroll, supplemental labor costs, cost of materials consumed, operating expenses, value of shipments, value added, fuels and energy used, and inventories. It uses a sample survey of approximately 50 000 establishments with new samples selected at 5-year intervals. The ASM data allow the examination of multiple factors (value added, payroll, energy use, and more) of manufacturing at a detailed subsector level. The Economic Census, used for years ending in 2 or 7, is a survey of all employer establishments in the U.S. that has been taken as an integrated program at 5-year intervals since 1967. Both the ASM and the Economic Census use NAICS classification; however, prior to NAICS the Standard Industrial Classification system was used. Detailed 2009 data is shown in Table C.1, which contains the number of employees, value added, total value of shipments, net income, and other metrics for chemical manufacturing (NAICS 325); machinery manufacturing (NAICS 333); computer and electronic products manufacturing (NAICS 334); electrical equipment, appliance, and component manufacturing (NAICS 335); and transportation equipment manufacturing (NAICS 336) along with all the subsectors.

Table C.1: Annual Survey of Manufactures: Medium- and High-tech Sectors

		Number of Employees	Value Added ($1000)	Total Value of Shipments ($1000)	Net Income ($1000)	Compensation per Employee ($1000)	Value Added per Employee ($1000)	Net Income per Employee ($1000)	Net Income per Expenditure Dollar ($1000)
325	Chemical mfg	724 683	328 870 852	628 945 803	181 231 086	85.9	453.8	250.1	0.426
3251	Basic chemical mfg	142 143	66 710 327	175 439 319	24 952 054	93.6	469.3	175.5	0.176
32511	Petrochemical manufacturing	9 167	18 846 611	52 086 422	14 466 939	127.9	2055.9	1578.2	0.399
325110	Petrochemical manufacturing	9 167	18 846 611	52 086 422	14 466 939	127.9	2055.9	1578.2	0.399
32512	Industrial gas manufacturing	9 287	4 930 678	7 499 403	1 999 242	90.5	530.9	215.3	0.405
325120	Industrial gas manufacturing	9 287	4 930 678	7 499 403	1 999 242	90.5	530.9	215.3	0.405
32513	Synthetic dye and pigment manufacturing	9 549	3 070 544	6 212 514	1 332 338	87.8	321.6	139.5	0.300
32513M	Synthetic dye and pigment manufacturing	9 549	3 070 544	6 212 514	1 332 338	87.8	321.6	139.5	0.300
32518	Other basic inorganic chemical manufacturing	37 420	16 066 348	27 796 541	6 801 242	95.4	429.4	181.8	0.343
325181	Alkalies and chlorine manufacturing	5 973	2 856 531	5 376 112	1 026 361	108.7	478.2	171.8	0.247
325182	Carbon black manufacturing	1 489	418 525	1 183 144	78 401	87.3	281.1	52.7	0.078
325188	All other basic inorganic chemical manufacturing	29 958	12 791 293	21 237 284	5 696 477	93.2	427.0	190.1	0.389
32519	Other basic organic chemical manufacturing	76 720	23 796 146	81 844 439	352 292	89.7	310.2	4.6	0.005
32519M	Other basic organic chemical manufacturing	76 720	23 796 146	81 844 439	352 292	89.7	310.2	4.6	0.005
3252	Resin, syn rubber, & artificial syn fibers & filaments mfg	81 177	27 236 501	72 112 280	10 442 794	82.7	335.5	128.6	0.178
32521	Resin and synthetic rubber manufacturing	67 932	25 447 365	66 857 343	10 359 499	87.3	374.6	152.5	0.192
325211	Plastics material and resin manufacturing	59 202	23 057 280	60 744 217	9 844 146	85.9	389.5	166.3	0.203
325212	Synthetic rubber manufacturing	8 730	2 390 085	6 113 126	515 353	96.8	273.8	59.0	0.095
32522	Artificial and synthetic fibers and filaments manufacturing	13 246	1 789 136	5 254 937	83 297	59.5	135.1	6.3	0.017
32522M	Artificial and synthetic fibers and filaments manufacturing	13 246	1 789 136	5 254 937	83 297	59.5	135.1	6.3	0.017
3253	Pesticide, fertilizer, & other agricultural chemical mfg	26 794	16 142 416	32 950 257	8 938 460	75.5	602.5	333.6	0.396
32531	Fertilizer manufacturing	17 373	8 704 599	20 963 464	3 753 707	74.8	501.0	216.1	0.235
325311	Nitrogenous fertilizer manufacturing	3 950	3 775 018	7 054 673	2 188 935	92.9	955.7	554.2	0.492
325312	Phosphatic fertilizer manufacturing	6 065	3 012 934	8 688 260	834 340	83.6	496.8	137.6	0.115
325314	Fertilizer (mixing only) manufacturing	7 358	1 916 647	5 220 531	730 431	58.0	260.5	99.3	0.169
32532	Pesticide and other agricultural chemical manufacturing	9 422	7 437 817	11 986 793	5 184 755	76.6	789.4	550.3	0.788
325320	Pesticide and other agricultural chemical manufacturing	9 422	7 437 817	11 986 793	5 184 755	76.6	789.4	550.3	0.788
3254	Pharmaceutical & medicine mfg	236 439	140 568 339	191 409 938	94 384 540	99.9	594.5	399.2	1.018
32541	Pharmaceutical and medicine manufacturing	236 439	140 568 339	191 409 938	94 384 540	99.9	594.5	399.2	1.018
325411	Medicinal and botanical manufacturing	26 647	6 868 675	10 780 248	2 088 565	94.9	257.8	78.4	0.253

		Number of Employees	Value Added ($1000)	Total Value of Shipments ($1000)	Net Income ($1000)	Compensation per Employee ($1000)	Value Added per Employee ($1000)	Net Income per Employee ($1000)	Net Income per Expenditure Dollar ($1000)
325412	Pharmaceutical preparation manufacturing	143 792	106 165 160	141 936 232	78 832 874	98.3	738.3	548.2	1.315
325413	In-vitro diagnostic substance manufacturing	26 516	8 134 126	11 878 476	2 507 315	107.0	306.8	94.6	0.275
325414	Biological product (except diagnostic) manufacturing	39 484	19 400 377	26 814 983	10 955 785	104.5	491.3	277.5	0.711
3255	Paint, coating, & adhesive mfg	54 419	14 000 152	29 202 317	6 960 821	70.9	257.3	127.9	0.325
32551	Paint and coating manufacturing	33 873	9 703 320	19 630 904	5 345 374	72.4	286.5	157.8	0.388
325510	Paint and coating manufacturing	33 873	9 703 320	19 630 904	5 345 374	72.4	286.5	157.8	0.388
32552	Adhesive manufacturing	20 545	4 296 831	9 571 413	1 615 450	68.4	209.1	78.6	0.212
325520	Adhesive manufacturing	20 545	4 296 831	9 571 413	1 615 450	68.4	209.1	78.6	0.212
3256	Soap, cleaning compound, & toilet preparation mfg	97 604	44 800 949	86 992 023	28 531 518	69.5	459.0	292.3	0.507
32561	Soap and cleaning compound manufacturing	43 612	24 824 391	48 470 784	16 739 308	72.4	569.2	383.8	0.550
32561M	Soap and cleaning compound manufacturing	43 612	24 824 391	48 470 784	16 739 308	72.4	569.2	383.8	0.550
32562	Toilet preparation manufacturing	53 992	19 976 559	38 521 239	11 792 207	67.1	370.0	218.4	0.458
325620	Toilet preparation manufacturing	53 992	19 976 559	38 521 239	11 792 207	67.1	370.0	218.4	0.458
3259	Other chemical product & preparation mfg	86 106	19 412 167	40 839 669	7 020 901	68.7	225.4	81.5	0.217
32591	Printing ink manufacturing	12 131	1 827 126	4 265 317	331 346	63.0	150.6	27.3	0.086
325910	Printing ink manufacturing	12 131	1 827 126	4 265 317	331 346	63.0	150.6	27.3	0.086
32592	Explosives manufacturing	6 303	1 177 942	2 045 937	388 698	70.8	186.9	61.7	0.241
325920	Explosives manufacturing	6 303	1 177 942	2 045 937	388 698	70.8	186.9	61.7	0.241
32599	All other chemical product and preparation manufacturing	67 672	16 407 100	34 528 415	6 300 854	69.5	242.5	93.1	0.234
325991	Custom compounding of purchased resins	16 712	2 276 233	7 297 569	372 921	63.8	136.2	22.3	0.056
32599N	All other miscellaneous chemical product and preparation mfg	50 959	14 130 867	27 230 846	5 927 935	71.4	277.3	116.3	0.292
333	Machinery mfg	962 083	133 056 578	287 634 198	24 575 525	66.0	138.3	25.5	0.097
3331	Agriculture, construction, & mining machinery mfg	180 379	31 666 182	75 886 277	9 652 216	66.0	175.6	53.5	0.151
33311	Agricultural implement manufacturing	70 923	12 752 651	30 933 763	5 410 521	61.2	179.8	76.3	0.219
333111	Farm machinery and equipment manufacturing	51 595	10 826 116	23 612 919	5 224 116	65.8	209.8	101.3	0.294
333112	Lawn and garden equipment manufacturing	19 328	1 926 535	7 320 844	186 408	48.7	99.7	9.6	0.027
33312	Construction machinery manufacturing	56 142	9 503 183	24 689 398	2 329 963	63.1	169.3	41.5	0.110
333120	Construction machinery manufacturing	56 142	9 503 183	24 689 398	2 329 963	63.1	169.3	41.5	0.110
33313	Mining and oil and gas field machinery manufacturing	53 314	9 410 347	20 263 115	1 911 728	75.4	176.5	35.9	0.105
33313M	Mining and oil and gas field machinery manufacturing	53 314	9 410 347	20 263 115	1 911 728	75.4	176.5	35.9	0.105
3332	Industrial machinery mfg	109 976	12 272 993	26 417 663	-1 769 644	74.6	111.6	-16.1	-0.066
33321	Sawmill and woodworking machinery manufacturing	3 689	239 619	466 533	-50 750	48.8	65.0	-13.8	-0.105

		Number of Employees	Value Added ($1000)	Total Value of Shipments ($1000)	Net Income ($1000)	Compensation per Employee ($1000)	Value Added per Employee ($1000)	Net Income per Employee ($1000)	Net Income per Expenditure Dollar ($1000)
333210	Sawmill and woodworking machinery manufacturing	3 689	239 619	466 533	-50 750	48.8	65.0	-13.8	-0.105
33322	Plastics and rubber industry machinery manufacturing	12 627	1 366 600	2 959 693	-13 934	65.8	108.2	-1.1	-0.005
333220	Plastics and rubber industry machinery manufacturing	12 627	1 366 600	2 959 693	-13 934	65.8	108.2	-1.1	-0.005
33329	Other industrial machinery manufacturing	93 660	10 666 774	22 991 436	-1 689 804	76.8	113.9	-18.0	-0.072
333295	Semiconductor machinery manufacturing	19 362	1 731 996	5 704 230	-2 389 732	104.7	89.5	-123.4	-0.311
33329N	Other machinery manufacturing	74 297	8 934 778	17 287 206	699 929	69.6	120.3	9.4	0.045
3333	Commercial & service industry machinery mfg	75 385	11 039 940	20 930 670	2 693 144	67.7	146.4	35.7	0.153
33331	Commercial and service industry machinery manufacturing	75 385	11 039 940	20 930 670	2 693 144	67.7	146.4	35.7	0.153
333313	Office machinery manufacturing	5 333	988 941	1 659 541	457 775	70.1	185.4	85.8	0.395
333314	Optical instrument and lens manufacturing	16 348	2 384 283	4 673 039	217 089	82.2	145.8	13.3	0.051
333315	Photographic and photocopying equipment manufacturing	5 503	1 096 295	1 975 217	482 483	66.1	199.2	87.7	0.335
33331N	All other commercial and service industry machinery mfg	48 201	6 570 422	12 622 873	1 535 796	62.7	136.3	31.9	0.143
3334	Ventilation, heating, AC, & commercial refrigeration equip mfg	126 063	15 970 899	34 646 153	4 485 617	55.6	126.7	35.6	0.153
33341	HVAC and commercial refrigeration equipment manufacturing	126 063	15 970 899	34 646 153	4 485 617	55.6	126.7	35.6	0.153
333414	Heating equipment (except warm air furnaces) manufacturing	16 539	1 951 684	3 786 626	-183 262	59.7	118.0	-11.1	-0.048
333415	AC, forced air heating, and refrigeration equipment mfg	86 454	11 641 118	26 308 906	4 222 576	55.8	134.7	48.8	0.197
33341N	Ventilation equipment manufacturing	23 070	2 378 097	4 550 622	446 303	51.9	103.1	19.3	0.113
3335	Metalworking machinery mfg	129 596	11 970 310	20 604 679	-639 099	62.9	92.4	-4.9	-0.032
33351	Metalworking machinery manufacturing	129 596	11 970 310	20 604 679	-639 099	62.9	92.4	-4.9	-0.032
333511	Industrial mold manufacturing	30 488	2 807 137	4 221 870	-152 699	60.8	92.1	-5.0	-0.037
333512	Machine tool (metal cutting types) manufacturing	15 652	1 732 273	3 473 464	-300 061	72.8	110.7	-19.2	-0.084
333513	Machine tool (metal forming types) manufacturing	6 223	620 475	1 217 675	20 517	64.6	99.7	3.3	0.018
333514	Special die and tool, die set, jig, and fixture manufacturing	40 528	3 496 247	5 745 328	-236 893	61.9	86.3	-5.8	-0.042
333515	Cutting tool and machine tool accessory manufacturing	26 469	2 208 315	3 502 270	28 929	55.4	83.4	1.1	0.009
333516	Rolling mill machinery and equipment manufacturing	3 068	394 536	789 668	80 055	73.1	128.6	26.1	0.109
333518	Other metalworking machinery manufacturing	7 168	711 328	1 654 404	-78 949	77.9	99.2	-11.0	-0.048
3336	Engine, turbine, & power transmission equipment mfg	89 434	12 546 873	35 462 893	899 134	68.3	140.3	10.1	0.027
33361	Engine, turbine, and power transmission equipment mfg	89 434	12 546 873	35 462 893	899 134	68.3	140.3	10.1	0.027
333611	Turbine and turbine generator set unit manufacturing	26 200	4 126 854	11 873 050	686 358	77.6	157.5	26.2	0.063
333612	Speed changer, industrial high-speed drive, and gear mfg	12 100	1 481 069	2 787 931	115 969	61.1	122.4	9.6	0.047
333613	Mechanical power transmission equipment manufacturing	13 718	1 796 014	3 300 479	378 400	62.8	130.9	27.6	0.137
333618	Other engine equipment manufacturing	37 416	5 142 936	17 501 433	-281 594	66.2	137.5	-7.5	-0.017

		Number of Employees	Value Added ($1000)	Total Value of Shipments ($1000)	Net Income ($1000)	Compensation per Employee ($1000)	Value Added per Employee ($1000)	Net Income per Employee ($1000)	Net Income per Expenditure Dollar ($1000)
3339	Other general purpose machinery mfg	251 250	37 589 382	73 685 863	9 254 154	67.9	149.6	36.8	0.147
33391	Pump and compressor manufacturing	55 175	11 400 046	20 927 621	4 186 622	76.2	206.6	75.9	0.249
333911	Pump and pumping equipment manufacturing	31 108	6 167 791	11 461 531	1 965 195	77.7	198.3	63.2	0.214
333912	Air and gas compressor manufacturing	19 866	4 558 489	8 375 152	2 057 085	75.9	229.5	103.5	0.308
333913	Measuring and dispensing pump manufacturing	4 201	673 766	1 090 937	164 343	66.6	160.4	39.1	0.179
33392	Material handling equipment manufacturing	73 853	10 950 707	23 479 360	3 314 426	61.0	148.3	44.9	0.167
33392M	Material handling equipment manufacturing	73 853	10 950 707	23 479 360	3 314 426	61.0	148.3	44.9	0.167
33399	All other general purpose machinery manufacturing	122 223	15 238 628	29 278 883	1 753 107	68.3	124.7	14.3	0.066
333991	Power-driven hand tool manufacturing	5 032	822 091	1 563 263	369 862	56.6	163.4	73.5	0.337
333993	Packaging machinery manufacturing	17 451	2 052 170	4 127 960	95 187	74.6	117.6	5.5	0.024
333994	Industrial process furnace and oven manufacturing	9 766	1 116 524	2 071 558	154 303	65.4	114.3	15.8	0.083
33399N	Fluid power equipment manufacturing	29 148	3 449 954	6 965 101	171 745	71.2	118.4	5.9	0.027
33399P	All other miscellaneous general purpose machinery mfg	60 826	7 797 889	14 551 000	962 011	66.5	128.2	15.8	0.073
334	Computer & electronic product mfg	908 299	193 242 334	327 991 364	51 326 615	84.5	212.8	56.5	0.194
3341	Computer & peripheral equipment mfg	90 407	25 973 603	52 530 237	11 156 089	72.6	287.3	123.4	0.277
33411	Computer and peripheral equipment manufacturing	90 407	25 973 603	52 530 237	11 156 089	72.6	287.3	123.4	0.277
334111	Electronic computer manufacturing	39 640	18 163 961	36 155 504	10 003 285	82.1	458.2	252.4	0.390
334112	Computer storage device manufacturing	13 683	3 195 160	6 321 021	753 694	67.8	233.5	55.1	0.141
334113	Computer terminal manufacturing	1 678	217 110	467 003	21 272	89.2	129.4	12.7	0.048
334119	Other computer peripheral equipment manufacturing	35 406	4 397 372	9 586 709	377 839	63.1	124.2	10.7	0.043
3342	Communications equipment mfg	115 293	24 940 758	45 164 081	6 546 738	89.3	216.3	56.8	0.172
33421	Telephone apparatus manufacturing	23 938	3 637 637	8 551 513	548 649	77.4	152.0	22.9	0.070
334210	Telephone apparatus manufacturing	23 938	3 637 637	8 551 513	548 649	77.4	152.0	22.9	0.070
33422	Broadcasting and wireless communications equipment mfg	76 502	19 002 222	32 610 694	5 415 116	95.9	248.4	70.8	0.202
334220	Broadcasting and wireless communications equipment mfg	76 502	19 002 222	32 610 694	5 415 116	95.9	248.4	70.8	0.202
33429	Other communications equipment manufacturing	14 853	2 300 898	4 001 873	582 974	74.2	154.9	39.2	0.173
334290	Other communications equipment manufacturing	14 853	2 300 898	4 001 873	582 974	74.2	154.9	39.2	0.173
3343	Audio & video equipment mfg	10 283	1 463 934	3 275 474	-269 072	61.0	142.4	-26.2	-0.081
33431	Audio and video equipment manufacturing	10 283	1 463 934	3 275 474	-269 072	61.0	142.4	-26.2	-0.081
334310	Audio and video equipment manufacturing	10 283	1 463 934	3 275 474	-269 072	61.0	142.4	-26.2	-0.081
3344	Semiconductor & other electronic component mfg	293 537	58 360 636	96 459 857	13 056 896	71.9	198.8	44.5	0.173
33441	Semiconductor and other electronic component manufacturing	293 537	58 360 636	96 459 857	13 056 896	71.9	198.8	44.5	0.173

		Number of Employees	Value Added ($1000)	Total Value of Shipments ($1000)	Net Income ($1000)	Compensation per Employee ($1000)	Value Added per Employee ($1000)	Net Income per Employee ($1000)	Net Income per Expenditure Dollar ($1000)
334411	Electron tube manufacturing	4 992	591 801	1 106 990	-24 634	70.8	118.5	-4.9	-0.023
334412	Bare printed circuit board manufacturing	24 772	2 101 606	3 749 722	102 827	50.9	84.8	4.2	0.029
334413	Semiconductor and related device manufacturing	120 257	41 433 504	59 240 375	11 930 457	92.3	344.5	99.2	0.292
334414	Electronic capacitor manufacturing	6 108	499 912	824 102	25 809	48.7	81.8	4.2	0.035
334415	Electronic resistor manufacturing	3 876	339 677	548 694	-11 329	54.7	87.6	-2.9	-0.022
334416	Electronic coil, transformer, and other inductor manufacturing	10 029	773 421	1 687 131	7 979	51.2	77.1	0.8	0.005
334417	Electronic connector manufacturing	19 424	2 575 532	3 987 346	652 273	61.7	132.6	33.6	0.208
334418	Printed circuit assembly (electronic assembly) manufacturing	59 171	5 455 307	17 332 394	388 101	58.1	92.2	6.6	0.024
334419	Other electronic component manufacturing	44 910	4 589 874	7 983 103	-1 471	60.5	102.2	0.0	0.000
3345	Navigational, measuring, medical, & control instruments mfg	375 344	79 359 432	125 081 153	20 331 363	97.9	211.4	54.2	0.198
33451	Navigational, measuring, medical, and control instruments mfg	375 344	79 359 432	125 081 153	20 331 363	97.9	211.4	54.2	0.198
334510	Electromedical and electrotherapeutic apparatus manufacturing	63 926	16 469 553	24 913 089	5 157 889	98.7	257.6	80.7	0.267
334511	Search, detection, and navigation system and instrument mfg	142 920	33 399 152	50 552 170	10 000 996	111.4	233.7	70.0	0.249
334512	Automatic environmental control manufacturing	10 646	1 476 840	2 474 232	378 049	68.2	138.7	35.5	0.184
334513	Industrial process variable instruments	32 563	4 772 189	7 688 300	685 862	73.8	146.6	21.1	0.101
334514	Totalizing fluid meter and counting device manufacturing	12 384	2 323 936	4 961 859	813 849	74.2	187.7	65.7	0.197
334515	Electricity and signal testing instrument manufacturing	31 163	5 233 149	7 987 445	167 041	93.9	167.9	5.4	0.022
334516	Analytical laboratory instrument manufacturing	36 827	7 687 180	12 177 335	1 244 580	95.3	208.7	33.8	0.116
334517	Irradiation apparatus manufacturing	14 361	2 989 021	6 036 626	703 942	107.4	208.1	49.0	0.133
334518	Watch, clock, and parts manufacturing	1 678	186 132	330 417	-	59.7	110.9	-	-
334519	Other measuring and controlling device manufacturing	28 876	4 822 280	7 959 681	1 154 040	83.1	167.0	40.0	0.176
3346	Mfg & reproducing magnetic & optical media	23 436	3 143 970	5 480 561	504 596	62.2	134.2	21.5	0.108
33461	Manufacturing and reproducing magnetic and optical media	23 436	3 143 970	5 480 561	504 596	62.2	134.2	21.5	0.108
334611	Software reproducing	2 498	355 831	624 192	-	60.7	142.4	-	-
334612	Audio and video media reproducing	14 973	2 047 940	2 811 913	638 754	50.4	136.8	42.7	0.320
334613	Magnetic and optical recording media manufacturing	5 965	740 199	2 044 456	-	92.5	124.1	-	-
335	Electrical equipment, appliance, & component mfg	352 940	50 498 178	106 650 713	13 768 428	61.8	143.1	39.0	0.155
3351	Electric lighting equipment mfg	47 784	5 814 469	11 540 560	739 537	58.5	121.7	15.5	0.071
33511	Electric lamp bulb and parts manufacturing	7 719	957 935	1 941 446	-56 916	73.3	124.1	-7.4	-0.030
335110	Electric lamp bulb and parts manufacturing	7 719	957 935	1 941 446	-56 916	73.3	124.1	-7.4	-0.030
33512	Lighting fixture manufacturing	40 065	4 856 534	9 599 114	796 454	55.7	121.2	19.9	0.094
33512M	Lighting fixture manufacturing	40 065	4 856 534	9 599 114	796 454	55.7	121.2	19.9	0.094

		Number of Employees	Value Added ($1000)	Total Value of Shipments ($1000)	Net Income ($1000)	Compensation per Employee ($1000)	Value Added per Employee ($1000)	Net Income per Employee ($1000)	Net Income per Expenditure Dollar ($1000)
3352	Household appliance mfg	48 581	8 451 085	18 707 942	3 289 821	55.6	174.0	67.7	0.227
33521	Small electrical appliance manufacturing	10 676	1 883 992	3 875 919	549 109	52.0	176.5	51.4	0.189
33521M	Small electrical appliance manufacturing	10 676	1 883 992	3 875 919	549 109	52.0	176.5	51.4	0.189
33522	Major appliance manufacturing	37 905	6 567 093	14 832 023	2 740 713	56.6	173.3	72.3	0.237
335221	Household cooking appliance manufacturing	10 014	1 438 911	3 835 185	540 600	47.6	143.7	54.0	0.176
335222	Household refrigerator and home freezer manufacturing	10 449	1 707 879	3 649 074	704 189	62.4	163.4	67.4	0.247
335224	Household laundry equipment manufacturing	7 927	1 295 279	3 357 541	-	57.3	163.4	-	-
335228	Other major household appliance manufacturing	9 516	2 125 024	3 990 223	-	59.1	223.3	-	-
3353	Electrical equipment mfg	124 722	17 929 414	36 420 717	5 816 333	62.5	143.8	46.6	0.198
33531	Electrical equipment manufacturing	124 722	17 929 414	36 420 717	5 816 333	62.5	143.8	46.6	0.198
335311	Power, distribution, and specialty transformer manufacturing	19 185	2 891 941	5 989 002	837 196	60.3	150.7	43.6	0.169
335312	Motor and generator manufacturing	37 640	5 098 260	10 855 168	1 851 752	55.3	135.4	49.2	0.217
335313	Switchgear and switchboard apparatus manufacturing	33 917	5 289 214	10 598 214	1 689 870	68.2	155.9	49.8	0.195
335314	Relay and industrial control manufacturing	33 980	4 649 998	8 978 333	1 437 516	66.2	136.8	42.3	0.199
3359	Other electrical equipment & component mfg	131 852	18 303 209	39 981 495	3 922 735	64.5	138.8	29.8	0.114
33591	Battery manufacturing	25 666	4 187 587	9 220 680	1 693 654	61.7	163.2	66.0	0.236
335911	Storage battery manufacturing	18 430	2 379 930	5 508 397	577 409	59.6	129.1	31.3	0.124
335912	Primary battery manufacturing	7 235	1 807 657	3 712 283	1 116 249	66.9	249.8	154.3	0.442
33592	Communication and energy wire and cable manufacturing	29 566	3 969 359	11 404 357	966 411	60.7	134.3	32.7	0.095
33592M	Communication and energy wire and cable manufacturing	29 566	3 969 359	11 404 357	966 411	60.7	134.3	32.7	0.095
33593	Wiring device manufacturing	39 558	5 490 955	9 901 061	1 595 780	58.8	138.8	40.3	0.204
33593M	Wiring device manufacturing	39 558	5 490 955	9 901 061	1 595 780	58.8	138.8	40.3	0.204
33599	All other electrical equipment and component manufacturing	37 063	4 655 309	9 455 398	-333 112	75.5	125.6	-9.0	-0.036
335991	Carbon and graphite product manufacturing	7 790	874 379	1 982 585	-186 283	62.2	112.2	-23.9	-0.093
335999	All other miscellaneous electrical equipment mfg	29 273	3 780 930	7 472 813	-146 827	79.1	129.2	-5.0	-0.020
336	Transportation equipment mfg	1 240 320	229 642 082	545 018 370	65 962 476	78.9	185.1	53.2	0.141
3361	Motor vehicle mfg	123 484	41 968 097	149 900 446	19 353 433	93.6	339.9	156.7	0.154
33611	Automobile and light duty motor vehicle manufacturing	101 510	38 798 362	134 129 035	18 707 916	98.0	382.2	184.3	0.168
336111	Automobile manufacturing	51 440	13 338 967	53 724 061	3 335 421	95.8	259.3	64.8	0.069
336112	Light truck and utility vehicle manufacturing	50 070	25 459 395	80 404 974	15 372 495	100.1	508.5	307.0	0.245
33612	Heavy duty truck manufacturing	21 974	3 169 734	15 771 411	645 516	73.7	144.2	29.4	0.044
336120	Heavy duty truck manufacturing	21 974	3 169 734	15 771 411	645 516	73.7	144.2	29.4	0.044

		Number of Employees	Value Added ($1000)	Total Value of Shipments ($1000)	Net Income ($1000)	Compensation per Employee ($1000)	Value Added per Employee ($1000)	Net Income per Employee ($1000)	Net Income per Expenditure Dollar ($1000)
3362	Motor vehicle body & trailer mfg	89 012	6 877 283	21 289 121	5 190	49.9	77.3	0.1	0.000
33621	Motor vehicle body and trailer manufacturing	89 012	6 877 283	21 289 121	5 190	49.9	77.3	0.1	0.000
336211	Motor vehicle body manufacturing	37 561	3 099 055	9 571 235	-111 467	54.0	82.5	-3.0	-0.012
336212	Truck trailer manufacturing	17 781	1 341 215	4 094 631	68 530	47.1	75.4	3.9	0.018
336213	Motor home manufacturing	6 889	454 220	1 715 710	-37 815	47.9	65.9	-5.5	-0.023
336214	Travel trailer and camper manufacturing	26 781	1 982 792	5 907 545	85 943	46.6	74.0	3.2	0.015
3363	Motor vehicle parts mfg	403 660	51 569 867	130 520 776	5 401 701	62.5	127.8	13.4	0.046
33631	Motor vehicle gasoline engine and engine parts manufacturing	43 338	6 673 109	16 122 589	983 186	70.1	154.0	22.7	0.070
33631M	Motor vehicle gasoline engine and engine parts manufacturing	43 338	6 673 109	16 122 589	983 186	70.1	154.0	22.7	0.070
33632	Motor vehicle electrical and electronic equipment mfg	51 816	6 250 356	13 796 310	483 295	65.1	120.6	9.3	0.038
33632M	Motor vehicle electrical and electronic equipment mfg	51 816	6 250 356	13 796 310	483 295	65.1	120.6	9.3	0.038
33633	Motor vehicle steering and suspension component mfg	33 338	3 032 241	8 092 743	-83 538	54.7	91.0	-2.5	-0.011
336330	Motor vehicle steering and suspension component mfg	33 338	3 032 241	8 092 743	-83 538	54.7	91.0	-2.5	-0.011
33634	Motor vehicle brake system manufacturing	20 021	2 994 044	7 541 072	890 961	55.7	149.5	44.5	0.142
336340	Motor vehicle brake system manufacturing	20 021	2 994 044	7 541 072	890 961	55.7	149.5	44.5	0.142
33635	Motor vehicle transmission and power train parts mfg	46 946	9 417 340	21 046 860	1 385 509	85.1	200.6	29.5	0.076
336350	Motor vehicle transmission and power train parts mfg	46 946	9 417 340	21 046 860	1 385 509	85.1	200.6	29.5	0.076
33636	Motor vehicle seating and interior trim manufacturing	37 555	3 906 049	12 941 768	283 320	56.3	104.0	7.5	0.023
336360	Motor vehicle seating and interior trim manufacturing	37 555	3 906 049	12 941 768	283 320	56.3	104.0	7.5	0.023
33637	Motor vehicle metal stamping	65 146	7 562 837	17 738 909	383 861	63.8	116.1	5.9	0.024
336370	Motor vehicle metal stamping	65 146	7 562 837	17 738 909	383 861	63.8	116.1	5.9	0.024
33639	Other motor vehicle parts manufacturing	105 501	11 733 891	33 240 525	1 075 104	53.1	111.2	10.2	0.035
336391	Motor vehicle air-conditioning manufacturing	11 201	903 056	3 539 306	-317 057	56.8	80.6	-28.3	-0.087
336399	All other miscellaneous motor vehicle parts manufacturing	94 300	10 830 835	29 701 219	1 392 161	52.7	114.9	14.8	0.052
3364	Aerospace product & parts mfg	429 777	99 173 054	178 924 241	35 161 491	99.3	230.8	81.8	0.238
33641	Aerospace product and parts manufacturing	429 777	99 173 054	178 924 241	35 161 491	99.3	230.8	81.8	0.238
336411	Aircraft manufacturing	182 045	49 349 285	95 409 243	19 771 945	104.7	271.1	108.6	0.248
336412	Aircraft engine and engine parts manufacturing	63 393	14 726 478	29 573 759	5 755 190	88.3	232.3	90.8	0.252
336413	Other aircraft parts and auxiliary equipment manufacturing	110 853	21 622 751	32 050 688	8 248 127	84.1	195.1	74.4	0.341
336414	Guided missile and space vehicle manufacturing	50 338	9 646 809	16 141 661	758 293	128.9	191.6	15.1	0.047
336415	Space vehicle propulsion unit and propulsion unit parts mfg	15 486	3 076 885	4 521 328	773 901	103.1	198.7	50.0	0.216
336419	Other guided missile and space vehicle parts manufacturing	7 662	750 847	1 227 563	-145 963	79.4	98.0	-19.1	-0.111

		Number of Employees	Value Added ($1000)	Total Value of Shipments ($1000)	Net Income ($1000)	Compensation per Employee ($1000)	Value Added per Employee ($1000)	Net Income per Employee ($1000)	Net Income per Expenditure Dollar ($1000)
3365	Railroad rolling stock mfg	25 078	4 352 692	12 019 211	1 055 417	77.0	173.6	42.1	0.098
33651	Railroad rolling stock manufacturing	25 078	4 352 692	12 019 211	1 055 417	77.0	173.6	42.1	0.098
336510	Railroad rolling stock manufacturing	25 078	4 352 692	12 019 211	1 055 417	77.0	173.6	42.1	0.098
3366	Ship & boat building	126 824	16 322 216	27 247 521	1 021 226	69.8	128.7	8.1	0.040
33661	Ship and boat building	126 824	16 322 216	27 247 521	1 021 226	69.8	128.7	8.1	0.040
336611	Ship building and repairing	100 372	14 125 452	21 801 484	1 468 171	75.7	140.7	14.6	0.074
336612	Boat building	26 453	2 196 764	5 446 037	-446 947	47.5	83.0	-16.9	-0.082
3369	Other transportation equipment mfg	42 485	9 378 874	25 117 054	3 964 019	75.9	220.8	93.3	0.192
33699	Other transportation equipment manufacturing	42 485	9 378 874	25 117 054	3 964 019	75.9	220.8	93.3	0.192
336991	Motorcycle, bicycle, and parts manufacturing	10 506	2 456 478	5 097 019	924 983	63.7	233.8	88.0	0.236
336992	Military armored vehicle, tank, and tank component mfg	20 285	5 222 991	14 807 987	2 807 727	87.4	257.5	138.4	0.237
336999	All other transportation equipment manufacturing	11 695	1 699 406	5 212 048	231 308	66.9	145.3	19.8	0.048

Appendix D: Schematic Data Map (ASM)

The Annual Survey of Manufactures (ASM) is conducted every year except for years ending in 2 or 7 when the Economic Census is conducted. The ASM provides statistics on employment, payroll, supplemental labor costs, cost of materials consumed, operating expenses, value of shipments, value added, fuels and energy used, and inventories. It uses a sample survey of approximately 50 000 establishments with new samples selected at 5-year intervals. The ASM data allows the examination of multiple factors (value added, payroll, energy use, and more) of manufacturing at a detailed subsector level. The Economic Census, used for years ending in 2 or 7, is a survey of all employer establishments in the U.S. that has been taken as an integrated program at 5-year intervals since 1967. Both the ASM and the Economic Census use NAICS classification; however, prior to NAICS the Standard Industrial Classification system was used.

Table D.1 contains items from the Annual Survey of Manufactures. The color scheme matches that of the color scheme in the manufacturing supply chains in Tables D.2 through D.7 indicating that the items in the table were used to calculate the items in the schematic. For example, the items labeled in green in Table D.1 are used to calculate the items in green in Table D.2. Table D.2 contains the entirety of the manufacturing industry while D.3 through D.7 are a selection of sectors. The sectors were chosen based on being related to the medium- and high-technology manufacturing industry.

Table D.1: Supply Chain Components

ASM Data Item	Schematic name
Number of employees	Payroll, Benefits, and employment
Annual payroll	Payroll, Benefits, and employment
Total fringe benefits	Payroll, Benefits, and employment
Employer's cost for health insurance	
Employer's cost for defined benefit pension plans	
Employer's cost for defined contribution plans	
Employer's cost for other fringe benefits	
Production workers avg per year	
Production workers hours (1,000)	
Production workers wages	
Total cost of materials	
Materials, parts, containers, packaging, etc. used	Materials, parts, containers, packaging, etc used
Cost of resales	Contract work and resales
Contract work	Contract work and resales
Cost of purchased fuels	Purchased fuels and electricity
Purchased electricity	Purchased fuels and electricity
Quantity of electricity purchased	
Quantity of generated electricity	
Quantity of electricity sold or transferred	
Total value of shipments	Shipments
Value of products shipments	
Total miscellaneous receipts	
Value of resales	
Contract receipts	
Other miscellaneous receipts	
Value of interplant transfers	
Value added	Value added
Total EOY inventories	
Finished goods inventories, EOY	Net Inventories Shipped
Work-in-process inventories, EOY	Net Inventories Shipped
Materials and supplies inventories, EOY	
Total BOY inventories	
Finished goods inventories, BOY	Net Inventories Shipped
Work-in-process inventories, BOY	Net Inventories Shipped
Materials and supplies inventories, BOY	
Total capital expenditures (new and used)	
Capital expenditures: buildings & other structures (new and used)	Capital expenditures: buildings and other structures (new and used)
Capital expenditures: machinery and equipment (new and used)	
Capital expenditures: autos, trucks, etc. for highway use	Capital expenditures: machinery and equipment (new and used)
Capital expenditures: computer and data processing equipment	Computer hardware, software, and other equipment
Capital expenditures: all other machinery and equipment	Capital expenditures: machinery and equipment (new and used)
Total depreciation	Depreciation
Total rental payments	
Buildings rentals	Capital expenditures: buildings and other structures (new and used): Rental
Machinery rentals	Capital expenditures: machinery and equipment (new and used): Rental
Total other expenses	
Temporary staff and leased employee expenses	Other costs
Expensed computer hardware and other equipment	Computer hardware, software, and other equipment
Expensed purchases of software	Computer hardware, software, and other equipment
Data processing and other purchased computer services	Professional, technical, and data services
Communication services	Communication services
Repair and maintenance services of buildings and/or machinery	Maintenance and repair
Refuse removal (including hazardous waste) services	Refuse removal
Advertising and promotional services	Other costs
Purchased professional and technical services	Professional, technical, and data services
Taxes and license fees	Other costs
All other expenses	Other costs

Volume of Production=total costs (blue plus orange plus red plus green plus gold)
Net Inventories Shipped=sum of EOY finished goods and work-in-process inventories less the sum of BOY finished goods and work-in-process inventories

Table D.2: Manufacturing Supply Chain

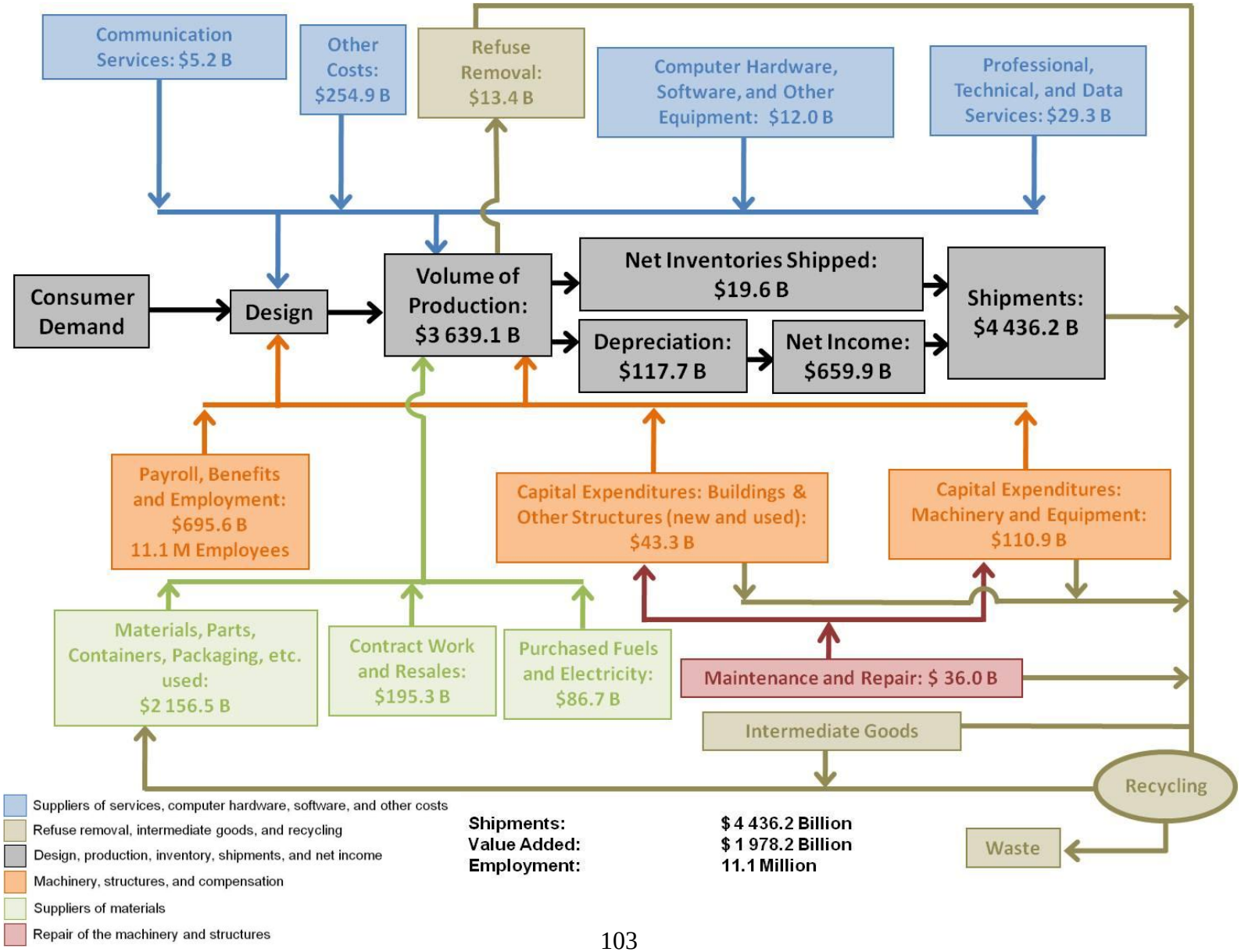


Table D.3: Manufacturing Supply Chain, NAICS 325: Chemical Manufacturing

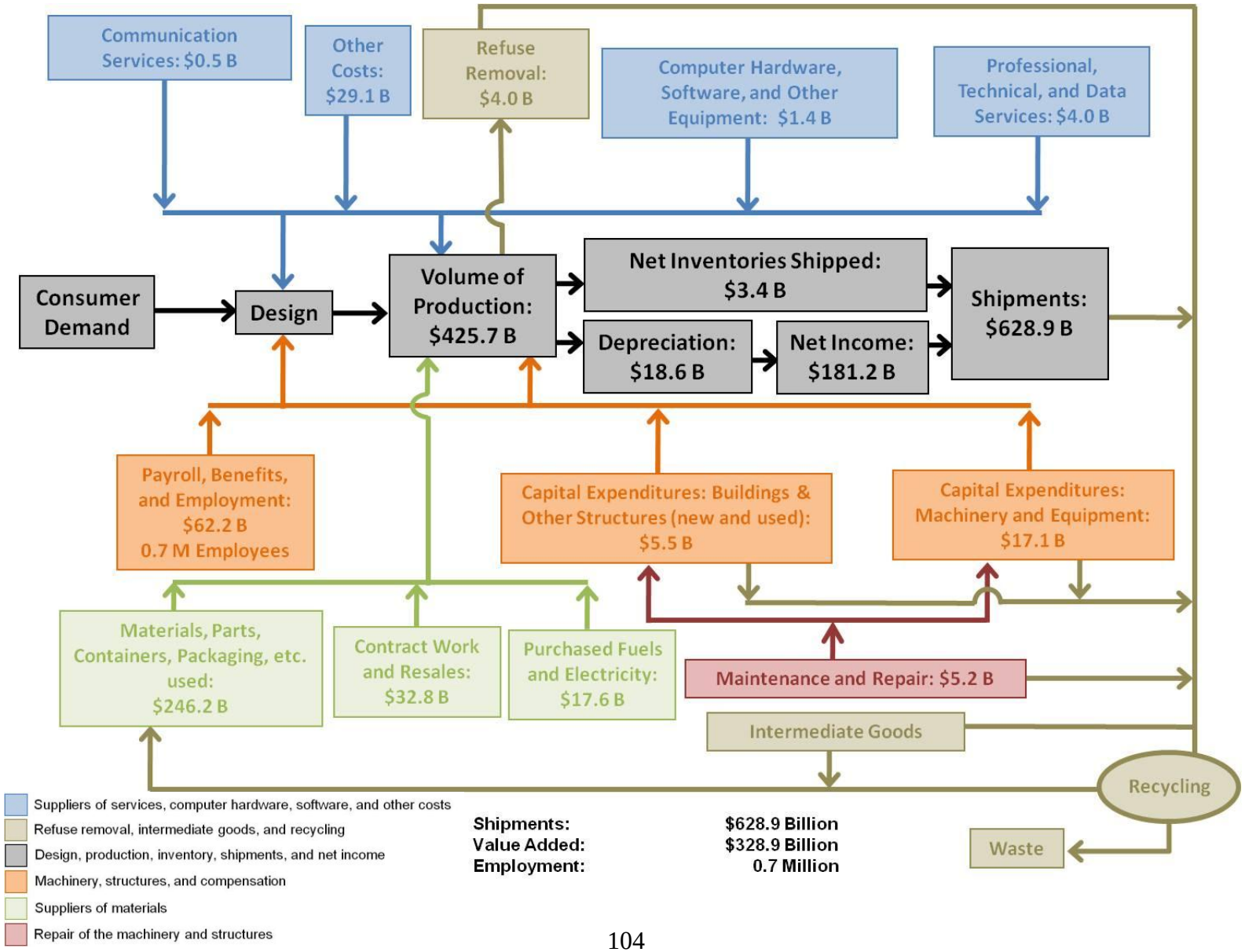


Table D.4: Manufacturing Supply Chain, NAICS 333: Machinery Manufacturing

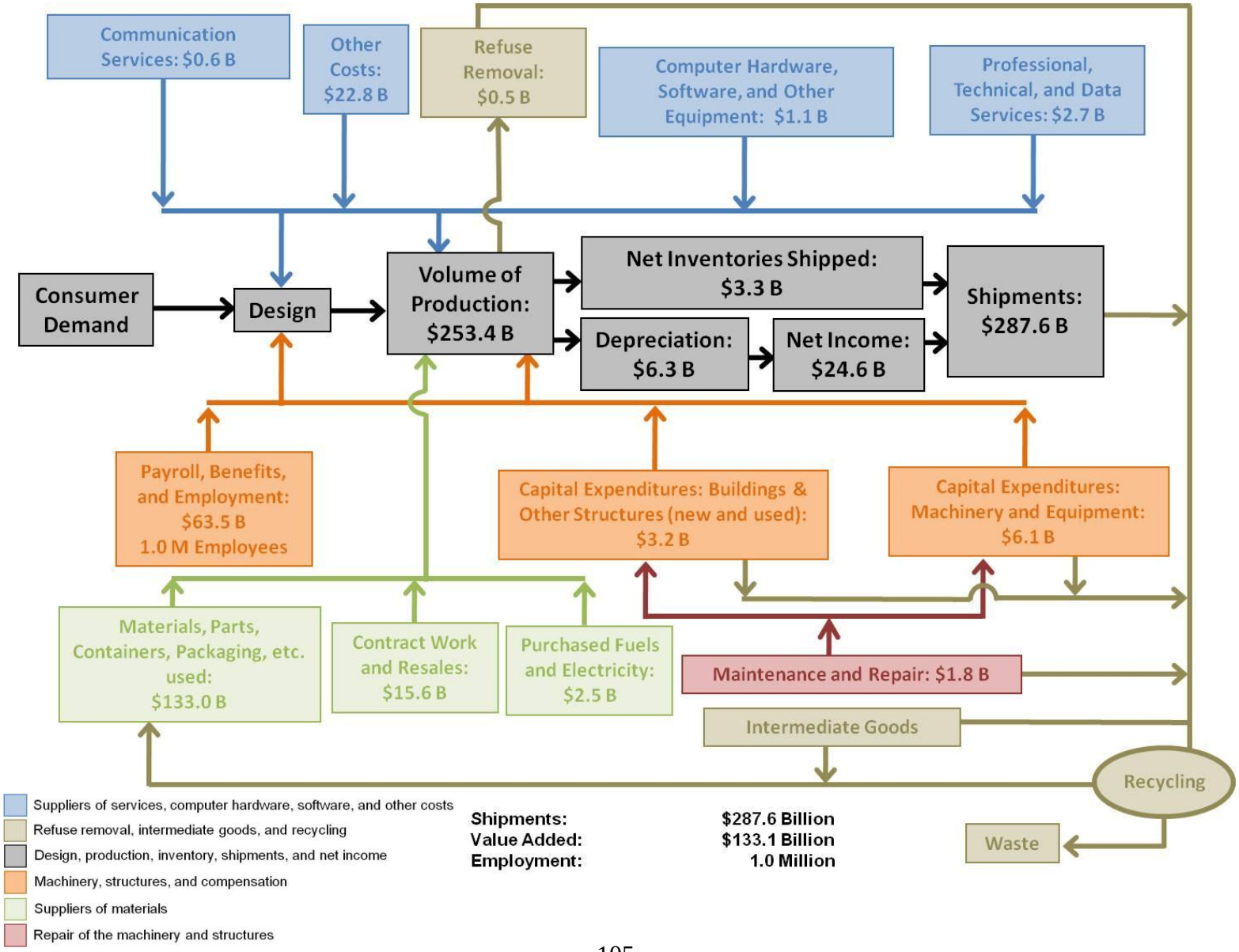


Table D.5: Manufacturing Supply Chain, NAICS 334: Computer and Electronic Product Manufacturing

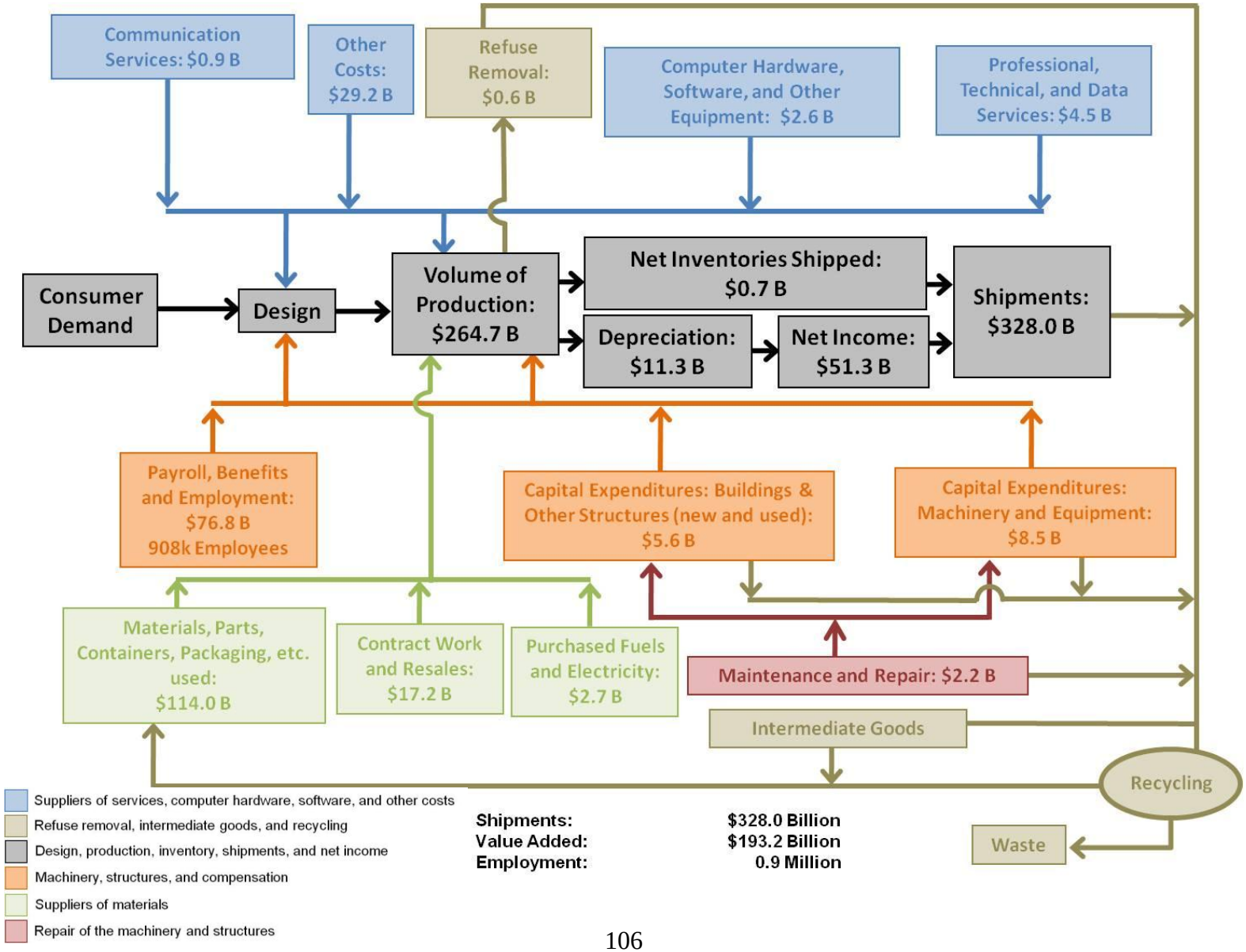


Table D.6: Manufacturing Supply Chain, NAICS 335: Electrical Equipment, Appliance, and Component Manufacturing

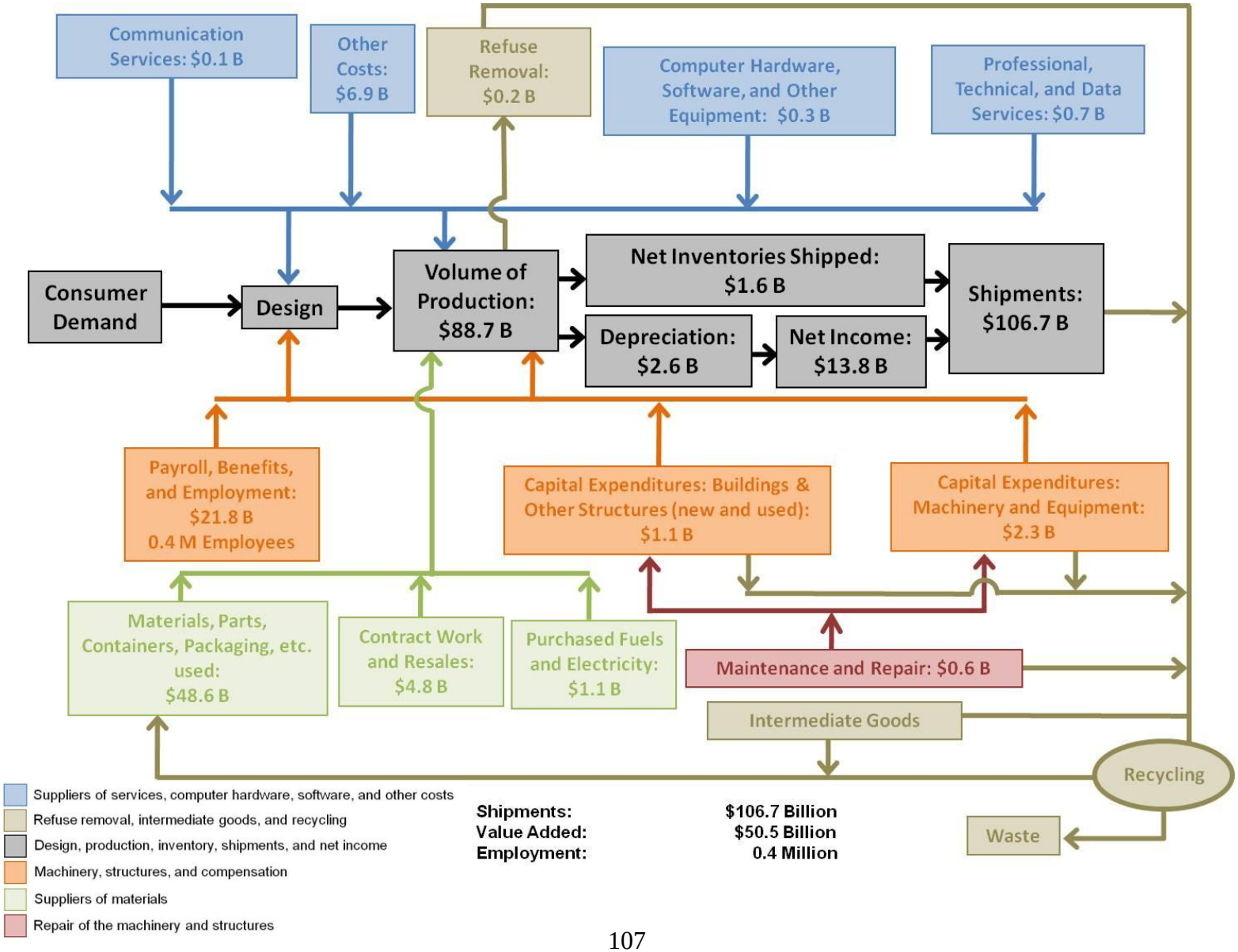
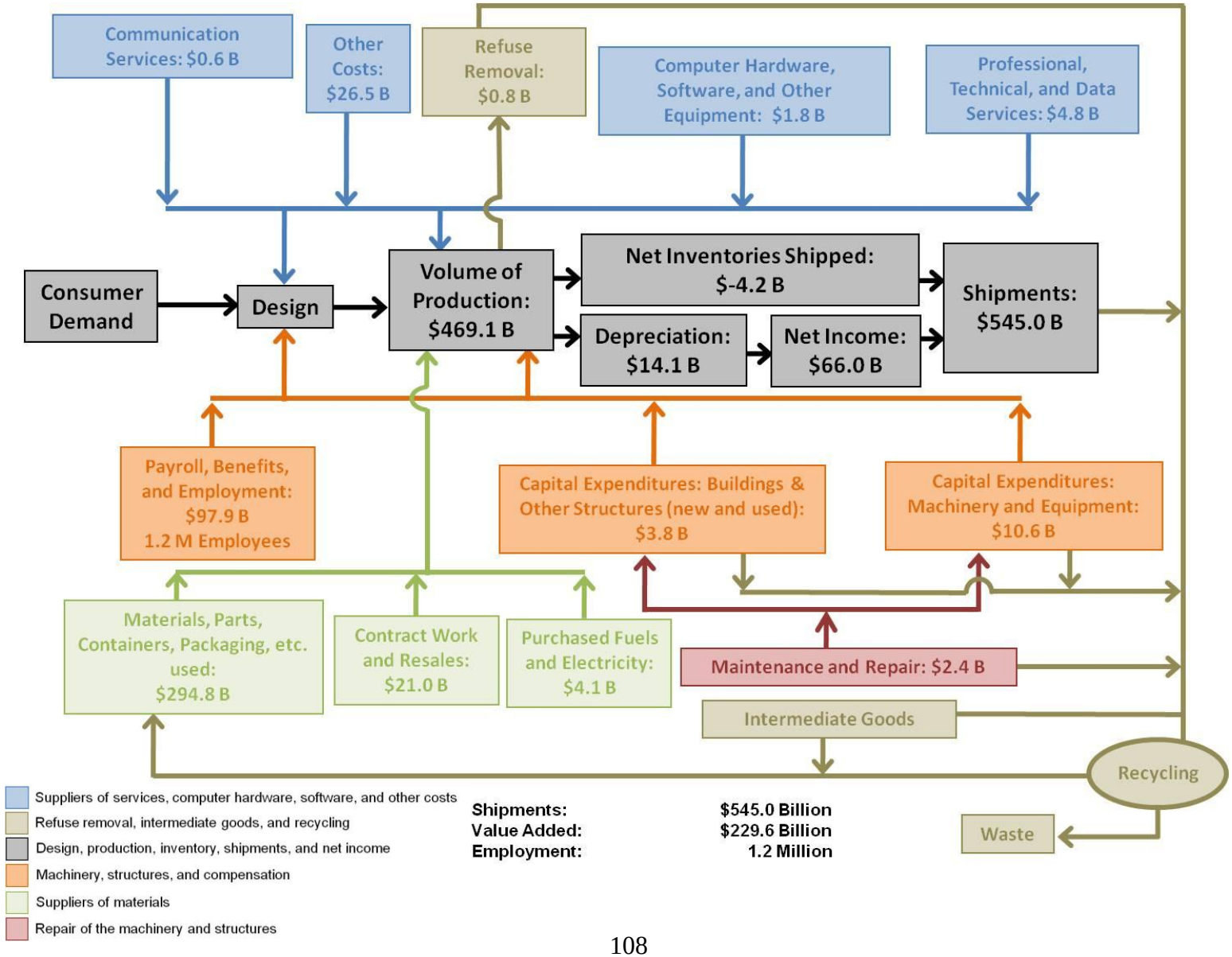


Table D.7: Manufacturing Supply Chain, NAICS 336: Transportation Equipment Manufacturing



Appendix E: Glossary of Terms

Each dataset used in this report contains a set of terms to describe the boundaries of the data. A single term does not fully describe what the dataset includes and different organizations may define terms differently. Data from the Bureau of Economic Analysis, for example, defines value added differently than the Annual Survey of Manufactures. In order to understand these datasets completely, the terms describing them must be defined. Some datasets contain a significant number of inter-related variables, each being described with unique terms. The manufacturing supply chain in Table D.1, for instance, contains data from the Annual Survey of Manufactures. This dataset contains numerous terms, which need to be defined so the reader can understand the inter-relationships of the data and the meaning of the data. This section provides definitions for the various terms used in this report and in doing so outlines many of the inter-relationships in various datasets. Definitions of terms used by specific organizations are taken verbatim from the source and have the organization or data source name in parentheses. Terms specific to this report have the location in the report where they are used. The sources for definitions include the following:

Annual Survey of Manufactures (ASM).
<http://www.census.gov/manufacturing/asm/index.html>

Bureau of Economic Analysis (BEA). Horowitz, Karen J. and Mark A. Planting. (2009) Concepts and Methods of the U.S. Input-Output Accounts. Bureau of Economic Analysis. <http://www.bea.gov/papers/pdf/IOmanual_092906.pdf>

Organization for Economic Co-operation and Development (OECD). "StatExtracts." <http://stats.oecd.org/Index.aspx>

United Nations Statistics Division (UNSD). "National Accounts Main Aggregates Database." <http://unstats.un.org/unsd/snaama/Introduction.asp>

U.S. Census Bureau. "Manufacturers' Shipments, Inventories, and Orders." <http://www.census.gov/manufacturing/m3/>

Advertising and promotional services (ASM): Included in the cost of selected advertising and promotional services are payments made to other companies for these services which were paid directly by the establishment. These include payments for printing, media coverage, and other services and materials. Excluded are the salaries paid to employees of this establishment for these services.

All other expenses (ASM): Included in the cost of all other expenses are payments made to other companies for services other than those listed elsewhere. These include, but are not limited to, items such as insurance, travel, training, transportation and office supplies.

Annual payroll (ASM): This item includes the gross earnings of all employees on the payrolls of operating manufacturing establishments paid in the calendar year. Respondents are told they could follow the definition of payrolls used for calculating the federal withholding tax. It includes all forms of compensation, such as salaries, wages, commissions, dismissal pay, bonuses, vacation and sick leave pay, and compensation in kind, prior to such deductions as employees' social security contributions, withholding taxes, group insurance, union dues, and savings bonds. The total includes salaries of officers of corporations; it excludes payments to proprietors or partners of unincorporated concerns. Also excluded are payments to members of Armed Forces and pensioners carried on the active payrolls of manufacturing establishments.

The census definition of payrolls is identical to that recommended to all federal statistical agencies by the Office of Management and Budget. It should be noted that this definition does not include employers' social security contributions or other nonpayroll labor costs, such as employees' pension plans, group insurance premiums, and workers' compensation.

Note: Beginning with the 2006 ASM, for employment and related fields (payroll, production hours, benefits), respondents were asked to report only those full- and part-time employees whose payroll was reported on the IRS Form 941 filing for the Employer Identification Number (EIN) used by that manufacturing establishment. Other temporary workers and workers whose payroll was reported under a different company's EIN were reported elsewhere on the form. In 2002, these data constituted between 1 and 1 1/2% of the total for these fields. Comparisons with data prior to 2006 should be used with caution.

Buildings rentals (ASM): This item includes rental payments for the use of all items for which depreciation reserves would be maintained if they were owned by the establishment, e.g., structures and buildings, and production, office, and transportation equipment. Excluded are royalties and other payments for the use of intangibles and depletable assets and land rents where separable.

When an establishment of a multiestablishment company was charged rent by another part of the same company for the use of assets owned by the company, it was instructed to exclude that cost from rental payments.

If there were assets at an establishment rented from another company and the rents were paid centrally by the head office of the establishment, the company was instructed to report these rental payments as if they were paid directly by the establishment.

Capital expenditures: all other machinery and equipment (ASM): Represents the total new and used capital expenditures reported by establishments in operation and any known plants under construction.

These data include expenditures for:

1. Permanent additions and major alterations to manufacturing and mining establishments.
2. New and used machinery and equipment used for replacement and additions to plant capacity, if they are of the type for which depreciation, depletion, or (for mining establishments) Office of Minerals Exploration accounts are ordinarily maintained. In addition, for mining establishments, these data include expenditures made during the year for development and exploration of mineral properties. For manufacturing establishments, these data are broken down into three types:
    a. Automobiles, trucks, etc. for highway use. These include vehicles acquired under a lease-purchase agreement and exclude vehicles leased or normally designed to transport materials, property, or equipment on mining, construction, petroleum development, and similar projects. These vehicles are of such size or weight as to be normally restricted by state laws or regulations from operating on public highways. Also excluded are vehicles that are purchased by a company for highway use.
    b. Computers and peripheral data processing equipment. This item includes all purchases of computers and related equipment.
    c. All other expenditures for machinery and equipment excluding automobiles and computer equipment.

Capital expenditures include work done by contract, as well as by the establishment's own workforce.

These data exclude expenditures for land and mineral rights and cost of maintenance and repairs charged as current operating expenses.

Capital expenditures: autos, trucks, etc. for highway use (ASM): Represents the total new and used capital expenditures reported by establishments in operation and any known plants under construction.

These data include expenditures for:

1. Permanent additions and major alterations to manufacturing and mining establishments.
2. New and used machinery and equipment used for replacement and additions to plant capacity, if they are of the type for which depreciation, depletion, or (for mining establishments) Office of Minerals Exploration accounts are ordinarily maintained. In addition, for mining establishments, these data include expenditures made during the year for development and exploration of mineral properties. For manufacturing establishments, these data are broken down into three types:
    a. Automobiles, trucks, etc. for highway use. These include vehicles acquired under a lease-purchase agreement and exclude vehicles leased or

normally designed to transport materials, property, or equipment on mining, construction, petroleum development, and similar projects. These vehicles are of such size or weight as to be normally restricted by state laws or regulations from operating on public highways. Also excluded are vehicles that are purchased by a company for highway use.

b. Computers and peripheral data processing equipment. This item includes all purchases of computers and related equipment.
c. All other expenditures for machinery and equipment excluding automobiles and computer equipment.

Capital expenditures include work done by contract, as well as by the establishment's own workforce.

These data exclude expenditures for land and mineral rights and cost of maintenance and repairs charged as current operating expenses.

Capital expenditures: buildings and other structures (new and used) (ASM): Represents the total new and used capital expenditures reported by establishments in operation and any known plants under construction.

These data include expenditures for:

1. Permanent additions and major alterations to manufacturing and mining establishments.
2. New and used machinery and equipment used for replacement and additions to plant capacity, if they are of the type for which depreciation, depletion, or (for mining establishments) Office of Minerals Exploration accounts are ordinarily maintained. In addition, for mining establishments, these data include expenditures made during the year for development and exploration of mineral properties. For manufacturing establishments, these data are broken down into three types:
    a. Automobiles, trucks, etc. for highway use. These include vehicles acquired under a lease-purchase agreement and exclude vehicles leased or normally designed to transport materials, property, or equipment on mining, construction, petroleum development, and similar projects. These vehicles are of such size or weight as to be normally restricted by state laws or regulations from operating on public highways. Also excluded are vehicles that are purchased by a company for highway use.
    b. Computers and peripheral data processing equipment. This item includes all purchases of computers and related equipment.
    c. All other expenditures for machinery and equipment excluding automobiles and computer equipment.

Capital expenditures include work done by contract, as well as by the establishment's own workforce.

These data exclude expenditures for land and mineral rights and cost of maintenance and repairs charged as current operating expenses.

Capital expenditures: buildings and other structures (new and used) (Figure 4.5): This item is the sum of capital expenditures: buildings and other structures (new and used) and buildings rentals from the ASM.

Capital expenditures: computer and data processing equipment (ASM): Represents the total new and used capital expenditures reported by establishments in operation and any known plants under construction.

These data include expenditures for:

1. Permanent additions and major alterations to manufacturing and mining establishments.
2. New and used machinery and equipment used for replacement and additions to plant capacity, if they are of the type for which depreciation, depletion, or (for mining establishments) Office of Minerals Exploration accounts are ordinarily maintained. In addition, for mining establishments, these data include expenditures made during the year for development and exploration of mineral properties. For manufacturing establishments, these data are broken down into three types:
    a. Automobiles, trucks, etc. for highway use. These include vehicles acquired under a lease-purchase agreement and exclude vehicles leased or normally designed to transport materials, property, or equipment on mining, construction, petroleum development, and similar projects. These vehicles are of such size or weight as to be normally restricted by state laws or regulations from operating on public highways. Also excluded are vehicles that are purchased by a company for highway use.
    b. Computers and peripheral data processing equipment. This item includes all purchases of computers and related equipment.
    c. All other expenditures for machinery and equipment excluding automobiles and computer equipment.

Capital expenditures include work done by contract, as well as by the establishment's own workforce.

These data exclude expenditures for land and mineral rights and cost of maintenance and repairs charged as current operating expenses.

Capital expenditures: machinery and equipment (new and used) (ASM): Represents the total new and used capital expenditures reported by establishments in operation and any known plants under construction.

These data include expenditures for:

1. Permanent additions and major alterations to manufacturing and mining establishments.
2. New and used machinery and equipment used for replacement and additions to plant capacity, if they are of the type for which depreciation, depletion, or (for mining establishments) Office of Minerals Exploration accounts are ordinarily maintained. In addition, for mining establishments, these data include expenditures made during the year for development and exploration of mineral properties. For manufacturing establishments, these data are broken down into three types:
    a. Automobiles, trucks, etc. for highway use. These include vehicles acquired under a lease-purchase agreement and exclude vehicles leased or normally designed to transport materials, property, or equipment on mining, construction, petroleum development, and similar projects. These vehicles are of such size or weight as to be normally restricted by state laws or regulations from operating on public highways. Also excluded are vehicles that are purchased by a company for highway use.
    b. Computers and peripheral data processing equipment. This item includes all purchases of computers and related equipment.
    c. All other expenditures for machinery and equipment excluding automobiles and computer equipment.

Capital expenditures include work done by contract, as well as by the establishment's own workforce.

These data exclude expenditures for land and mineral rights and cost of maintenance and repairs charged as current operating expenses.

Capital expenditures: machinery and equipment (Figure 4.5): This item is the sum of the following items from the ASM: capital expenditures: autos, trucks, etc. for highway use, capital expenditures: all other machinery and equipment, and machinery rentals.

Capital Gains (Table 2.1): An increase in the value of a capital asset

Capital Goods (Table 2.1): Human made goods used in the production of other goods.

Commodity (BEA): A commodity is a product or service. It may be produced by one or by many industries. Commodity output represents the total output of the product or service, regardless of the industry that produced it.

If an industry and the commodity produced by the industry have the same name, the commodity is considered to be the primary product of that industry. Any other commodity produced by that industry is a secondary product of that industry.

Communication services (ASM): Included in the cost of selected purchased services for communication are the actual expenses incurred or payable during the year for any type of communication. Such types of communication include telephone, data transmission, telegraph, Internet connectivity, fax, telex, photo transmission, paging, cellular telephone, online access and related services, etc.

Computer hardware, software, and other equipment (Figure 4.5): This item is the sum of Expensed computer hardware and other equipment, expensed purchases of software, and capital expenditures: computer and data processing equipment from the ASM.

Contract receipts (ASM): Miscellaneous receipts represent receipts from activities of the establishment other than the manufacturing of products from its own materials. Service activities such as installation, repair, and training are miscellaneous receipts. Assembly of products from materials owned by others and the sale of products bought and resold without further value added are other examples of miscellaneous receipts. Miscellaneous receipts are collected using the following categories:

1. Reported contract work - receipts for work or services that a plant performed for others on their materials.
2. Value of resales - sales of products bought and sold without further manufacture, processing, or assembly.
3. Other miscellaneous receipts - such as repair work, installation, sales of scrap, etc.

Contract work (ASM): This term refers to direct charges actually paid or payable for items consumed or put into production during the year, including freight charges and other direct charges incurred by the establishment in acquiring these materials. It includes the cost of materials or fuel consumed, whether purchased by the individual establishment from other companies, transferred to it from other establishments of the same company, or withdrawn from inventory during the year.

Included in this item are:

1. Cost of parts, components, containers, etc. Includes all raw materials, semifinished goods, parts, containers, scrap, and supplies put into production or used as operating supplies and for repair and maintenance during the year.
2. Cost of products bought and sold in the same condition.
3. Cost of fuels consumed for heat and power. Includes the cost of materials or fuel consumed, whether purchased by the individual establishment from other companies, transferred to it from other establishments of the same company, or withdrawn from inventory during the year.
4. Cost of purchased electricity. The cost of purchased electric energy represents the amount actually used during the year for heat and power. In addition, information was collected on the quantity of electric energy generated by the establishment

and the quantity of electric energy sold or transferred to other plants of the same company.

5. Cost of contract work. This term applies to work done by others on materials furnished by the manufacturing establishment. The actual cost of the material is to be reported on the cost of materials, parts, and containers line of this item. The term "contract work" refers to the fee a company pays to another company to perform a service.

Contract work and resales (Figure 4.5): This item is the sum of the cost of resales and contract work from the ASM.

Cost of purchased fuels (ASM): This term refers to direct charges actually paid or payable for items consumed or put into production during the year, including freight charges and other direct charges incurred by the establishment in acquiring these materials. It includes the cost of materials or fuel consumed, whether purchased by the individual establishment from other companies, transferred to it from other establishments of the same company, or withdrawn from inventory during the year.

Included in this item are:

1. Cost of parts, components, containers, etc. Includes all raw materials, semifinished goods, parts, containers, scrap, and supplies put into production or used as operating supplies and for repair and maintenance during the year.
2. Cost of products bought and sold in the same condition.
3. Cost of fuels consumed for heat and power. Includes the cost of materials or fuel consumed, whether purchased by the individual establishment from other companies, transferred to it from other establishments of the same company, or withdrawn from inventory during the year.
4. Cost of purchased electricity. The cost of purchased electric energy represents the amount actually used during the year for heat and power. In addition, information was collected on the quantity of electric energy generated by the establishment and the quantity of electric energy sold or transferred to other plants of the same company.
5. Cost of contract work. This term applies to work done by others on materials furnished by the manufacturing establishment. The actual cost of the material is to be reported on the cost of materials, parts, and containers line of this item. The term "contract work" refers to the fee a company pays to another company to perform a service.

Cost of resales (ASM): This term refers to direct charges actually paid or payable for items consumed or put into production during the year, including freight charges and other direct charges incurred by the establishment in acquiring these materials. It includes the cost of materials or fuel consumed, whether purchased by the individual establishment from other companies, transferred to it from other establishments of the same company, or withdrawn from inventory during the year.

Included in this item are:

1. Cost of parts, components, containers, etc. Includes all raw materials, semifinished goods, parts, containers, scrap, and supplies put into production or used as operating supplies and for repair and maintenance during the year.
2. Cost of products bought and sold in the same condition.
3. Cost of fuels consumed for heat and power. Includes the cost of materials or fuel consumed, whether purchased by the individual establishment from other companies, transferred to it from other establishments of the same company, or withdrawn from inventory during the year.
4. Cost of purchased electricity. The cost of purchased electric energy represents the amount actually used during the year for heat and power. In addition, information was collected on the quantity of electric energy generated by the establishment and the quantity of electric energy sold or transferred to other plants of the same company.
5. Cost of contract work. This term applies to work done by others on materials furnished by the manufacturing establishment. The actual cost of the material is to be reported on the cost of materials, parts, and containers line of this item. The term "contract work" refers to the fee a company pays to another company to perform a service.

Data processing and other purchased computer services (ASM): Included in the cost of selected data processing and other purchased computer services are purchases of computer facilities management services, computer input preparation, data storage, computer time rental, optical scanning services, and other computer-related advice and services, including training. Excluded are services such as expensed integrated systems, repair and maintenance of computer equipment, payroll processing and credit card transaction fees, and expenses for telecommunication services (e.g., Internet connectivity, telephone).

Economic Success (Table 2.1): A constant and suitable magnitude of production resulting in competitive benefits (profits, capital gains, income, and product utilization) for an industry’s stakeholders.

Employer’s cost for health insurance (ASM): This item is the employer's costs for social security tax, unemployment tax, workers' compensation insurance, state disability insurance pension plans, stock purchase plans, union-negotiated benefits, life insurance premiums, and insurance premiums on hospital and medical plans for employees. Also included are the employer's costs for benefits to individual employees such as stock purchase plans, deferred profit-sharing plans, and defined benefit and defined contribution retirement plans. They exclude such items as company-operated cafeterias, in-plant medical services, free parking lots, discounts on employee purchases, and uniforms and work clothing for employees.

These figures represent the total amount of employer-paid benefits for all categories shown, and are inclusive of payments made on behalf of individuals that may not be

included in the current payroll values . Consequently, for some manufacturing industries, payroll and benefits values may not move in tandem when compared to prior year tabulation totals.

Note: Beginning with the 2006 ASM, for employment and related fields (payroll, production hours, benefits), respondents were asked to report only those full- and part-time employees whose payroll was reported on the IRS Form 941 filing for the Employer Identification Number (EIN) used by that manufacturing establishment. Other temporary workers and workers whose payroll was reported under a different company's EIN were reported elsewhere on the form. In 2002, these data constituted between 1 and 1 1/2% of the total for these fields. Comparisons with data prior to 2006 should be used with caution.

Employer’s cost for defined benefit pension plans (ASM): This item is the employer's costs for social security tax, unemployment tax, workers' compensation insurance, state disability insurance pension plans, stock purchase plans, union-negotiated benefits, life insurance premiums, and insurance premiums on hospital and medical plans for employees. Also included are the employer's costs for benefits to individual employees such as stock purchase plans, deferred profit-sharing plans, and defined benefit and defined contribution retirement plans. They exclude such items as company-operated cafeterias, in-plant medical services, free parking lots, discounts on employee purchases, and uniforms and work clothing for employees.

These figures represent the total amount of employer-paid benefits for all categories shown, and are inclusive of payments made on behalf of individuals that may not be included in the current payroll values . Consequently, for some manufacturing industries, payroll and benefits values may not move in tandem when compared to prior year tabulation totals.

Note: Beginning with the 2006 ASM, for employment and related fields (payroll, production hours, benefits), respondents were asked to report only those full- and part-time employees whose payroll was reported on the IRS Form 941 filing for the Employer Identification Number (EIN) used by that manufacturing establishment. Other temporary workers and workers whose payroll was reported under a different company's EIN were reported elsewhere on the form. In 2002, these data constituted between 1 and 1 1/2% of the total for these fields. Comparisons with data prior to 2006 should be used with caution.

Employer’s cost for defined contribution plans (ASM): This item is the employer's costs for social security tax, unemployment tax, workers' compensation insurance, state disability insurance pension plans, stock purchase plans, union-negotiated benefits, life insurance premiums, and insurance premiums on hospital and medical plans for employees. Also included are the employer's costs for benefits to individual employees such as stock purchase plans, deferred profit-sharing plans, and defined benefit and defined contribution retirement plans. They exclude such

items as company-operated cafeterias, in-plant medical services, free parking lots, discounts on employee purchases, and uniforms and work clothing for employees.

These figures represent the total amount of employer-paid benefits for all categories shown, and are inclusive of payments made on behalf of individuals that may not be included in the current payroll values . Consequently, for some manufacturing industries, payroll and benefits values may not move in tandem when compared to prior year tabulation totals.

Note: Beginning with the 2006 ASM, for employment and related fields (payroll, production hours, benefits), respondents were asked to report only those full- and part-time employees whose payroll was reported on the IRS Form 941 filing for the Employer Identification Number (EIN) used by that manufacturing establishment. Other temporary workers and workers whose payroll was reported under a different company's EIN were reported elsewhere on the form. In 2002, these data constituted between 1 and 1 1/2% of the total for these fields. Comparisons with data prior to 2006 should be used with caution.

Employer’s cost for other fringe benefits (ASM): This item is the employer's costs for social security tax, unemployment tax, workers' compensation insurance, state disability insurance pension plans, stock purchase plans, union-negotiated benefits, life insurance premiums, and insurance premiums on hospital and medical plans for employees. Also included are the employer's costs for benefits to individual employees such as stock purchase plans, deferred profit-sharing plans, and defined benefit and defined contribution retirement plans. They exclude such items as company-operated cafeterias, in-plant medical services, free parking lots, discounts on employee purchases, and uniforms and work clothing for employees.

These figures represent the total amount of employer-paid benefits for all categories shown, and are inclusive of payments made on behalf of individuals that may not be included in the current payroll values . Consequently, for some manufacturing industries, payroll and benefits values may not move in tandem when compared to prior year tabulation totals.

Note: Beginning with the 2006 ASM, for employment and related fields (payroll, production hours, benefits), respondents were asked to report only those full- and part-time employees whose payroll was reported on the IRS Form 941 filing for the Employer Identification Number (EIN) used by that manufacturing establishment. Other temporary workers and workers whose payroll was reported under a different company's EIN were reported elsewhere on the form. In 2002, these data constituted between 1 and 1 1/2% of the total for these fields. Comparisons with data prior to 2006 should be used with caution.

Establishment (BEA): An economic unit—business or industrial—at a single physical location where business is conducted or where services or industrial operations are performed. Examples include a factory, mill, store, hotel, movie

theater, mine, farm, ranch, bank, railroad depot, airline terminal, sales office, warehouse, or central administrative office. One or more establishments make up an enterprise or a company. However, a single establishment may be comprised of subunits, departments, or divisions. In the industry classification systems—SIC and NAICS— the establishment is the basic unit for collecting many types of economic information.

Expensed computer hardware and other equipment (ASM): Included in the cost of selected expensed computer hardware and other equipment are actual expenses incurred or payable during the year for this item. Purchases of copiers, fax machines, telephones, shop and lab equipment, CPUs, and monitors are all included. Excluded are services provided by other establishments of the same company (such as software and data processing services).

Expensed purchases of software (ASM): Included in the cost of selected expensed purchases of software are actual expenses incurred or payable during the year for this item. Purchases of software developed or customized by others, web-design services and purchases, licensing agreements, upgrades of software, and maintenance fees related to software upgrades and alterations are all included.

Financial Capital (Table 2.1): Funds provided by investors to purchase real capital equipment for production.

Final Product Utilization (Table 2.1): The utility gained from the end user of a product.

Finished goods inventories, BOY (ASM): Respondents were asked to report their beginning of year and end of year inventories at cost or market. Effective with the 1982 Economic Census, this change to a uniform instruction for reporting inventories was introduced for all sector reports. Prior to 1982, respondents were permitted to value inventories using any generally accepted accounting method (FIFO, LIFO, or market, to name a few). Beginning in 1982, LIFO users were asked to first report inventory values prior to the LIFO adjustment and then to report the LIFO reserve and the LIFO value after adjustment for the reserve.

Inventory data by stage of fabrication

Total inventories and three detailed components were collected:

1. Finished goods
2. Work-in-process
3. Materials, supplies, fuels, etc.

Materials inventories refer to goods that are raw inputs to the manufacturing process, and that will be substantially altered to produce an establishment's output. Work-in-process inventories refer to goods that have been substantially transformed

in the manufacturing process, but that are not yet the final output of the establishment. Finished goods are goods that represent the final output of the establishment, but that are still within ownership of the establishment.

When using inventory data by stage of fabrication for "all industries" and at the three-digit subsector level, it should be noted that an item treated as a finished product by an establishment in one industry may be reported as a raw material by an establishment in a different industry. For example, the finished product inventories of a steel mill would be reported as raw materials by a stamping plant. Such differences are present in the inventory figures by stage of fabrication shown for all publication levels.

Finished goods inventories, EOY (ASM): Respondents were asked to report their beginning of year and end of year inventories at cost or market. Effective with the 1982 Economic Census, this change to a uniform instruction for reporting inventories was introduced for all sector reports. Prior to 1982, respondents were permitted to value inventories using any generally accepted accounting method (FIFO, LIFO, or market, to name a few). Beginning in 1982, LIFO users were asked to first report inventory values prior to the LIFO adjustment and then to report the LIFO reserve and the LIFO value after adjustment for the reserve.

Inventory data by stage of fabrication

Total inventories and three detailed components were collected:

1. Finished goods
2. Work-in-process
3. Materials, supplies, fuels, etc.

Materials inventories refer to goods that are raw inputs to the manufacturing process, and that will be substantially altered to produce an establishment's output. Work-in-process inventories refer to goods that have been substantially transformed in the manufacturing process, but that are not yet the final output of the establishment. Finished goods are goods that represent the final output of the establishment, but that are still within ownership of the establishment.

When using inventory data by stage of fabrication for "all industries" and at the three-digit subsector level, it should be noted that an item treated as a finished product by an establishment in one industry may be reported as a raw material by an establishment in a different industry. For example, the finished product inventories of a steel mill would be reported as raw materials by a stamping plant. Such differences are present in the inventory figures by stage of fabrication shown for all publication levels.

Final use (BEA): The consumption of the goods and services that are produced and distributed in the economy. In the I-O accounts, final-use transactions consist of the transactions that make up the final-expenditure components of GDP: Personal

consumption expenditures; private fixed investment; change in private inventories; exports of goods and services; imports of goods and services; and Federal, state, and local government consumption expenditures and gross investment (including investment by government enterprises).

Gross Domestic Product (BEA): The market value of the goods and services produced by labor and property located within the borders of the United States. In 1991, GDP replaced gross national product (GNP) as the featured measure of U.S. production.

Gross operating surplus (Table 3.5 and Table 3.10): Gross output less a subset of costs (i.e., intermediate expenditures, compensation, and taxes less subsidies). It is similar to profit with the exception that it does not take into account the depreciation of capital.

Gross operating surplus (BEA): It is a profits-like measure that includes proprietors' income, corporate profits, net interest, business transfer payments, etc. GOS can be calculated as gross output less (1) intermediate inputs, (2) employee compensation, and (3) "taxes on production and imports less subsidies."

Intermediate Inputs (BEA): Purchases of goods and services—such as energy, materials, and purchased services—that are used for the production of other goods and services rather than for final consumption. These inputs are sometimes referred to as current-account expenditures. They do not include any capital-account purchases nor do they include the inputs from the primary factors of production (capital and labor) that are components of value added.

Labor (Table 2.1): Human effort used in production, which includes technical and marketing expertise.

Land (Table 2.1): Naturally-occurring goods such as water, air, soil, mineral, and flora used in the formation of products.

Machinery rentals (ASM): This item includes rental payments for the use of all items for which depreciation reserves would be maintained if they were owned by the establishment, e.g., structures and buildings, and production, office, and transportation equipment. Excluded are royalties and other payments for the use of intangibles and depletable assets and land rents where separable.

When an establishment of a multiestablishment company was charged rent by another part of the same company for the use of assets owned by the company, it was instructed to exclude that cost from rental payments.

If there were assets at an establishment rented from another company and the rents were paid centrally by the head office of the establishment, the company was instructed to report these rental payments as if they were paid directly by the establishment.

Maintenance and repair (Figure 4.5): See repair and maintenance services of buildings and/or machinery

Make table (BEA): Matrix that shows the value in producers' prices of each commodity produced by each industry. The entries in a row represent the dollar value of commodities produced by the industry at the beginning of the row. The entries in a column represent the dollar value of production by each industry of the commodity at the top of the column. It is one of the two primary tables in the I-O accounts. The make table, together with the use table, is used to derive the I-O total requirements tables.

Materials and supplies inventories, EOY (ASM): Respondents were asked to report their beginning of year and end of year inventories at cost or market. Effective with the 1982 Economic Census, this change to a uniform instruction for reporting inventories was introduced for all sector reports. Prior to 1982, respondents were permitted to value inventories using any generally accepted accounting method (FIFO, LIFO, or market, to name a few). Beginning in 1982, LIFO users were asked to first report inventory values prior to the LIFO adjustment and then to report the LIFO reserve and the LIFO value after adjustment for the reserve.

Inventory data by stage of fabrication

Total inventories and three detailed components were collected:

1. Finished goods
2. Work-in-process
3. Materials, supplies, fuels, etc.

Materials inventories refer to goods that are raw inputs to the manufacturing process, and that will be substantially altered to produce an establishment's output. Work-in-process inventories refer to goods that have been substantially transformed in the manufacturing process, but that are not yet the final output of the establishment. Finished goods are goods that represent the final output of the establishment, but that are still within ownership of the establishment.

When using inventory data by stage of fabrication for "all industries" and at the three-digit subsector level, it should be noted that an item treated as a finished product by an establishment in one industry may be reported as a raw material by an establishment in a different industry. For example, the finished product inventories of a steel mill would be reported as raw materials by a stamping plant. Such differences are present in the inventory figures by stage of fabrication shown for all publication levels.

Materials and supplies inventories, BOY (ASM): Respondents were asked to report their beginning of year and end of year inventories at cost or market.

Effective with the 1982 Economic Census, this change to a uniform instruction for reporting inventories was introduced for all sector reports. Prior to 1982, respondents were permitted to value inventories using any generally accepted accounting method (FIFO, LIFO, or market, to name a few). Beginning in 1982, LIFO users were asked to first report inventory values prior to the LIFO adjustment and then to report the LIFO reserve and the LIFO value after adjustment for the reserve.

Inventory data by stage of fabrication

Total inventories and three detailed components were collected:

1. Finished goods
2. Work-in-process
3. Materials, supplies, fuels, etc.

Materials inventories refer to goods that are raw inputs to the manufacturing process, and that will be substantially altered to produce an establishment's output. Work-in-process inventories refer to goods that have been substantially transformed in the manufacturing process, but that are not yet the final output of the establishment. Finished goods are goods that represent the final output of the establishment, but that are still within ownership of the establishment.

When using inventory data by stage of fabrication for "all industries" and at the three-digit subsector level, it should be noted that an item treated as a finished product by an establishment in one industry may be reported as a raw material by an establishment in a different industry. For example, the finished product inventories of a steel mill would be reported as raw materials by a stamping plant. Such differences are present in the inventory figures by stage of fabrication shown for all publication levels.

Materials, parts, containers, packaging, etc. used (ASM): This term refers to direct charges actually paid or payable for items consumed or put into production during the year, including freight charges and other direct charges incurred by the establishment in acquiring these materials. It includes the cost of materials or fuel consumed, whether purchased by the individual establishment from other companies, transferred to it from other establishments of the same company, or withdrawn from inventory during the year.

Included in this item are:

1. Cost of parts, components, containers, etc. Includes all raw materials, semifinished goods, parts, containers, scrap, and supplies put into production or used as operating supplies and for repair and maintenance during the year.
2. Cost of products bought and sold in the same condition.

3. Cost of fuels consumed for heat and power. Includes the cost of materials or fuel consumed, whether purchased by the individual establishment from other companies, transferred to it from other establishments of the same company, or withdrawn from inventory during the year.
4. Cost of purchased electricity. The cost of purchased electric energy represents the amount actually used during the year for heat and power. In addition, information was collected on the quantity of electric energy generated by the establishment and the quantity of electric energy sold or transferred to other plants of the same company.
5. Cost of contract work. This term applies to work done by others on materials furnished by the manufacturing establishment. The actual cost of the material is to be reported on the cost of materials, parts, and containers line of this item. The term "contract work" refers to the fee a company pays to another company to perform a service.

Net Income (Manufacturing Supply Chain and Table 4.1): The total value of shipments less all costs (communication services; other costs; refuse removal; computer hardware, software, and other equipment; professional, technical, and data services, payroll and benefits; capital expenditures; materials, parts, containers, packaging, etc used; contract work and resales; purchased fuels and electicity; and maintenance and repair) and depreciation.

Net Inventories Shipped (Manufacturing Supply Chain and Table 4.1): The total beginning of year (BOY) inventories (finished goods and work-in-process inventories) less the total end of year (EOY) inventories (finished goods and work-in-process inventories).

Other Costs (Figure 4.5): The sum of Taxes and license fees, advertising and promotional services, temporary staff and leased employee expenses, and all other expenses from the ASM.

Other misc. receipts (ASM): Miscellaneous receipts represent receipts from activities of the establishment other than the manufacturing of products from its own materials. Service activities such as installation, repair, and training are miscellaneous receipts. Assembly of products from materials owned by others and the sale of products bought and resold without further value added are other examples of miscellaneous receipts. Miscellaneous receipts are collected using the following categories:

1. Reported contract work - receipts for work or services that a plant performed for others on their materials.
2. Value of resales - sales of products bought and sold without further manufacture, processing, or assembly.
3. Other miscellaneous receipts - such as repair work, installation, sales of scrap, etc.

Payroll, Benefits, and Employment (Figure 4.5): This is the sum of annual payroll and total fringe benefits from the ASM shown with the number of employees.

Production workers wages (ASM): "Production workers" refers to workers up through the line-supervisor level engaged in fabricating, processing, assembling, inspecting, receiving, packing, warehoursing, shipping (but not delivering) maintenance, repair, janitorial, guard services, product development, auxiliary production for the plant's own use (e.g., power plant workers), recordkeeping, and other closely associated services (including truck drivers delivering ready-mixed concrete).

"Payroll" includes the gross earnings of all employees on the payrolls of operating manufacturing establishments paid in the calendar year. Respondents were told they could follow the definition of payrolls used for calculating the federal withholding tax. It includes all forms of compensation, such as salaries, wages, commissions, dismissal pay, bonuses, vacation and sick leave pay, and compensation in kind, prior to such deductions as employees' social security contributions, withholding taxes, group insurance, union dues, and savings bonds. The total includes salaries of officers of corporations; it excludes payments to proprietors or partners of unincorporated concerns. Also excluded are payments to members of Armed Forces and pensioners carried on the active payrolls of manufacturing establishments.

The census definition of payrolls is identical to that recommended to all federal statistical agencies by the Office of Management and Budget. It should be noted that this definition does not include employers' social security contributions or other nonpayroll labor costs, such as employees' pension plans, group insurance premiums, and workers' compensation.

Note: Beginning with the 2006 ASM, for employment and related fields (payroll, production hours, benefits), respondents were asked to report only those full- and part-time employees whose payroll was reported on the IRS Form 941 filing for the Employer Identification Number (EIN) used by that manufacturing establishment. Other temporary workers and workers whose payroll was reported under a different company's EIN were reported elsewhere on the form. In 2002, these data constituted between 1 and 1 1/2% of the total for these fields. Comparisons with data prior to 2006 should be used with caution.

Professional, Technical, and Data Services (Figure 4.5): This is the sum of data processing and other purchased computer services and purchased professional and technical services from the ASM.

Profit from Fees (Table 2.1): The financial benefit realized when revenues exceed costs and taxes for a service.

Profit from Markup (Table 2.1): The difference between the cost of a good and its selling price.

Profit from Sales (Table 2.1): The financial benefit realized when revenues exceed costs and taxes for a product.

Purchased electricity (ASM): This term refers to direct charges actually paid or payable for items consumed or put into production during the year, including freight charges and other direct charges incurred by the establishment in acquiring these materials. It includes the cost of materials or fuel consumed, whether purchased by the individual establishment from other companies, transferred to it from other establishments of the same company, or withdrawn from inventory during the year.

Included in this item are:

1. Cost of parts, components, containers, etc. Includes all raw materials, semifinished goods, parts, containers, scrap, and supplies put into production or used as operating supplies and for repair and maintenance during the year.
2. Cost of products bought and sold in the same condition.
3. Cost of fuels consumed for heat and power. Includes the cost of materials or fuel consumed, whether purchased by the individual establishment from other companies, transferred to it from other establishments of the same company, or withdrawn from inventory during the year.
4. Cost of purchased electricity. The cost of purchased electric energy represents the amount actually used during the year for heat and power. In addition, information was collected on the quantity of electric energy generated by the establishment and the quantity of electric energy sold or transferred to other plants of the same company.
5. Cost of contract work. This term applies to work done by others on materials furnished by the manufacturing establishment. The actual cost of the material is to be reported on the cost of materials, parts, and containers line of this item. The term "contract work" refers to the fee a company pays to another company to perform a service.

Purchased fuels and electricity (Figure 4.5): This item is the sum of the cost of purchased fuels and purchased electricity from the ASM.

Purchased professional and technical services (ASM): Included in the cost of selected purchased professional and technical services are payments made to other companies for these services which were paid directly by the establishment. These include payments for management consulting, accounting, auditing, bookkeeping, legal, actuarial, payroll processing, architectural, engineering, and other professional services. Excluded are the salaries paid to employees of this establishment for these services.

Purchasing Price (Table 2.1): Market value of goods sold

Redefinition (BEA): Redefinitions, one of the three methods for handling secondary products, are made as part of the preparation of the supplementary I-O make and use tables.

Redefinitions are made when an industry's production of a secondary product has very different inputs ("recipe") than those for the production of its primary product. In such a case, the secondary product (output and inputs) is moved ("redefined") from the industry in which the output occurs to the industry in which the product is primary. For example, the output and associated inputs for restaurants located in hotels are moved from the hotels and lodging places industry to the eating and drinking places industry.

Redefinitions do not affect the definition of the commodity or the measurement of commodity output, which consists of all of the output of that commodity wherever it's produced. However, redefinitions do affect industry output.

Refuse removal (including hazardous waste) services (ASM): Included in the cost of selected purchased refuse removal services are payments made to other companies for these services which were paid directly by the establishment, including costs for hazardous waste removal or treatment. Excluded are all costs included in rental payments or as capital expenditures and the salaries paid to employees of the establishment for these services.

Repair and maintenance services of buildings and/or machinery (ASM): Included in the cost of selected purchased services for the repair and maintenance services of buildings and/or machinery are payments made for all maintenance and repair work on buildings and equipment. Payments made to other establishments of the same company and for repair and maintenance of any leased property also are included. Excluded from this item are extensive repairs or reconstruction that was capitalized, which is considered capital expenditures; costs incurred directly by the establishment in using its own work force to perform repairs and maintenance work; and repairs and maintenance provided by the building or machinery owner as part of the rental contract.

Requirements table (BEA): There are four I-O requirements tables: Commodity-by-industry direct requirements, commodity-by-commodity total requirements, industry-by-commodity total requirements, and industry-by-industry total requirements.

Secondary product (BEA): A good or service that is produced by an industry in addition to its primary product. Secondary products are the primary product of another industry. Secondary products in the I-O accounts are termed redefinitions, reclassifications, and other secondary products.

Shipments (Manufacturers' Shipments, Inventories, and Orders Survey): Manufacturers' shipments measure the dollar value of products sold by

manufacturing establishments and are based on net selling values, f.o.b. (free on board) plant, after discounts and allowances are excluded. Freight charges and excise taxes are excluded. Where the products of an industry are customarily delivered to distributors or consumers by the manufacturing establishment (such as in certain foods industries – fluid milk, bakery, soft drinks), the value is based on delivered price rather than f.o.b. plant price. Multi-industry companies report value information for each industry category as if it were a separate economic unit. Thus, products transferred from one plant to another are valued at their full economic value.

Standard make and use tables (BEA): The featured tables in the 1997 benchmark I-O, these tables are based on NAICS. They are constructed before the redefinitions of selected secondary products. (In the 1992 I-O accounts, these make and use tables were referred to as "alternative" tables.)

Supplementary make and use tables (BEA): A second set of tables in the 1997 benchmark I-O, these tables are derived from the standard make and use tables. The estimates in the supplementary make and use tables are after the redefinitions of selected secondary products. (In the 1992 I-O accounts, these make and use tables and the requirements tables were referred to as "traditional" tables, and the NIPA bridge tables were referred to as "supplementary" tables.)

Taxes and license fees (ASM): Includes payments made to government agencies for business and property taxes and licensing fees. Income taxes are excluded from this item.

Temporary staff and leased employee expenses (ASM): Included in the cost of selected temporary staff and leased employee expenses are total costs which were paid directly by the establishment to Professional Employer Organizations (PEOs) and staffing agencies for personnel. These include all charges for payroll, benefits, and services.

Total BOY inventories (ASM): Respondents were asked to report their beginning of year and end of year inventories at cost or market. Effective with the 1982 Economic Census, this change to a uniform instruction for reporting inventories was introduced for all sector reports. Prior to 1982, respondents were permitted to value inventories using any generally accepted accounting method (FIFO, LIFO, or market, to name a few). Beginning in 1982, LIFO users were asked to first report inventory values prior to the LIFO adjustment and then to report the LIFO reserve and the LIFO value after adjustment for the reserve.

Inventory data by stage of fabrication

Total inventories and three detailed components were collected:

1. Finished goods

2. Work-in-process
3. Materials, supplies, fuels, etc.

Materials inventories refer to goods that are raw inputs to the manufacturing process, and that will be substantially altered to produce an establishment's output. Work-in-process inventories refer to goods that have been substantially transformed in the manufacturing process, but that are not yet the final output of the establishment. Finished goods are goods that represent the final output of the establishment, but that are still within ownership of the establishment.

When using inventory data by stage of fabrication for "all industries" and at the three-digit subsector level, it should be noted that an item treated as a finished product by an establishment in one industry may be reported as a raw material by an establishment in a different industry. For example, the finished product inventories of a steel mill would be reported as raw materials by a stamping plant. Such differences are present in the inventory figures by stage of fabrication shown for all publication levels.

Total capital expenditures (new and used) (ASM): Represents the total new and used capital expenditures reported by establishments in operation and any known plants under construction.

These data include expenditures for:

1. Permanent additions and major alterations to manufacturing and mining establishments.
2. New and used machinery and equipment used for replacement and additions to plant capacity, if they are of the type for which depreciation, depletion, or (for mining establishments) Office of Minerals Exploration accounts are ordinarily maintained. In addition, for mining establishments, these data include expenditures made during the year for development and exploration of mineral properties. For manufacturing establishments, these data are broken down into three types:
    a. Automobiles, trucks, etc. for highway use. These include vehicles acquired under a lease-purchase agreement and exclude vehicles leased or normally designed to transport materials, property, or equipment on mining, construction, petroleum development, and similar projects. These vehicles are of such size or weight as to be normally restricted by state laws or regulations from operating on public highways. Also excluded are vehicles that are purchased by a company for highway use.
    b. Computers and peripheral data processing equipment. This item includes all purchases of computers and related equipment.
    c. All other expenditures for machinery and equipment excluding automobiles and computer equipment.

Capital expenditures include work done by contract, as well as by the establishment's own workforce.

These data exclude expenditures for land and mineral rights and cost of maintenance and repairs charged as current operating expenses.

Total cost of materials (ASM): This term refers to direct charges actually paid or payable for items consumed or put into production during the year, including freight charges and other direct charges incurred by the establishment in acquiring these materials. It includes the cost of materials or fuel consumed, whether purchased by the individual establishment from other companies, transferred to it from other establishments of the same company, or withdrawn from inventory during the year.

Included in this item are:

1. Cost of parts, components, containers, etc. Includes all raw materials, semifinished goods, parts, containers, scrap, and supplies put into production or used as operating supplies and for repair and maintenance during the year.
2. Cost of products bought and sold in the same condition.
3. Cost of fuels consumed for heat and power. Includes the cost of materials or fuel consumed, whether purchased by the individual establishment from other companies, transferred to it from other establishments of the same company, or withdrawn from inventory during the year.
4. Cost of purchased electricity. The cost of purchased electric energy represents the amount actually used during the year for heat and power. In addition, information was collected on the quantity of electric energy generated by the establishment and the quantity of electric energy sold or transferred to other plants of the same company.
5. Cost of contract work. This term applies to work done by others on materials furnished by the manufacturing establishment. The actual cost of the material is to be reported on the cost of materials, parts, and containers line of this item. The term "contract work" refers to the fee a company pays to another company to perform a service.

Aggregate of total cost of materials and total value of shipments includes extensive duplication, since products of some industries are used as materials of others.

Total depreciation (ASM): This item includes depreciation and amortization charged during the year against assets. Depreciation charged against fixed assets acquired since the beginning of the year and against assets sold or retired during the year are components of this category. Respondents were requested to make certain that they did not report accumulated depreciation.

Total EOY inventories (ASM): Respondents were asked to report their beginning of year and end of year inventories at cost or market. Effective with the 1982 Economic Census, this change to a uniform instruction for reporting inventories was

introduced for all sector reports. Prior to 1982, respondents were permitted to value inventories using any generally accepted accounting method (FIFO, LIFO, or market, to name a few). Beginning in 1982, LIFO users were asked to first report inventory values prior to the LIFO adjustment and then to report the LIFO reserve and the LIFO value after adjustment for the reserve.

Inventory data by stage of fabrication

Total inventories and three detailed components were collected:

1. Finished goods
2. Work-in-process
3. Materials, supplies, fuels, etc.

Materials inventories refer to goods that are raw inputs to the manufacturing process, and that will be substantially altered to produce an establishment's output. Work-in-process inventories refer to goods that have been substantially transformed in the manufacturing process, but that are not yet the final output of the establishment. Finished goods are goods that represent the final output of the establishment, but that are still within ownership of the establishment.

When using inventory data by stage of fabrication for "all industries" and at the three-digit subsector level, it should be noted that an item treated as a finished product by an establishment in one industry may be reported as a raw material by an establishment in a different industry. For example, the finished product inventories of a steel mill would be reported as raw materials by a stamping plant. Such differences are present in the inventory figures by stage of fabrication shown for all publication levels.

Total Fringe Benefits (ASM): This item is the employer's costs for social security tax, unemployment tax, workers' compensation insurance, state disability insurance pension plans, stock purchase plans, union-negotiated benefits, life insurance premiums, and insurance premiums on hospital and medical plans for employees. Also included are the employer's costs for benefits to individual employees such as stock purchase plans, deferred profit-sharing plans, and defined benefit and defined contribution retirement plans. They exclude such items as company-operated cafeterias, in-plant medical services, free parking lots, discounts on employee purchases, and uniforms and work clothing for employees.

These figures represent the total amount of employer-paid benefits for all categories shown, and are inclusive of payments made on behalf of individuals that may not be included in the current payroll values . Consequently, for some manufacturing industries, payroll and benefits values may not move in tandem when compared to prior year tabulation totals.

Note: Beginning with the 2006 ASM, for employment and related fields (payroll, production hours, benefits), respondents were asked to report only those full- and part-time employees whose payroll was reported on the IRS Form 941 filing for the Employer Identification Number (EIN) used by that manufacturing establishment. Other temporary workers and workers whose payroll was reported under a different company's EIN were reported elsewhere on the form. In 2002, these data constituted between 1 and 1 1/2% of the total for these fields. Comparisons with data prior to 2006 should be used with caution.

Total misc. receipts (ASM): Miscellaneous receipts represent receipts from activities of the establishment other than the manufacturing of products from its own materials. Service activities such as installation, repair, and training are miscellaneous receipts. Assembly of products from materials owned by others and the sale of products bought and resold without further value added are other examples of miscellaneous receipts. Miscellaneous receipts are collected using the following categories:

1. Reported contract work - receipts for work or services that a plant performed for others on their materials.
2. Value of resales - sales of products bought and sold without further manufacture, processing, or assembly.
3. Other miscellaneous receipts - such as repair work, installation, sales of scrap, etc.

Total other expenses (ASM): Included in the total cost of other expenses are the totals for the following:

- Temporary staff and leased employee expenses
- Expensed computer hardware and other equipment
- Expensed purchases of software
- Data processing and other purchased computer services
- Communication services
- Repair and maintenance services of buildings and or machinery
- Refuse removal (including hazardous waste) services
- Advertising and promotional services
- Purchased professional and technical services
- Taxes and license fees
- All other expenses

Total rental payments (ASM): This item includes rental payments for the use of all items for which depreciation reserves would be maintained if they were owned by the establishment, e.g., structures and buildings, and production, office, and transportation equipment. Excluded are royalties and other payments for the use of intangibles and depletable assets and land rents where separable.

When an establishment of a multiestablishment company was charged rent by another part of the same company for the use of assets owned by the company, it was instructed to exclude that cost from rental payments.

If there were assets at an establishment rented from another company and the rents were paid centrally by the head office of the establishment, the company was instructed to report these rental payments as if they were paid directly by the establishment.

Total requirements tables (BEA): Three I-O tables showing the output required to meet a given level of final use. The three tables are the commodity-by-commodity total requirements table, the industry-by-commodity total requirements table, and the industry-by-industry total requirements table. All three tables are calculated from the supplementary make and use tables.

Total value of shipments (ASM): This item covers the received or receivable net selling values, f.o.b. plant (exclusive of freight and taxes), of all products shipped as well as all miscellaneous receipts, such as receipts for contract work performed for others, installation and repair, sales of scrap, and sales of products bought and sold without further processing. Included are all items made by or for the establishments from material owned by it, whether sold, transferred to other plants of the same company, or shipped on consignment. The net selling value of products made in one plant on a contract basis from materials owned by another was reported by the plant providing the materials.

In the case of multiunit companies, the manufacturer was requested to report the value of products transferred to other establishments of the same company at full economic or commercial value, including not only the direct cost of production but also a reasonable proportion of "all other costs" (including company overhead) and profit.

Data represent total value of shipments for most industries. For industries 311411, 311412, 311421, 311422, 311711, 311712, 311941, 311999, 312140, 312210, 312221, and 312229, value of production is shown. For industry 336611, value of work done is shown.

In addition to the value for NAICS-defined products, aggregates of the following categories of miscellaneous receipts are reported as part of a total establishment's value of products shipments:

1. Reported contract work - receipts for work or services that a plant performed for others on their materials;
2. Value of resales - sales of products bought and sold without further manufacture, processing, or assembly; and
3. Other miscellaneous receipts - includes repair work, installation, sales of scrap, etc.

Use table (BEA): Matrix that shows the consumption of commodities by each industry or final user. The entries in a row represent the dollar value of the commodity consumed by each industry or final user. The total output of each commodity is the sum of all intermediate uses of the commodity by industries and all sales to final users, or the sum of the row entries. The entries in a column represent the dollar value of each commodity and value-added component used by the industry. The total output of each industry is the sum of all intermediate uses of all commodities and value added, or the sum of the column entries. For the economy as a whole, the total of all final uses of commodities equals the sum of all value added by all industries, or GDP. Use tables are produced for industries both before redefinitions and after redefinitions. It is one of the two primary tables in the I-O accounts. The use table, together with the make table, is used to derive the I-O total requirements tables.

Value added (ASM): This measure of manufacturing activity is derived by subtracting the cost of materials, supplies, containers, fuel, purchased electricity, and contract work from the value of shipments (products manufactured plus receipts for services rendered). The result of this calculation is adjusted by the addition of value added by merchandising operations (i.e., the difference between the sales value and the cost of merchandise sold without further manufacture, processing, or assembly) plus the net change in finished goods and work-in-process between the beginning and end of year inventories.

For those industries where value of production is collected instead of value of shipments, value added is adjusted only for the change in work-in-process inventories between the beginning and end of year. For those industries where value of work done is collected, the value added does not include an adjustment for the change in finished goods or work-in-process inventories.

This item avoids the duplication in the figure for value of shipments that results from the use of products of some establishments as materials by others. Value added is considered to be the best value measure available for comparing the relative economic importance of manufacturing among industries and geographic areas.

Value added (BEA): The difference between an industry’s or an establishment's total output and the cost of its intermediate inputs. It equals gross output (sales or receipts and other operating income, plus inventory change) minus intermediate inputs (consumption of goods and services purchased from other industries or imported). Value added consists of compensation of employees, taxes on production and imports less subsidies (formerly indirect business taxes and nontax payments), and gross operating surplus (formerly “other value added”).

Value added (OECD): The value added used by the OECD is stated to be consistent with that described in the 1993 System of National Accounts.[92]

Value added (UNSD): Gross value added is the value of output less the value of intermediate consumption; it is a measure of the contribution to GDP made by an individual producer, industry or sector; gross value added is the source from which the primary incomes of the System of National Accounts (SNA) are generated and is therefore carried forward into the primary distribution of income account.

Value of interplant transfers (ASM): In the case of multiunit companies, the manufacturer was requested to report the value of products transferred to other establishments of the same company at full economic or commercial value, including not only the direct cost of production but also a reasonable proportion of "all other costs" (including company overhead) and profit.

Value of products shipments (ASM): This item covers the received or receivable net selling values, f.o.b. plant (exclusive of freight and taxes), of all products shipped. Miscellaneous receipts, such as receipts for contract work performed for others, installation and repair, sales of scrap, and sales of products bought and sold without further processing are excluded from this item. Included are all items made by or for the establishments from material owned by it, whether sold, transferred to other plants of the same company, or shipped on consignment. The net selling value of products made in one plant on a contract basis from materials owned by another was reported by the plant providing the materials.

In the case of multiunit companies, the manufacturer was requested to report the value of products transferred to other establishments of the same company at full economic or commercial value, including not only the direct cost of production but also a reasonable proportion of "all other costs" (including company overhead) and profit.

Data represent total value of shipments for most industries. For industries 311411, 311412, 311421, 311422, 311711, 311712, 311941, 311999, 312140, 312210, 312221, and 312229, value of production is shown. For industry 336611, value of work done is shown.

Value of resales (ASM): Miscellaneous receipts represent receipts from activities of the establishment other than the manufacturing of products from its own materials. Service activities such as installation, repair, and training are miscellaneous receipts. Assembly of products from materials owned by others and the sale of products bought and resold without further value added are other examples of miscellaneous receipts. Miscellaneous receipts are collected using the following categories:

[92] Yamano, Norihiko and Nadim Ahmad. (2006) "The OECD Input-Output Database: 2006 Edition." STI Working Paper 2006/8. Organisation for Economic Co-operation and Development. October 20, 2006. <http://www.oecd.org/dataoecd/46/54/37585924.pdf>

1. Reported contract work - receipts for work or services that a plant performed for others on their materials.
2. Value of resales - sales of products bought and sold without further manufacture, processing, or assembly.
3. Other miscellaneous receipts - such as repair work, installation, sales of scrap, etc.

Volume of Production (Figure 4.5): This item is the sum of all expenditures shown in Figure 4.5, including communication services; other costs; refuse removal; computer hardware, software, and other equipment; professional, technical, and data services; payroll and benefits; capital expenditures: Buildings and other structures; capital expenditures: machinery and equipment; materials, parts, containers, packaging, etc. used; contract work and resales; and purchased fuels and electricity.

Work-in- process inventories, BOY (ASM): Respondents were asked to report their beginning of year and end of year inventories at cost or market. Effective with the 1982 Economic Census, this change to a uniform instruction for reporting inventories was introduced for all sector reports. Prior to 1982, respondents were permitted to value inventories using any generally accepted accounting method (FIFO, LIFO, or market, to name a few). Beginning in 1982, LIFO users were asked to first report inventory values prior to the LIFO adjustment and then to report the LIFO reserve and the LIFO value after adjustment for the reserve.

Inventory data by stage of fabrication

Total inventories and three detailed components were collected:

1. Finished goods
2. Work-in-process
3. Materials, supplies, fuels, etc.

Materials inventories refer to goods that are raw inputs to the manufacturing process, and that will be substantially altered to produce an establishment's output. Work-in-process inventories refer to goods that have been substantially transformed in the manufacturing process, but that are not yet the final output of the establishment. Finished goods are goods that represent the final output of the establishment, but that are still within ownership of the establishment.

When using inventory data by stage of fabrication for "all industries" and at the three-digit subsector level, it should be noted that an item treated as a finished product by an establishment in one industry may be reported as a raw material by an establishment in a different industry. For example, the finished product inventories of a steel mill would be reported as raw materials by a stamping plant. Such differences are present in the inventory figures by stage of fabrication shown for all publication levels.

Work-in- process inventories, EOY (ASM): Respondents were asked to report their beginning of year and end of year inventories at cost or market. Effective with the 1982 Economic Census, this change to a uniform instruction for reporting inventories was introduced for all sector reports. Prior to 1982, respondents were permitted to value inventories using any generally accepted accounting method (FIFO, LIFO, or market, to name a few). Beginning in 1982, LIFO users were asked to first report inventory values prior to the LIFO adjustment and then to report the LIFO reserve and the LIFO value after adjustment for the reserve.

Inventory data by stage of fabrication

Total inventories and three detailed components were collected:

1. Finished goods
2. Work-in-process
3. Materials, supplies, fuels, etc.

Materials inventories refer to goods that are raw inputs to the manufacturing process, and that will be substantially altered to produce an establishment's output. Work-in-process inventories refer to goods that have been substantially transformed in the manufacturing process, but that are not yet the final output of the establishment. Finished goods are goods that represent the final output of the establishment, but that are still within ownership of the establishment.

When using inventory data by stage of fabrication for "all industries" and at the three-digit subsector level, it should be noted that an item treated as a finished product by an establishment in one industry may be reported as a raw material by an establishment in a different industry. For example, the finished product inventories of a steel mill would be reported as raw materials by a stamping plant. Such differences are present in the inventory figures by stage of fabrication shown for all publication levels.