NIST Advanced Manufacturing Series
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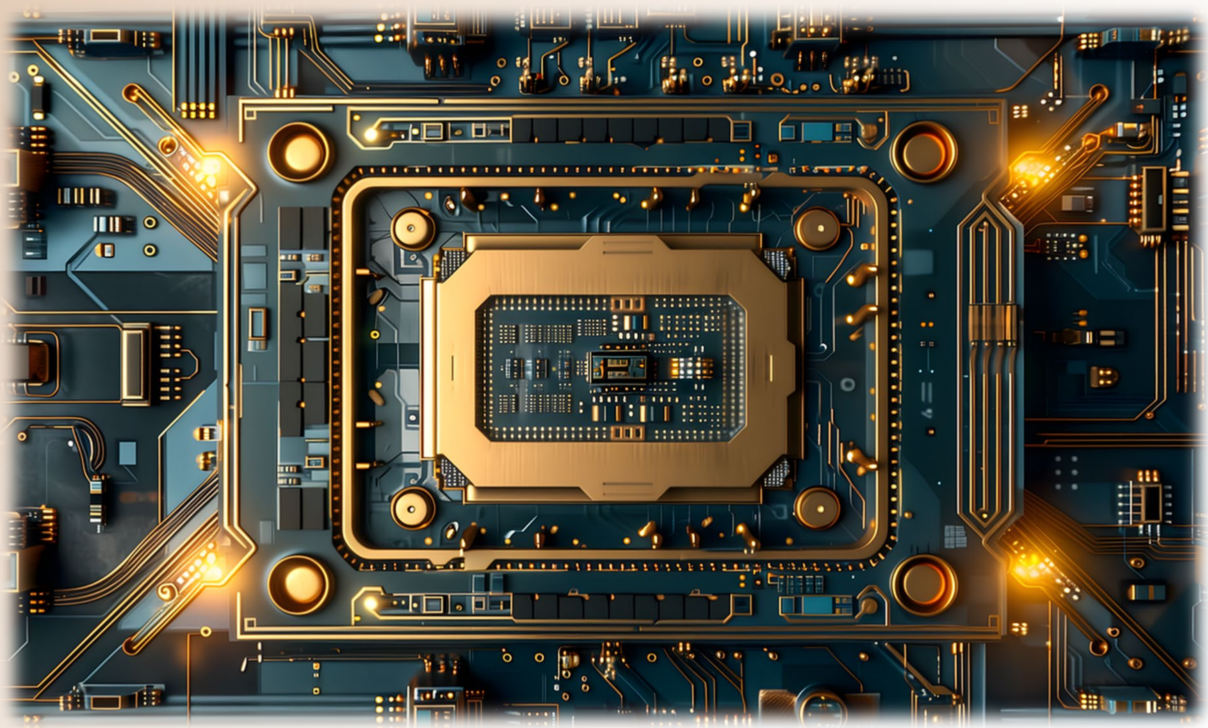
Annual Report on the U.S. Manufacturing Economy: 2025



Douglas Thomas

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NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE

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Applied Economics Office
Engineering Laboratory

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February 2026

U.S. Department of Commerce
Howard Lutnick, Secretary

National Institute of Standards and Technology
Craig Burkhardt, Acting Under Secretary of Commerce for Standards and Technology and Acting NIST Director

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Abstract

This report provides a statistical review of the U.S. manufacturing industry. There are three aspects of U.S. manufacturing that are considered: (1) how the U.S. industry compares to other countries, (2) the trends in the domestic industry, and (3) the industry trends compared to those in other countries. The report discusses forecasts for U.S. manufacturing and provides means for advancing national manufacturing competitiveness.

Keywords

manufacturing; economy; supply chain; value added; statistics

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Preface

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

Acronyms

AM: Additive Manufacturing
ASM: Annual Survey of Manufactures
ATP: Advanced Technology Program
BEA: Bureau of Economic Analysis
BLS: Bureau of Labor Statistics
CAG: Compound Annual Growth
CEO: Chief Executive Officer
DARPA: Defense Advanced Research Projects Agency
GDP: Gross Domestic Product
ISIC: International Standard Industrial Classification
NAICS: North American Industry Classification System
NIST: National Institute of Standards and Technology
OECD: Organization for Economic Cooperation and Development
PPP: Purchasing Power Parity
R&D: Research and Development
SBIR: Small Business Innovation Research Program
SIC: Standard Industrial Classification
STEP: Standard for the Exchange of Product Model Data
USGS: United States Geological Survey
VA: Value Added

Executive Summary

This report provides a statistical review of the U.S. manufacturing industry. There are three aspects of U.S. manufacturing that are considered: (1) how the U.S. industry compares to other countries, (2) the trends in the domestic industry, and (3) the industry trends compared to those in other countries. The U.S. remains a major manufacturing nation; however, other countries are rising rapidly.

Although U.S. manufacturing performs well in many respects, there are opportunities for advancing competitiveness. This would require strategic placement of resources to ensure that U.S. investments have the highest return possible.

Competitiveness – Manufacturing Industry Size: In 2023, there was $15.3 trillion of value added (i.e., GDP) in global manufacturing in constant 2015 dollars, which is 17.2 % of the value added by all industries ($89.2 trillion), according to the United Nations Statistics Division (2024). The U.S. accounted for 15.1 % of manufacturing valued added while China accounted for 31.4 %. U.S. direct and indirect (i.e., purchases from other industries) manufacturing accounts for 16.2 % of U.S. GDP. Among the ten largest manufacturing countries, the U.S. is the 4th largest manufacturing value added per capita (see Figure 2.5) and out of all countries the most recent U.S. rank is 13th, as illustrated in Figure 2.6. In 2020, China produced more than the U.S. in 9 of the 11 subsectors shown in Figure 2.8.

Competitiveness – Manufacturing Growth: Compound real (i.e., controlling for inflation) annual growth in the U.S. between 1998 and 2023 (i.e., 25-year growth) was 1.6 %, which places the U.S. below the 50th percentile. The compound annual growth for the U.S. between 2018 and 2023 (i.e., 5-year growth) was 0.9 %. This puts the U.S. just below the 50th percentile, above Canada and Germany among others.

Competitiveness – Productivity: Labor productivity for manufacturing decreased between 2022 and 2023 by 1.0 %, as illustrated in Figure 4.10. The five-year compound annual growth is -0.7 %. For U.S. manufacturing, total factor productivity decreased 3.2 % from 2022 to 2023 and has a 5-year compound annual growth rate of -0.7 %, as illustrated in Figure 4.11. In general, productivity in the U.S. is relatively high compared to other countries. As illustrated in Figure 4.12, the U.S. is ranked ninth in output per hour for all goods and services among 142 countries using data from the Conference Board (2023) – note that this is for all goods/services. In recent years, productivity growth has been negative or has come to a plateau in many countries and the U.S. seems to be following this pattern of slow growth. There are competing explanations for why productivity has slowed, such as an aging population, inequality, or other factors. A number of the explanations equate to low levels of capital investment. It is also important to note that productivity is difficult to measure and even more difficult to compare across countries. Moreover, the evidence does not seem to support any particular explanation over another as to why productivity appears to have stalled.

Competitiveness – Economic Environment: There is no agreed upon measure for research, innovation, and other factors for conducting business, but there are a number of common measures that are used. The ranking of the U.S. in these measures has mixed results, ranking high in some and lower in others. For instance, the U.S. ranks 4th in patent applications per million people but ranks 21st in researchers per capita and 27th in journal article publications per capita. The IMD World Competitiveness Index, which measures competitiveness for conducting business, ranked the U.S. 13th in competitiveness for conducting business and the World Economic Forum, which assesses the competitiveness in determining productivity, ranked the U.S. 5th. Note that neither of these are specific to manufacturing, though. The Competitive Industrial Performance Index, which measures capacity to produce and export manufactured goods; technological deepening and upgrading; and world impact, ranked the U.S. as 6th.

Domestic Specifics – Types of Goods Produced: The largest manufacturing subsector in the U.S. is chemical manufacturing followed computer and electronic products and then food, beverage, and tobacco products, as seen in Figure 2.12. Discrete technology products accounted for 36 % of U.S. manufacturing.

Domestic Specifics – Manufacturing Supply Chain Costs: High-cost supply chain industries/activities might pose as opportunities for advancing competitiveness. For discrete technology products, the largest supply chain items, based on NAICS code, include wholesale trade, primary metals, fabricated metals, chemical products, management of companies and enterprises. For process manufacturing, the largest items were oil and gas extraction; plastics and rubber products; wholesale trade; management of companies and enterprises; fabricated metal products; and miscellaneous professional, scientific, and technical services.

Domestic Specifics – Manufacturing Safety, Compensation, and Profits: As illustrated in Figure 4.5, employee compensation in manufacturing, which includes benefits, has had a five-year compound annual growth of -1.2 %. In recent years, manufacturing compensation has had a negative trend while that of private industry has had a positive trend. Compensation in manufacturing, which includes benefits, still slightly exceeds that of the total private industry; however, the difference has narrowed significantly. In terms of safety in manufacturing, injuries and the injury rate have generally trended downward since 2002; however, there was an increase in recent years (see Figure 4.2). Fatalities has plateaued or even increased slightly in recent years.

For those that invest in manufacturing, corporate profits have had a five-year compound annual growth of 9.6 %, as illustrated Figure 4.8, and nonfarm proprietors' income for manufacturing has had a five-year compound annual growth rate of 12.6 %, as illustrated in Figure 4.9.

Domestic Specifics – Outlook: The National Association of Manufacturers reported that those with a positive outlook was 55.4 % in the second quarter of 2025, as seen in Figure 6.1. The Bureau of Labor Statistics forecasts a compound annual growth rate of 1.2 % for manufacturing output.

<u>Methods and Opportunities for Advancing Manufacturing</u>: Methods and opportunities for advancing national manufacturing competitiveness discussed in Section 7 are summarized in the following bullets:

- Advancing competitiveness for a selection of industries rather than all industries can avoid overextension or dispersing of resources across many initiatives and losing the focus needed for competitiveness. These industries might include those that are the following:
    - Products critical to national and/or economic security
    - Products where there is great value resulting from differentiation (e.g., product quality)
    - Critical supply chain items for the previous two categories
- Managing the risk posed by supply chain disruption for moderately critical supply chain items to source products from lower risk suppliers can reduce costs and losses due to disruption.
- Developing strategic plans for public investments (e.g., standards, methods, technologies, and tools) can result in high-return systems of improvement. These types of systems include the following:
    - Creating comprehensive plans from the initial stages of project development to dissemination and adoption by manufacturers for granular levels of investment (e.g., investments less than $1 million).
    - Advancing forecast accuracy for granular levels of investment analysis (e.g., those less than $1 million).
    - Developing a system of continuous improvement where predictions of impact are validated to recalibrate prediction methods and inform future projects.
    - Incorporating plans for technology diffusion across the industry.
    - Engaging in purpose driven economic analysis that motivates manufacturers to adopt innovations when they are cost effective, guides public investments by identifying the highest impact solutions, and justifies investments by showing impact and/or returns.
- Increasing the accuracy of investment predictions for manufacturing can guide manufacturers in adopting new technologies when they are cost effective and avoiding them when they are not. Increasing accuracy includes the following:
    - Developing and implementing standardized classification systems for collecting/analyzing economic data, including the following:
        - Classification of investments to collect data and systematically study/learn from past investments
        - Classification of manufacturing industry costs to collect/analyze data on the impact of projects and to predict/forecast investment returns
    - Developing and implementing standard methods for investment analysis that can be implemented by non-experts because there are a vast number of investment decisions being made without expert insight.

    - Developing and implementing data tools and information on the various financial aspects of manufacturing that provide information that non-experts can understand.
- Ensuring that structural conditions in the economy (e.g., considering competing impacts) encourage productive investments can increase or magnify the returns for competitiveness investments.
- Producing better products faster and with fewer resources can be achieved by developing and implementing standards, technologies, methods, tools, and/or guides that advance the following:
    - Quality and performance of manufactured products
    - Cost of manufactured products
    - Cost of using manufactured products
- For countries that compete through differentiation (e.g., United States), competitiveness can be strengthened by creating and applying standards that make it easier to distinguish differences in product quality and performance. These standards help producers capture the value (e.g., profits) of higher-quality products. Such differentiation can be based on the following factors:
    - Quality and performance
    - Repairability and access to parts/components
    - Life expectancy
    - Cost of use (e.g., energy and maintenance)
- Advancing and maintaining competitive factors for conducting business can decrease costs and increase efficiency/productivity. These factors include the following:
    - An educated and well-trained labor force
    - An efficient transportation system
    - An efficient and reliable energy system
    - The mitigation of supply chain risks that are beyond the manufacturers control
- In addition to promoting the U.S. as a brand and maintaining/advancing the narrative on U.S. branding, maintaining and/or advancing standards for “Made in USA” branding can avoid diluting value.

1. Introduction

1.1. Background

Public entities have a significant role in the U.S. innovation process (Block and Keller 2016). The federal government has had a substantial impact in developing, supporting, and nurturing numerous innovations and industries, including the Internet, telecommunications, aerospace, semiconductors, computers, pharmaceuticals, and nuclear power among others, many of which may not have come to fruition without public support (Wessner and Wolff 2012). Although the Defense Advanced Research Projects Agency (DARPA), Small Business Innovation Research Program (SBIR), and Advanced Technology Program (ATP) have received attention in the scholarly community, there is generally limited awareness of the government's role in U.S. innovation. The vastness and diversity of U.S. federal research and development programs along with their changing nature make them difficult to categorize and evaluate (Block and Keller 2016), but their impact is often significant. For instance, the origins of Google are rooted in a public grant through the National Science Foundation (National Science Foundation 2004; Block and Keller 2016).One objective of public innovation is to enhance economic security and improve our quality of life (National Institute of Standards and Technology 2018), which is achieved in part by advancing efficiency in which resources are consumed or impacted by production. This includes decreasing inputs, which amount to costs, and negative externalities (e.g., environmental impacts) while increasing output, (i.e., the products produced), and the function of the product (e.g., the usefulness or quality of the product), as seen in Figure 1.1. In pursuit of this

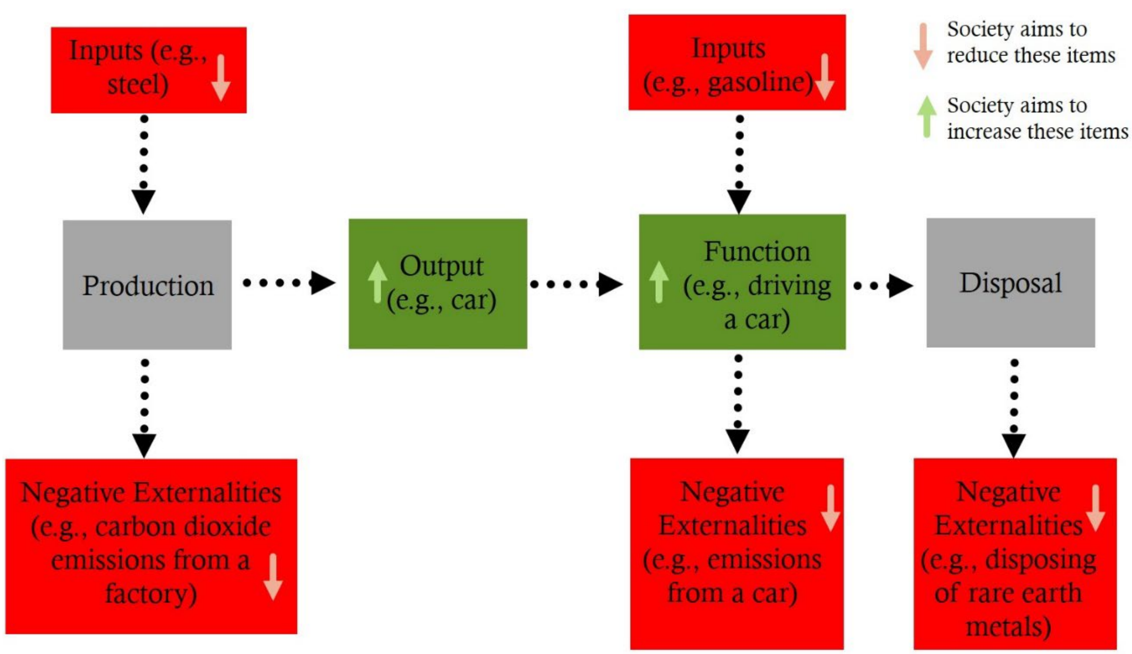


Figure 1.1: Illustration of Objectives – Drive Inputs and Negative Externalities Down while Increasing Production Output and Product Function

goal, the National Institute of Standards and Technology (NIST) has a number of projects in manufacturing, such as support for the development of the International Standard for the Exchange of Product Model Data (STEP) (Robert D. Niehaus, Inc 2014), which reduces the need for duplicative efforts such as re-entering design data.

1.2. Purpose of this Report

The purpose of this report is to characterize U.S. innovation and industrial competitiveness in manufacturing, as it relates to the objectives illustrated in Figure 1.1. It includes tracking domestic manufacturing activity and its supply chain in order to develop a quantitative depiction of U.S. manufacturing in the context of the domestic economy and global industry. There are five aspects that encapsulate the information discussed in this report:

- **Growth and Size**: The size of the U.S. manufacturing industry and its growth rate as compared to other countries reveals the relative competitiveness of the industry.
    - ***Metrics***: Value added, value added per capita, assets, and compound annual growth

- **Productivity**: It is necessary to use resources efficiently to have a competitive manufacturing industry. Productivity is a major driver of the growth and size of the industry.
    - ***Metrics***: Labor productivity index, total factor productivity index, output per hour

- **Economic Environment**: A number of factors, including research, policies, and societal trends, can affect the productivity and size of the industry.
    - ***Metrics***: Research and development expenditures as a percent of GDP, journal articles per capita, researchers per capita, competitiveness indices, inflation, patents

- **Stakeholder Impact**: Owners, employees, and other stakeholders invest their resources into manufacturing with the purpose of receiving some benefit. The costs and return that they receive can drive industry productivity and growth. However, data is limited on this topic area.
    - ***Metrics***: Number of employees, compensation, safety incidents, profits, exports, hours worked

- **Areas for Advancement**: It is important to identify areas of investment that have the potential to have a high return, which can facilitate productivity and growth in manufacturing.
    - ***Metrics***: High-cost supply chain components, country comparison indices

Currently, this annual report discusses items related to inputs for production and outputs from production. It does not discuss negative externalities, the inputs that are used in the function of a product (e.g., gasoline for an automobile), or the function of the product; however, these items might be included in future reports.

Manufacturing metrics can be categorized by stakeholder, scale, and metric type (see Figure 1.2). Stakeholders include the individuals that have an interest in manufacturing. Each metric in this report relates directly or indirectly to one or more stakeholders, such as a cost or benefit. The benefits for some stakeholders are costs for other stakeholders. For instance, the price of a product is a cost to the consumer but represents compensation and profit for the producers. The scale indicates whether the metric is nominal (e.g., the total U.S. manufacturing revenue) or is adjusted to a notionally common scale (e.g., revenue per capita). The metric type distinguishes whether the metric measures manufacturing activities directly (e.g., total employment) or measures those things that affect manufacturing (e.g., research and development). These metrics are then compared over time and/or between industries to provide context to U.S. manufacturing activities.

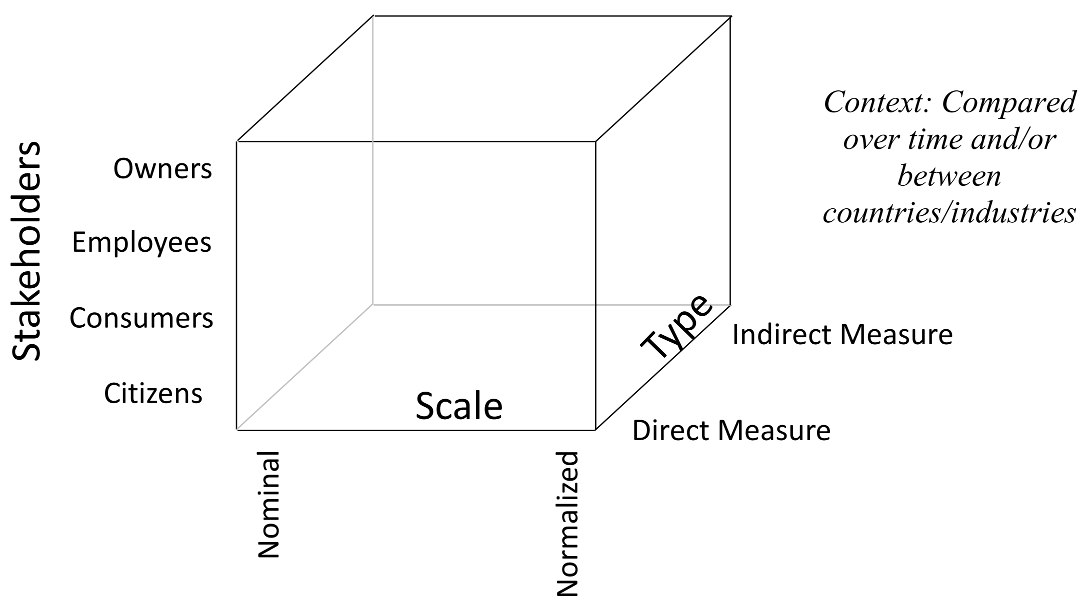


Figure 1.2: Data Categorization for Examining the Economics of Manufacturing

1.3. Scope and Approach

There are numerous aspects one could examine in manufacturing. This report discusses a subset of stakeholders and focuses on U.S. manufacturing. Among the many datasets available, it utilizes those that are prominent and are consistent with economic standards. These criteria are further discussed below.

Stakeholders: This report focuses on the employees and the owners/investors, as the data available facilitates examining these entities. Future work may move toward examining other stakeholders in manufacturing, such as the consumers and general public.

Geographic Scope: Many change agents are concerned with a certain group of people or organizations. Since NIST is concerned with "U.S. innovation and competitiveness," this report focuses on activities within national borders. In a world of globalization, this effort is challenging, as some of the parts and materials being used in U.S.-based manufacturing activities are imported. NIST, however, promotes U.S. innovation and industrial competitiveness; therefore, consideration of these imported goods and services are outside of the scope of this report.

Standard Data Categorization: Domestic data in the U.S. tends to be organized using NAICS codes, which are the standard used by federal statistical agencies classifying business establishments in the United States. NAICS was jointly developed by the U.S. Economic Classification Policy Committee, Statistics Canada, and Mexico's Instituto Nacional de Estadística y Geografía, and was adopted in 1997. 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 (SIC). NAICS codes are categorized at varying levels of detail. The broadest level of detail is the two-digit NAICS code, which has 20 categories. More detailed data is reported as the number of digits increase; thus, three-digit NAICS provide more detail than the two-digit and the four-digit provides more detail than the three-digit. The maximum is six digits. Sometimes a two, three, four, or five-digit code is followed by zeros, which do not represent categories. They are null or place holders. For example, the code 336000 represents NAICS 336. 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 subcategorization. This data categorization works similar to NAICS in that additional digits represent additional detail.

Data Sources: Thomas (2012) explores a number of data sources for examining U.S. manufacturing activity. This report selects from sources that are the most prominent and reveal the most information about the U.S. manufacturing industry. These data include the United Nations Statistics Division's National Accounts Main Aggregates Database and the U.S. Census Bureau's Annual Survey of Manufactures, among others. Because the data sources are scattered across several resources, there are differences in what yearly data is available for a particular category or topic. In each case, the most-up-to-date and available information is provided for the relevant category.

Data Limitations: Like all collections of information, the data on manufacturing has limitations. In general, there are 3 aspects to economic data of this type: 1) breadth of the data, 2) depth of the data, and 3) the timeliness of the data. The breadth of the data refers to the span of items covered, such as the number of countries and years. The depth of the data refers to the number of detailed breakouts, such as value added, expenditures, and industries. In general, breadth and depth are such that when the number of items in each are multiplied together it equals the number of observations in the dataset for a particular time period. For instance, if you have value added data on 5 industries for 20 countries for a single year, then you would have 100 observations (i.e., 5 x 20 = 100). The timeliness of the data refers to how recently the data was released. For instance, is the data 1 year old or 5 years old at release. In general, data can perform well in 2 of these 3 criteria, but it is less common to perform well on all 3 due to feasibility of data collection (see Figure 1.3). Moreover, in this report there is data that is very recent (timeliness) and spans numerous subsectors (depth), but it only represents the United States. On the other hand, there is data that spans multiple countries (breadth) and subsectors of manufacturing (depth); however, this data is from several years ago. Fortunately, industry level trends change slowly; thus, the data may not be from the most recent years, but it is still representative.

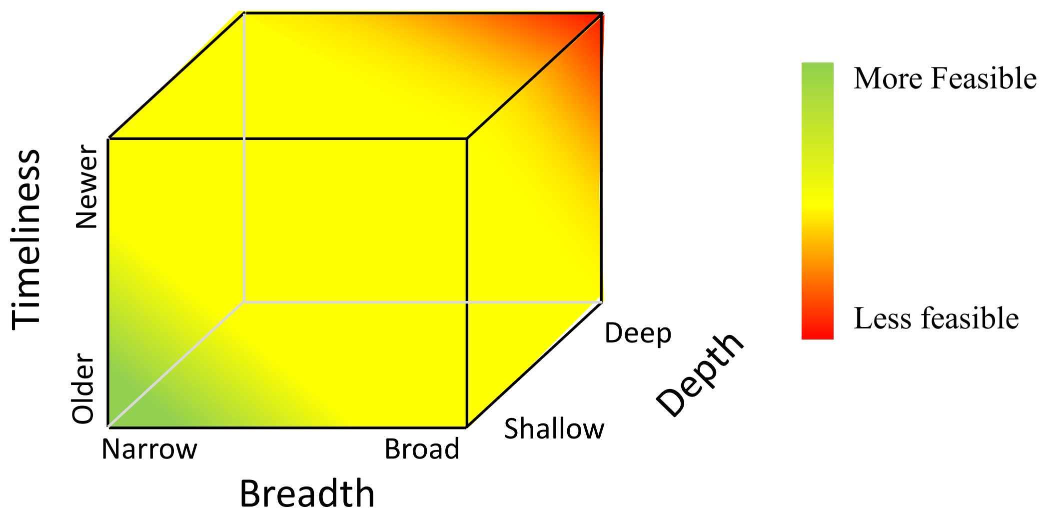


Figure 1.3: Illustration of the Feasibility of Data Collection and Availability

Official statistics are typically presented as descriptive point estimates. For many international comparisons, the dominant source of uncertainty is embedded in structural differences from variations in definitions and how data is collected rather than sampling error. As a result, conventional error bars or measures of statistical uncertainty may imply statistical properties that are not credible. This report provides a wide array of complex comparisons for a primarily non-technical audience. A focus on statistical precision can obscure the broader cross-country patterns and trends that are central to the analysis. For these reasons, this report presents point estimates without formal uncertainty measures, as is consistent with source agencies and peer publications. Nevertheless, it is important to recognize that the data and statistics are subject to measurement error and limitations; thus, small differences and variations should be interpreted with caution. Greater weight should be placed on persistent differences, broader trends, and order of magnitude differences.

2. Value Added and Capital Stock

Value added is the primary metric used to measure economic activity. It is defined as the increase in the value of output at a given stage of production; that is, it is the value of output minus the cost of inputs from other establishments (Dornbusch 2000). The primary elements that remain after subtracting inputs is taxes, compensation to employees, and gross operating surplus; thus, the sum of these also equal value added. Gross operating surplus is used to calculate profit, which is gross operating surplus less the depreciation of capital such as buildings and machinery. The sum of all value added for a country is that nation's Gross Domestic Product (GDP).

2.1. International Comparison of Industry Size, Growth, and Subsectors

There are a number of sources of international estimates of value added for manufacturing. The United Nations Statistics Division National Accounts Main Aggregates Database has a wide-ranging dataset that covers a large number of countries over a significant period of time. In 2023, there was $15.3 trillion of value added (i.e., GDP) in global manufacturing in constant 2015 dollars, which is 17.2 % of the value added by all industries ($89.2 trillion), according to the United Nations Statistics Division. Since 1970, manufacturing ranged between 13.8 % and 17.6 % of global GDP. The top 10 manufacturing countries accounted for $11.0 trillion or 71.6 % of global manufacturing value added: China (31.4 %), United States (15.1 %), Japan (6.5 %), Germany (4.9 %), South Korea (3.4 %), India (3.2 %), United Kingdom (1.8 %), Italy (1.9 %), Mexico (1.8 %), and France (1.7 %) (United Nations Statistics Division 2024).

As seen in Figure 2.1, U.S. compound real (i.e., controlling for inflation) annual growth between 1998 and 2023 was 1.6 %, which places the U.S. below the 50th percentile. This growth exceeded that of France, Canada, Japan, and Australia; however, it is slower than that for the world (3.8 %), Germany (1.7 %), and many emerging economies. It is important to note that emerging economies 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 the high growth rates in China or India has limited meaning concerning the ability of the U.S. to increase manufacturing. As seen in Figure 2.2, the compound annual growth for the U.S. between 2018 and 2023 was 0.9 %. This puts the U.S. just below the 50th percentile above France and Germany among others but still below the world growth of 2.4 %.

As seen in Figure 2.3, among the 10 largest manufacturing nations, U.S. manufacturing value added, as measured in constant 2015 dollars, is the fourth largest. In current

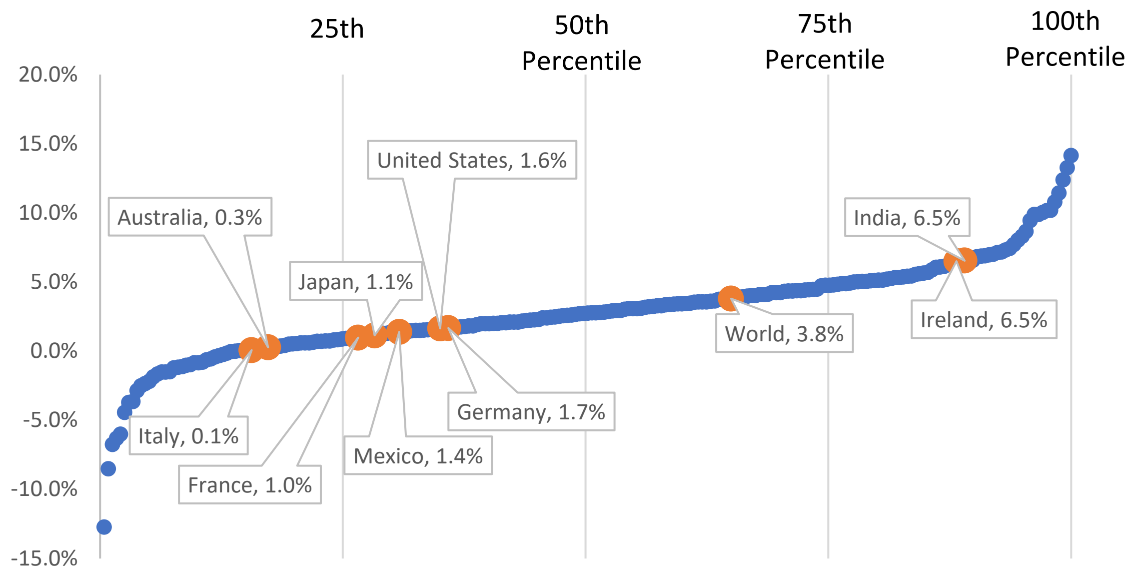


Figure 2.1: National 25-Year Compound Annual Growth, by Country (1998 to 2023): Higher is Better

Data Source: United Nations Statistics Division. (2025). "National Accounts Main Aggregates Database." https://unstats.un.org/unsd/snaama/

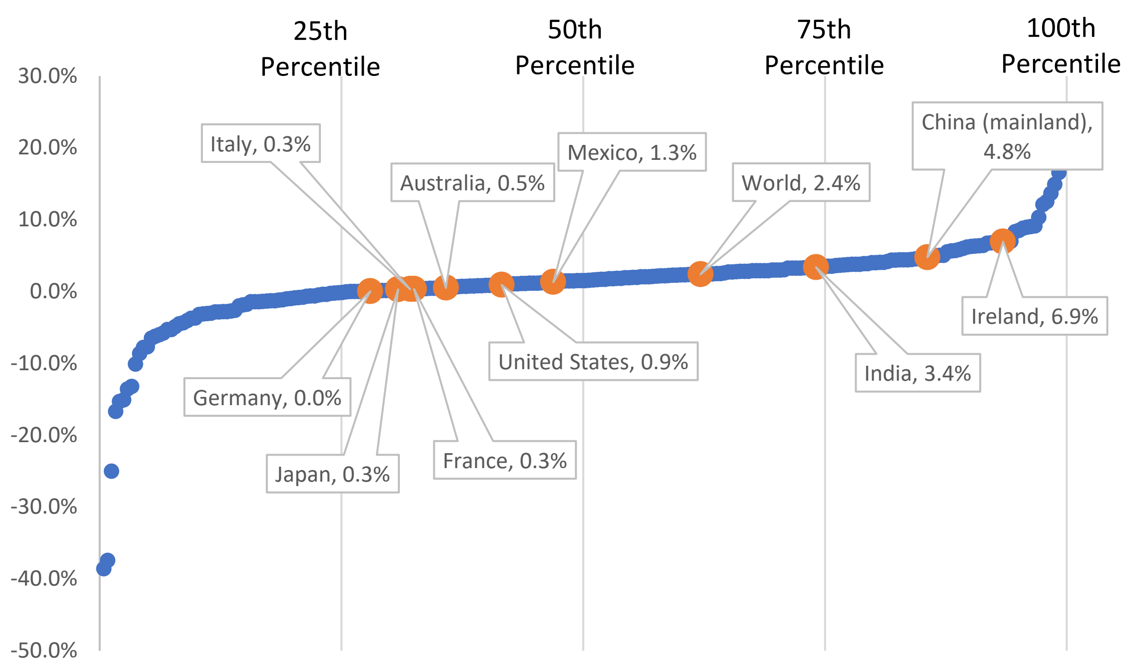
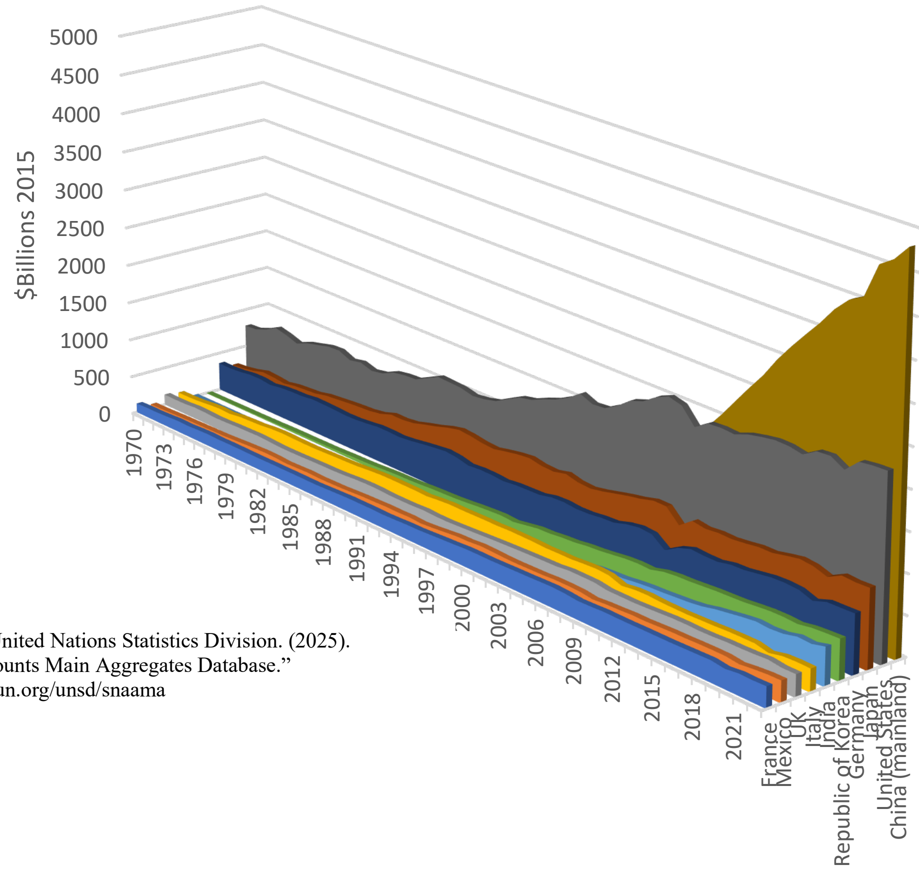


Figure 2.2: National 5-Year Compound Annual Growth, by Country (2018 to 2023): Higher is Better

Data Source: United Nations Statistics Division. (2025). "National Accounts Main Aggregates Database." https://unstats.un.org/unsd/snaama/



Data Source: United Nations Statistics Division. (2025). "National Accounts Main Aggregates Database." https://unstats.un.org/unsd/snaama

Figure 2.3: Manufacturing Value Added, Top 10 Manufacturing Countries (1970 to 2023)

dollars, the U.S. produced $2.8 trillion in manufacturing valued added while China produced $4.8 trillion in 2023. As illustrated in Figure 2.4, U.S. manufacturing value added was 10.5 % of national GDP in 2023. In comparison, Germany's manufacturing industry was 22.7 %, China was 28.1 %, and Japan was 21.7 % with the world average being 17.2 %. Although the U.S. is below average, this can be somewhat deceiving, as 2023 U.S. GDP per capita is significantly higher than both Japan and Germany along with most other countries, which makes the denominator disproportionally larger when calculating the proportion of the economy that manufacturing represents. For instance, 2023 per capita GDP in constant 2015 dollars was 64 158 for the U.S. while it was 12 074 for China, 39 276 for Germany, and 36 911 for Japan. Thus, a more meaningful measure might be manufacturing GDP (i.e., value added) per capita. Among the ten largest manufacturing countries, the U.S. has the 4^{th} largest manufacturing value added per capita, as seen in Figure 2.5. Out of all countries the U.S. ranks 13^{th}, as seen in Figure 2.6. Since 1970, the U.S. ranking has ranged between 11^{th} and 16^{th}. It is important to note that there are varying means for adjusting data that can change the rankings slightly. The UNSD data uses market exchange rates while others might use purchasing power parity (PPP) exchange rates. PPP is the rate that a currency in one country would have to be converted to purchase the same goods and services in another country. The drawback of

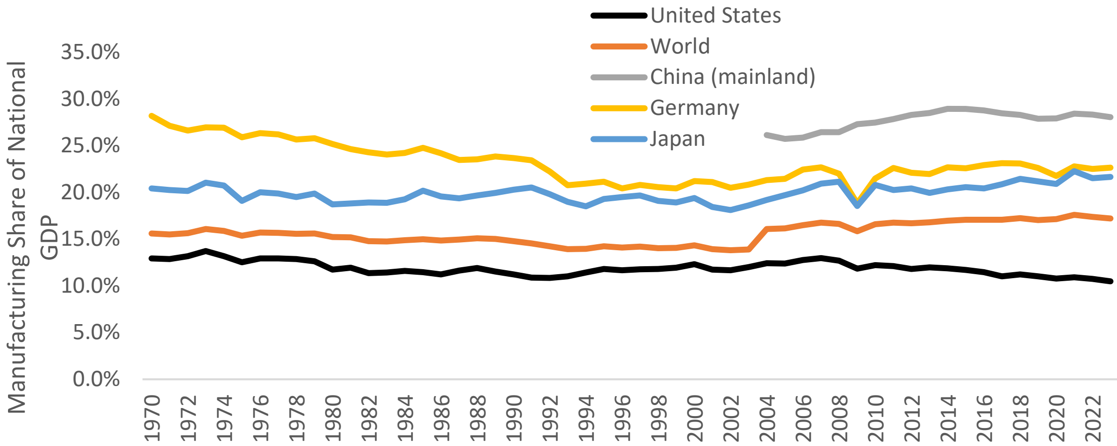
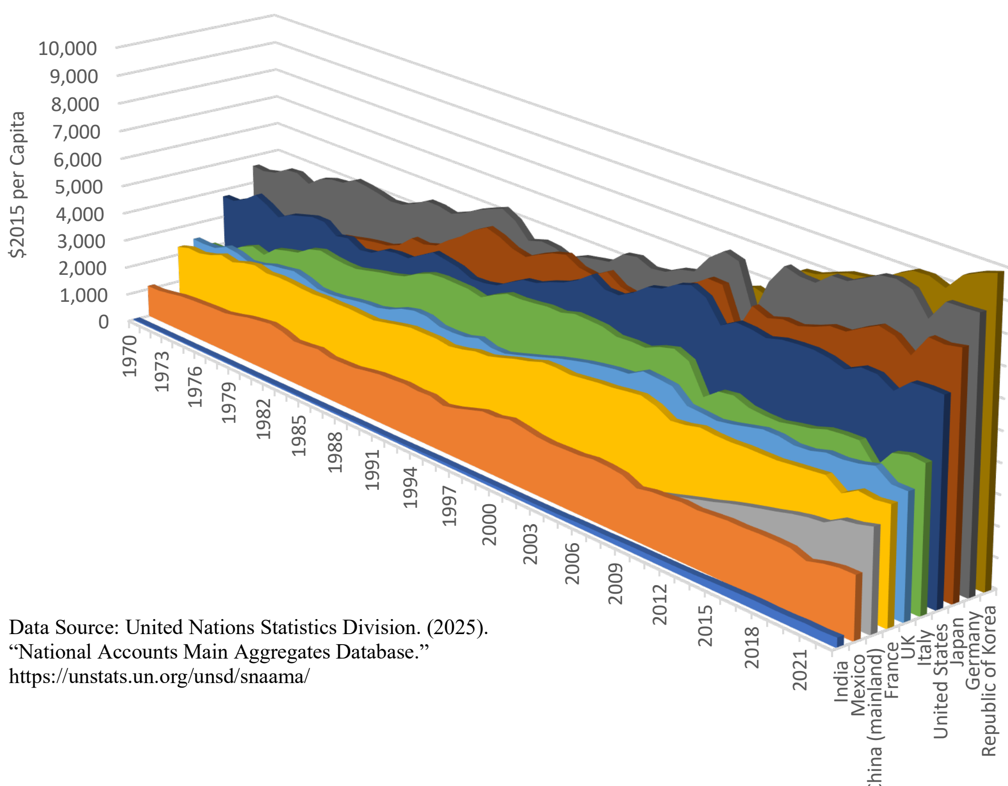


Figure 2.4: Manufacturing's Share of National GDP (Constant 2015 Dollars)

Data Source: United Nations Statistics Division. (2025). "National Accounts Main Aggregates Database." https://unstats.un.org/unsd/snaama/



Data Source: United Nations Statistics Division. (2025). "National Accounts Main Aggregates Database." https://unstats.un.org/unsd/snaama/

Figure 2.5: Manufacturing Value Added Per Capita, Top 10 Largest Manufacturing Countries (1970 to 2023): Higher is Better

PPP is that it is difficult to measure and methodological questions have been raised about some surveys that collect data for these calculations (Callen 2007). Market based rates tend to be relevant for internationally traded goods (Callen 2007); therefore, this report often utilizes these rates. As illustrated in Figure 2.7, manufacturing's share of GDP can vary based on whether the data is adjusted due to changes in prices. This tendency applies to other countries, as is illustrated for Germany in Figure 2.7.

In terms of subsectors of manufacturing, China produces more than the U.S. in 9 of the 11 subsectors shown in Figure 2.8. When aggregated together, U.S. and European manufacturing value added exceeds that of Eastern and South-eastern Asia (excluding Japan) for 7 of the 11 subsectors. Computer, electronic, and optical products is among those that Asia produces more value added.

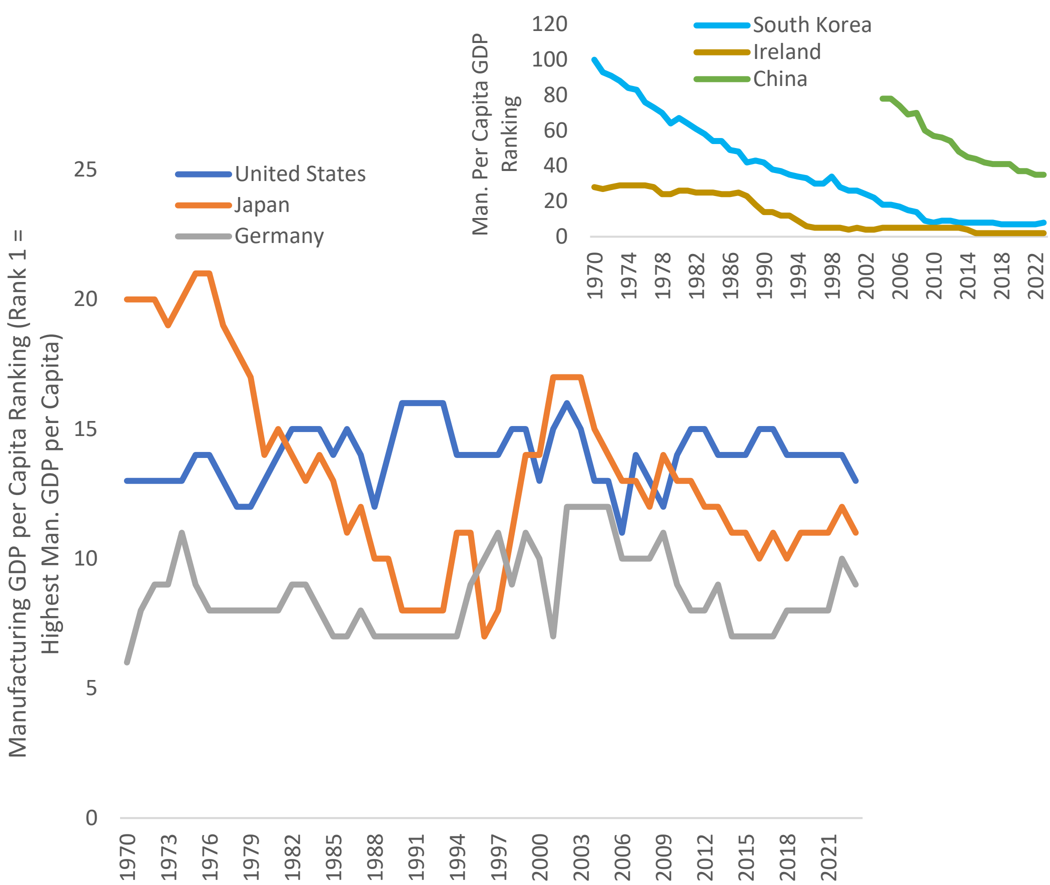


Figure 2.6: Manufacturing Per Capita Ranking, 1970 to 2022: Lower is Better

Data Source: United Nations Statistics Division. (2025). "National Accounts Main Aggregates Database." https://unstats.un.org/unsd/snaama/

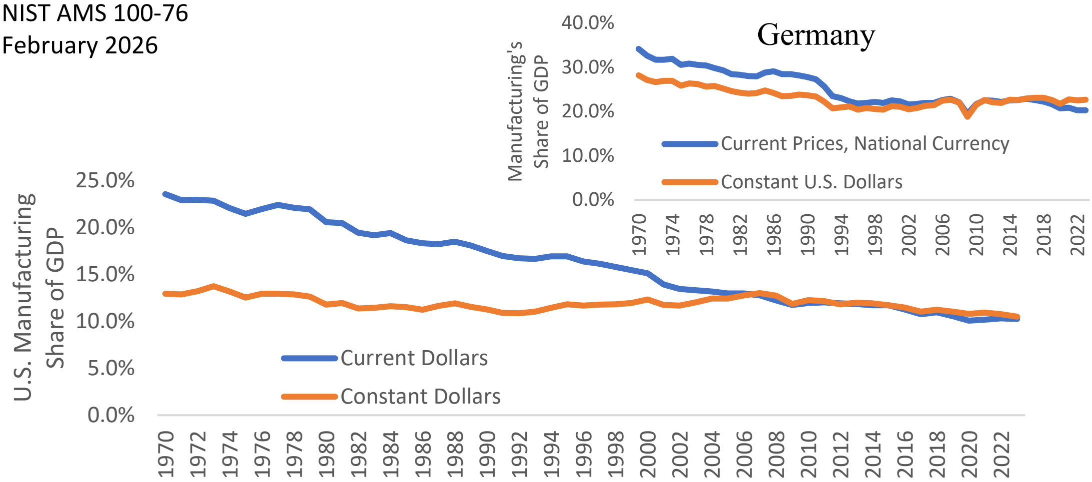


Figure 2.7: U.S. Manufacturing Share of GDP, Constant vs. Current Dollars

Data Source: United Nations Statistics Division. (2025). "National Accounts Main Aggregates Database." https://unstats.un.org/unsd/snaama/

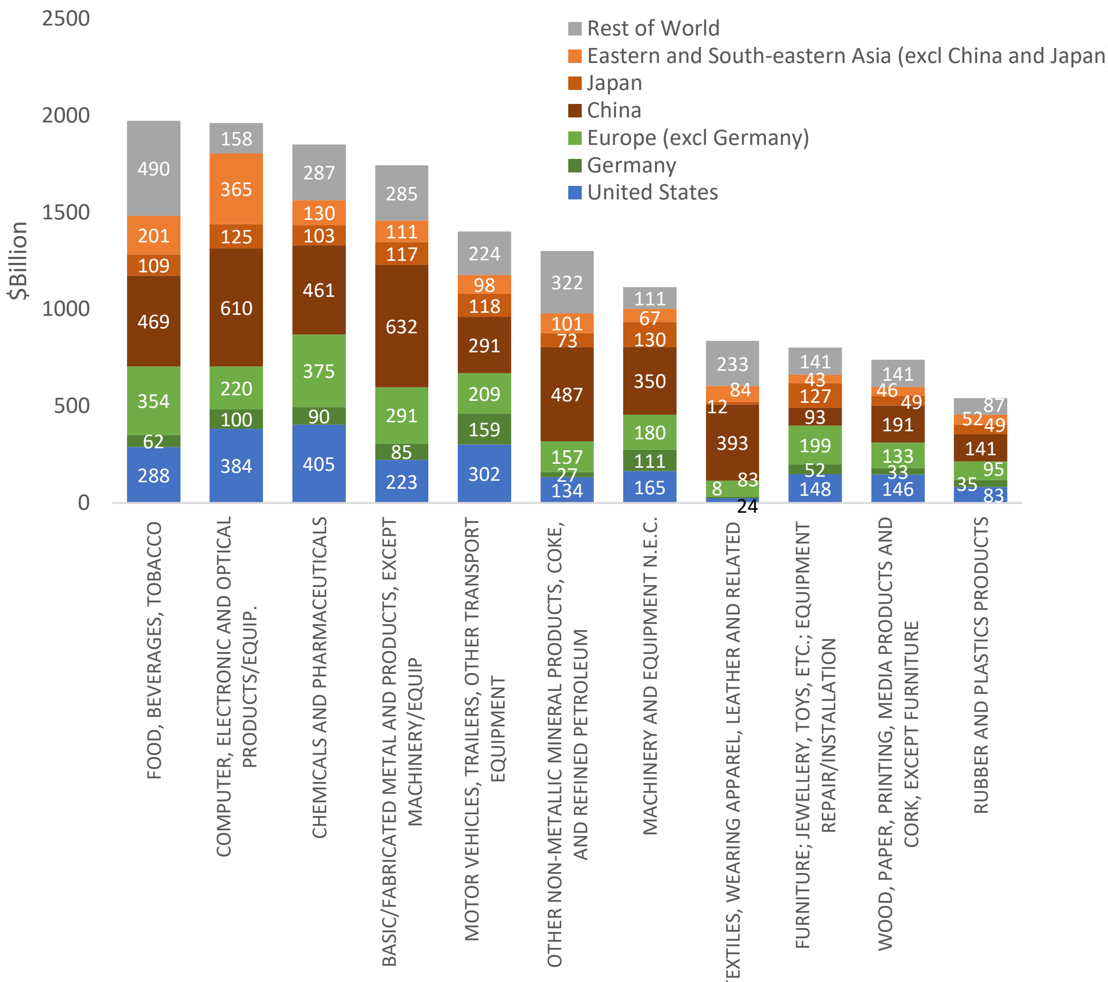


Figure 2.8: Global Manufacturing Value Added by Industry, by Country/Region (2020)

Data Source: OECD. (2024b) . Trade in Value Added (TiVA). https://www.oecd.org/en/tiva.html

2.2. Growth and Subsectors (Domestic Data)

There are two primary methods for adjusting value added for inflation. The first is using chained dollars, which uses a changing selection of goods to adjust for inflation. The second uses an unchanging selection of goods to adjust for inflation (Dornbusch 2000). There has been some dispute about the accuracy of each for some goods. The values in this section uses chained dollars. Previous versions of this report included both; however, the differences are often minor.

Figure 2.9 shows the cumulative change in manufacturing, durable goods, and nondurable goods manufacturing from 2005 forward. As seen in the figure, U.S. manufacturing value added dips during the financial crisis in the late 2000's and during the recent pandemic. During the 2005 to 2024 period, durable goods, which was 44.7 % higher than its 2005 value, has had more robust growth than nondurables, which is 12.7 % above its 2005 value.

Manufacturing value added in the U.S. in 2023 was $2.4 trillion in chained 2017 dollars or 10.2 % of GDP (Bureau of Economic Analysis 2024a). Using chained dollars from the BEA shows that manufacturing increased by 2.7 % between 2023 and 2024. Figure 2.10 and Figure 2.11 provide more detailed data on durable and nondurable goods within the manufacturing industry. As seen in Figure 2.10, computer and electronic products along with motor vehicles, bodies and trailers, and parts has grown 33.8 % and 47.8 %, respectively between 2014 and 2024. Primary metals also saw significant growth (72.9 %). Five of the eleven durable goods subsectors decreased in size between 2014 and 2024. As seen in Figure 2.11, in 2024 four of eight non-durable sectors were above their 2008 value. The largest manufacturing subsector in the U.S. is chemical products followed by computer and electronic products, as seen in Figure 2.12. Food, beverage, and tobacco products is third. Note that this is based on chained dollars. Adjustments using other methods or the nominal value can have slightly different results.

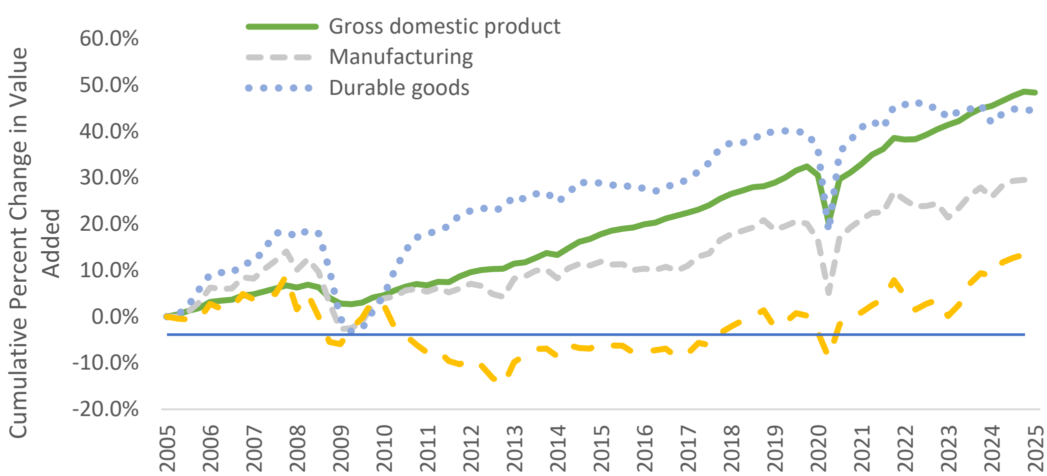
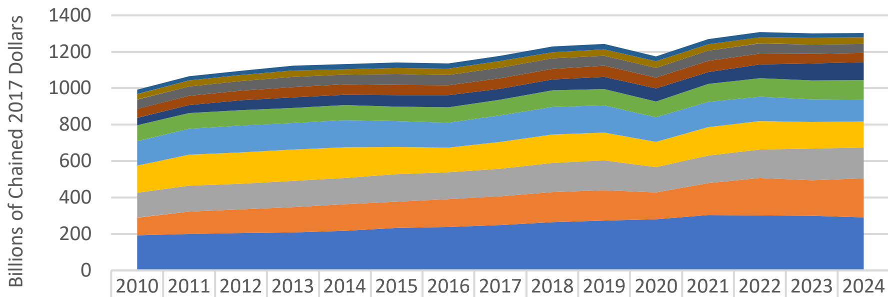


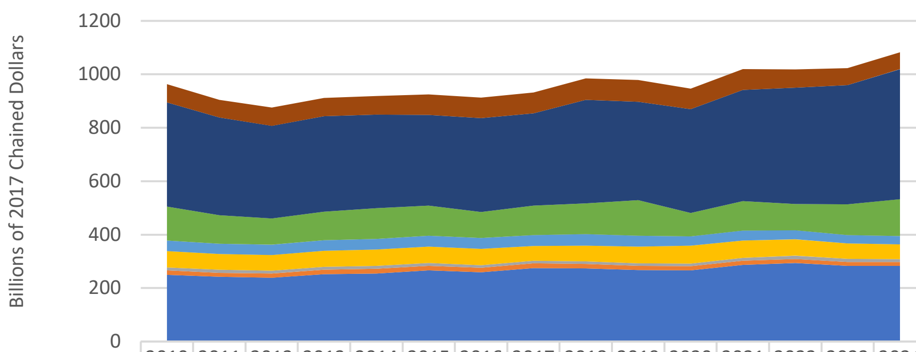
Figure 2.9: Cumulative Percent Change in Value Added (2017 Chained Dollars)
Data Source: Bureau of Economic Analysis. (2025a). "Industry Economic Accounts Data." http://www.bea.gov/iTable/index_industry_gdpIndy.cfm



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Furniture and related products	24	24	24	26	27	29	29	29	30	29	27	29	27	23	22
Wood products	30	33	34	34	31	34	35	36	34	35	37	35	35	39	38
Electrical equip., appliances, and components	53	51	52	57	53	60	55	58	58	55	53	57	55	50	49
Nonmetallic mineral products	48	51	53	56	57	57	55	59	58	61	59	61	59	53	51
Primary metals	41	45	54	58	57	63	67	60	60	67	72	66	76	93	98
Miscellaneous manufacturing	88	85	85	82	83	80	84	87	92	89	88	98	102	104	107
Fabricated metal products	134	142	147	147	148	142	137	145	151	149	135	139	134	124	120
Machinery	149	171	173	172	168	150	136	148	156	154	139	156	157	146	143
Other transportation equipment	137	142	140	144	146	151	148	151	159	162	138	151	156	174	169
Motor vehicles, bodies, trailers, and parts	97	123	130	139	145	145	153	159	166	167	148	176	206	194	214
Computer and electronic products	193	200	205	209	218	232	238	249	265	273	280	304	301	301	291

Figure 2.10: Value Added for Durable Goods by Type (billions of chained dollars), 2009 to 2023

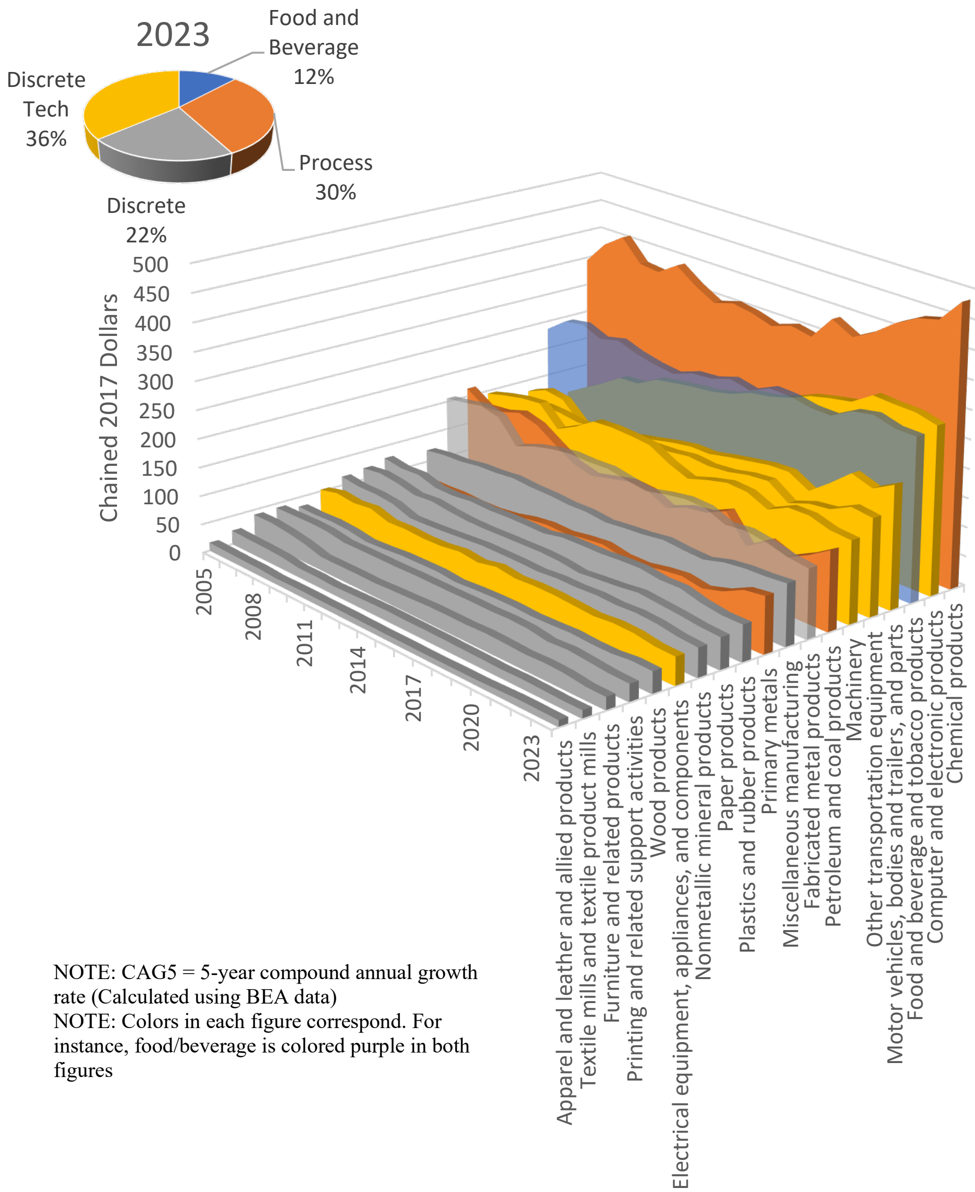
Data Source: Bureau of Economic Analysis. (2025a) "Industry Economic Accounts Data."
http://www.bea.gov/iTable/index_industry_gdpIndy.cfm



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Plastics and rubber products	68	67	69	69	69	76	77	77	80	82	77	78	69	64	64
Chemical products	390	366	346	357	351	340	352	345	388	369	388	416	436	445	486
Petroleum and coal products	127	107	98	107	115	113	97	111	116	133	87	110	98	116	139
Printing and related support activities	38	39	39	40	40	40	41	41	42	41	35	38	35	31	30
Paper products	61	59	59	60	61	62	61	56	60	63	68	64	61	57	55
Apparel, leather, and allied products	11	11	11	11	10	10	10	9	9	10	10	11	12	12	12
Textile mills and textile product mills	16	15	16	17	18	18	18	17	16	16	15	16	15	14	14
Food, beverage, and tobacco	250	243	239	252	255	266	259	275	274	267	267	287	294	284	283

Figure 2.11: Value Added for Nondurable Goods by Type (billions of chained dollars), 2009 to 2023

Data Source: Bureau of Economic Analysis. (2025a) "Industry Economic Accounts Data." http://www.bea.gov/iTable/index_industry_gdpIndy.cfm



NOTE: CAG5 = 5-year compound annual growth rate (Calculated using BEA data)
NOTE: Colors in each figure correspond. For instance, food/beverage is colored purple in both figures

Figure 2.12: Manufacturing Value Added by Subsector (billions of chained dollars), 2005 to 2023

Data Source: Bureau of Economic Analysis. (2025a) "Industry Economic Accounts Data." http://www.bea.gov/iTable/index_industry_gdpIndy.cfm

2.3. Equipment, Structures, and Intellectual Property

In addition to examining manufacturing value added, it is useful to examine the capital stock in manufacturing, as it reflects the investment in machinery, buildings, and intellectual property in the industry (see Figure 2.13, Figure 2.14, Figure 2.15, and Figure 2.16). Discrete technology manufacturing (i.e., computer manufacturing, transportation equipment manufacturing, machinery manufacturing, and electronics manufacturing) accounts for 29 %

of all manufacturing equipment and 33 % of structures. The 5-year compound annual growth in computer and electronic manufacturing equipment is -1.9 % while structures is growing at a rate of 3.2 %. Recall that computer and electronic product manufacturing is the largest durable goods manufacturing sector in the U.S., as shown in Figure 2.10. Note that for many subsectors, structures are growing at a five-year compound rate as high as 6.2 %, as seen in Figure 2.14. In terms of intellectual property, chemical products have the highest value, as seen in Figure 2.15. As of 2024, manufacturing net stock is split between intellectual property (34.2 %), structures (34.1 %), and equipment (31.6 %) somewhat evenly.

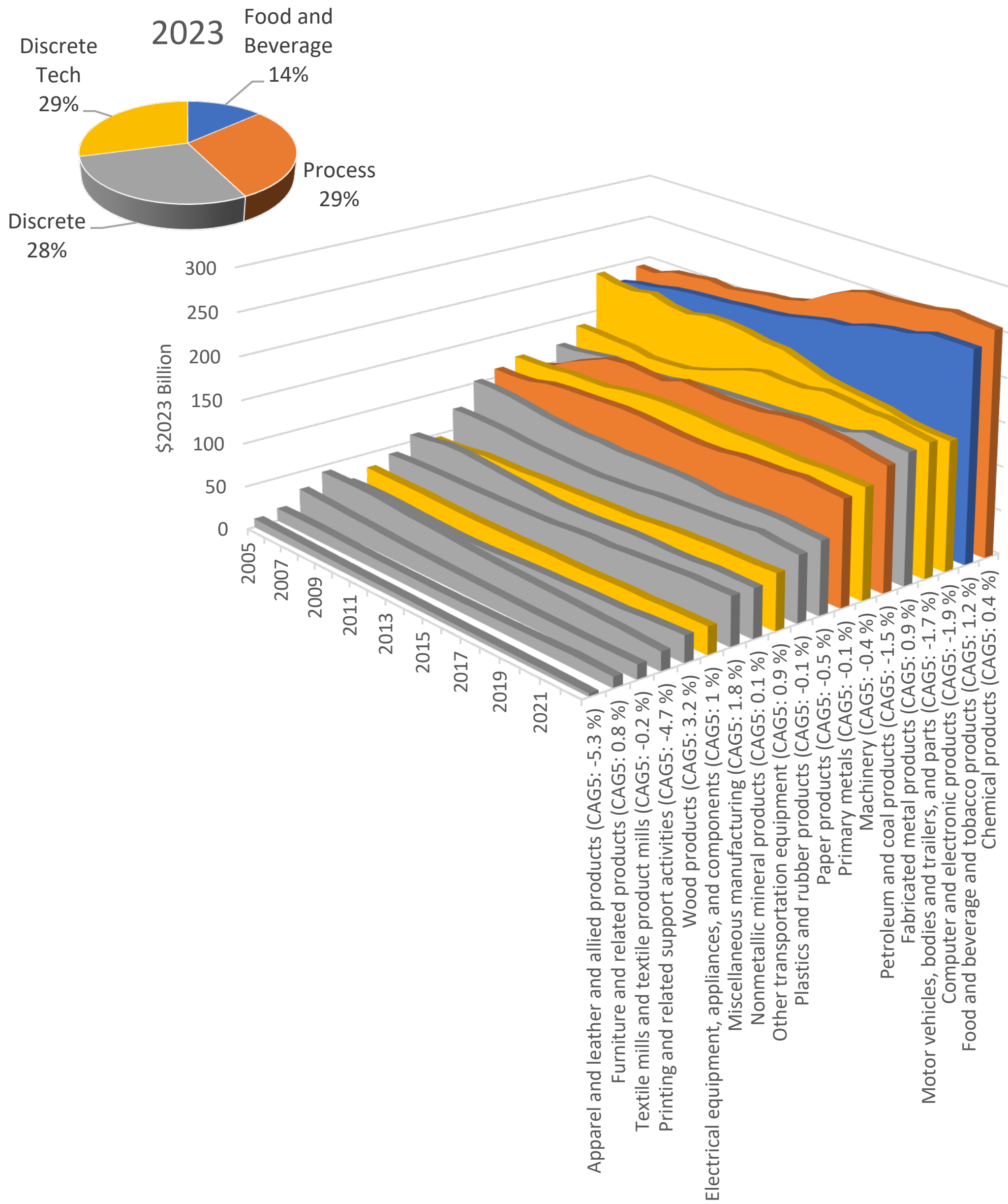


Figure 2.13: Current-Cost Net Stock: Private Equipment, Manufacturing (2005 to 2023)
NOTE: CAG5 = 5-year compound annual growth rate (Calculated using BEA data)
NOTE: Colors in each figure correspond. For instance, food/beverage is colored purple in both figures
Adjusted using the Consumer Price Index from the Bureau of Labor Statistics
Data Source: Bureau of Economic Analysis. (2025b) "Fixed Assets Accounts Tables."
https://apps.bea.gov/iTable/iTable.cfm?ReqID=10&step=2

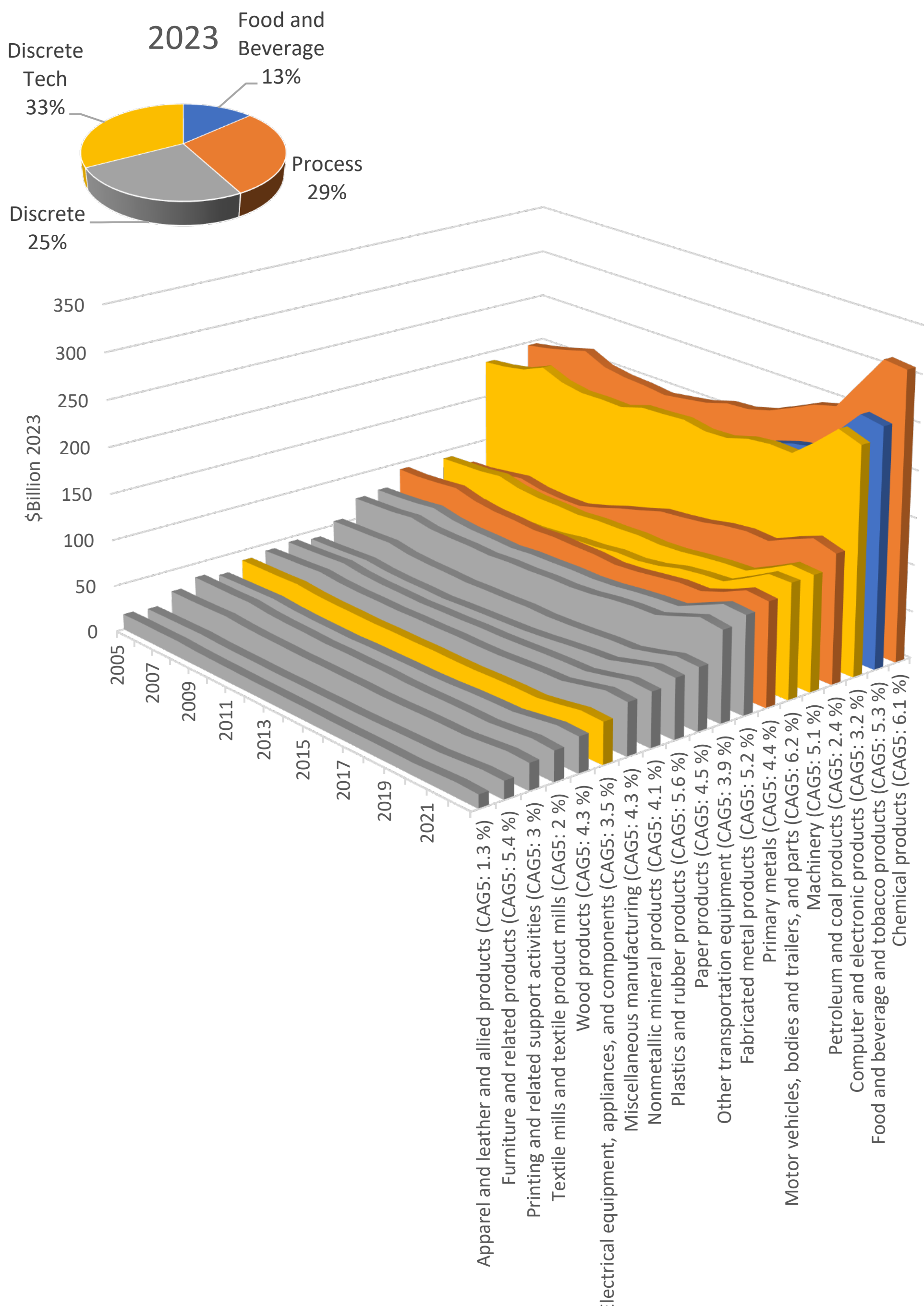


Figure 2.14: Current-Cost Net Stock: Private Structures, Manufacturing (2005 to 2023)
NOTE: CAG5 = 5-year compound annual growth rate (Calculated using BEA data)
NOTE: Colors in each figure correspond. For instance, food/beverage is colored purple in both figures
Adjusted using the Consumer Price Index from the Bureau of Labor Statistics
Data Source: Bureau of Economic Analysis. (2025b) "Fixed Assets Accounts Tables."
https://apps.bea.gov/iTable/iTable.cfm?ReqID=10&step=2

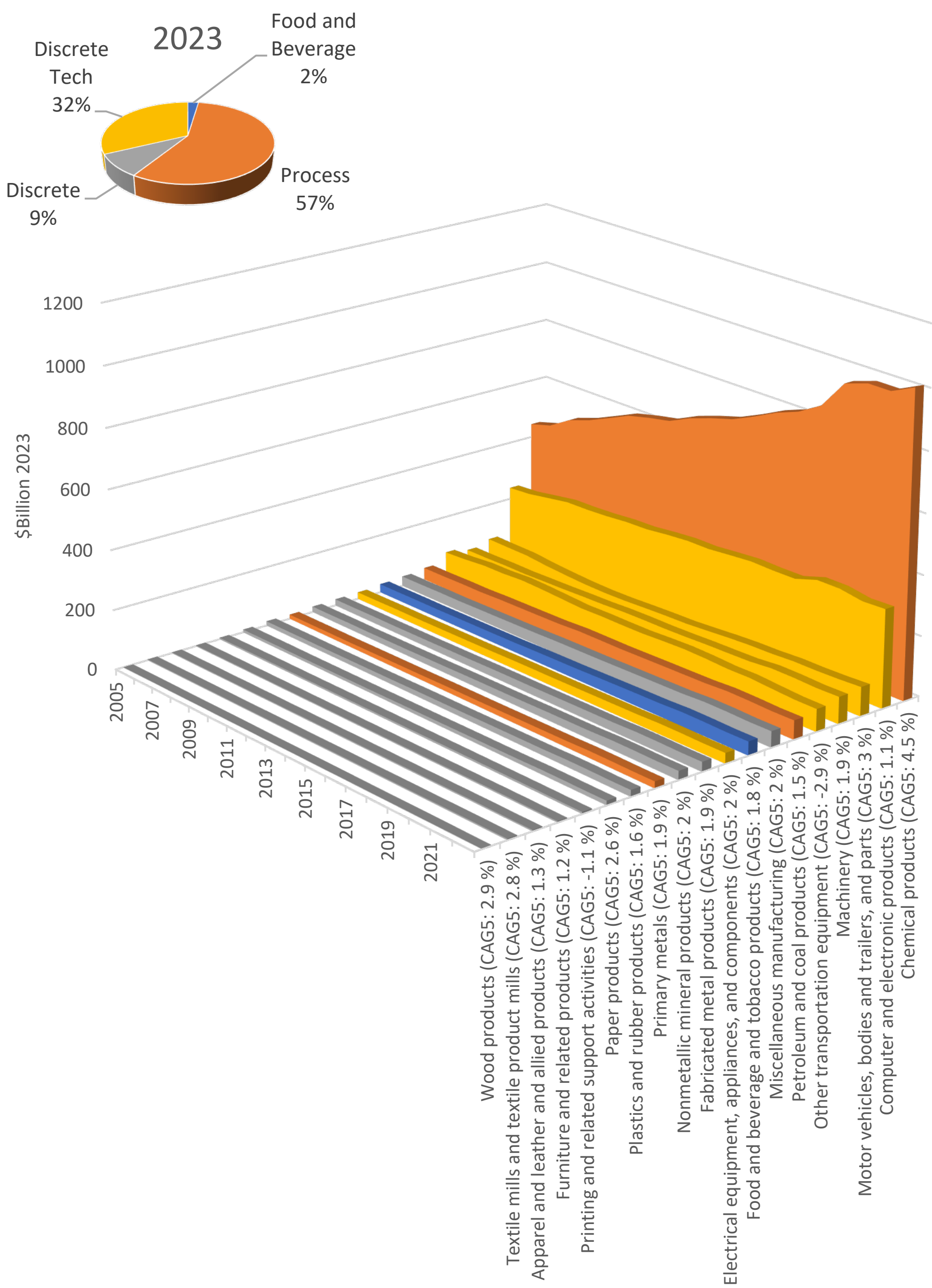


Figure 2.15: Current-Cost Net Stock: Intellectual Property Products, Manufacturing (2005 to 2023)

NOTE: CAG5 = 5-year compound annual growth rate (Calculated using BEA data)
NOTE: Colors in each figure correspond. For instance, food/beverage is colored blue in both figures
Adjusted using the Consumer Price Index from the Bureau of Labor Statistics
Data Source: Bureau of Economic Analysis. (2025b) "Fixed Assets Accounts Tables."
https://apps.bea.gov/iTable/iTable.cfm?ReqID=10&step=2

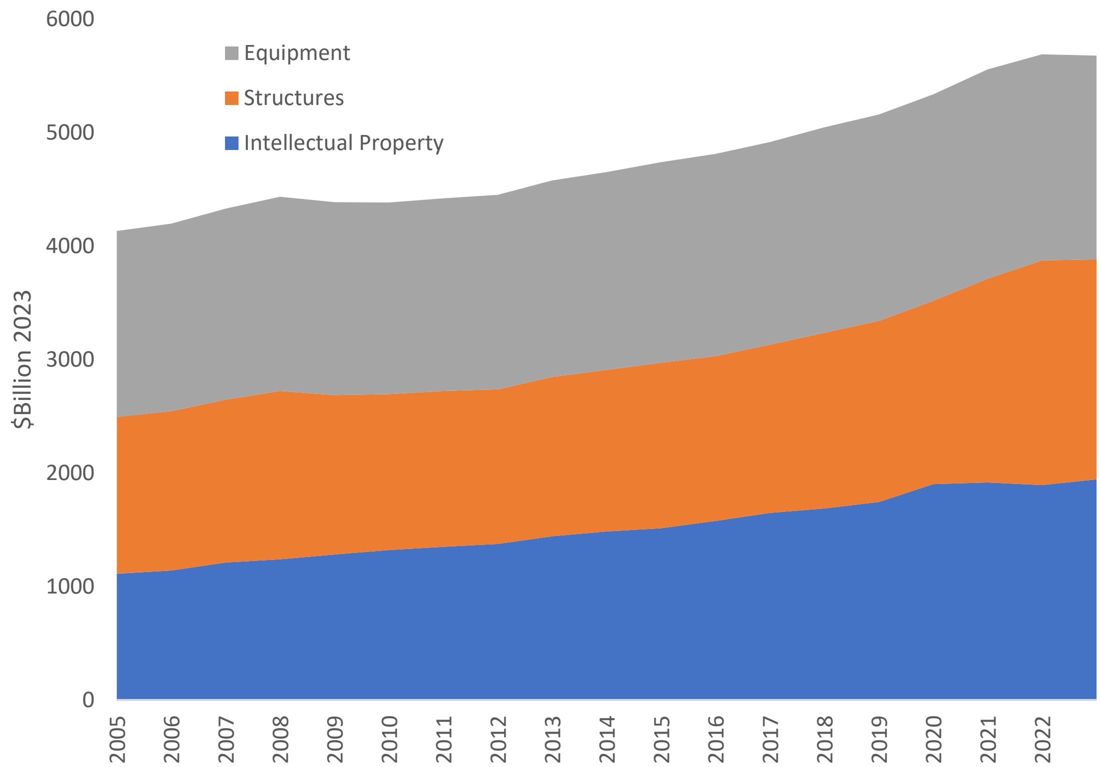


Figure 2.16: Current-Cost Net Stock in Manufacturing, by Type (2005 to 2023)

Adjusted using the Consumer Price Index from the Bureau of Labor Statistics
Data Source: Bureau of Economic Analysis. (2025b) "Fixed Assets Accounts Tables."
https://apps.bea.gov/iTable/iTable.cfm?ReqID=10&step=2

3. Expenditures and Supply Chains

There are many suppliers of goods and services that have a stake in manufacturing; these include resellers, providers of transportation and warehousing, raw material suppliers, suppliers of intermediate goods, and suppliers of professional services.

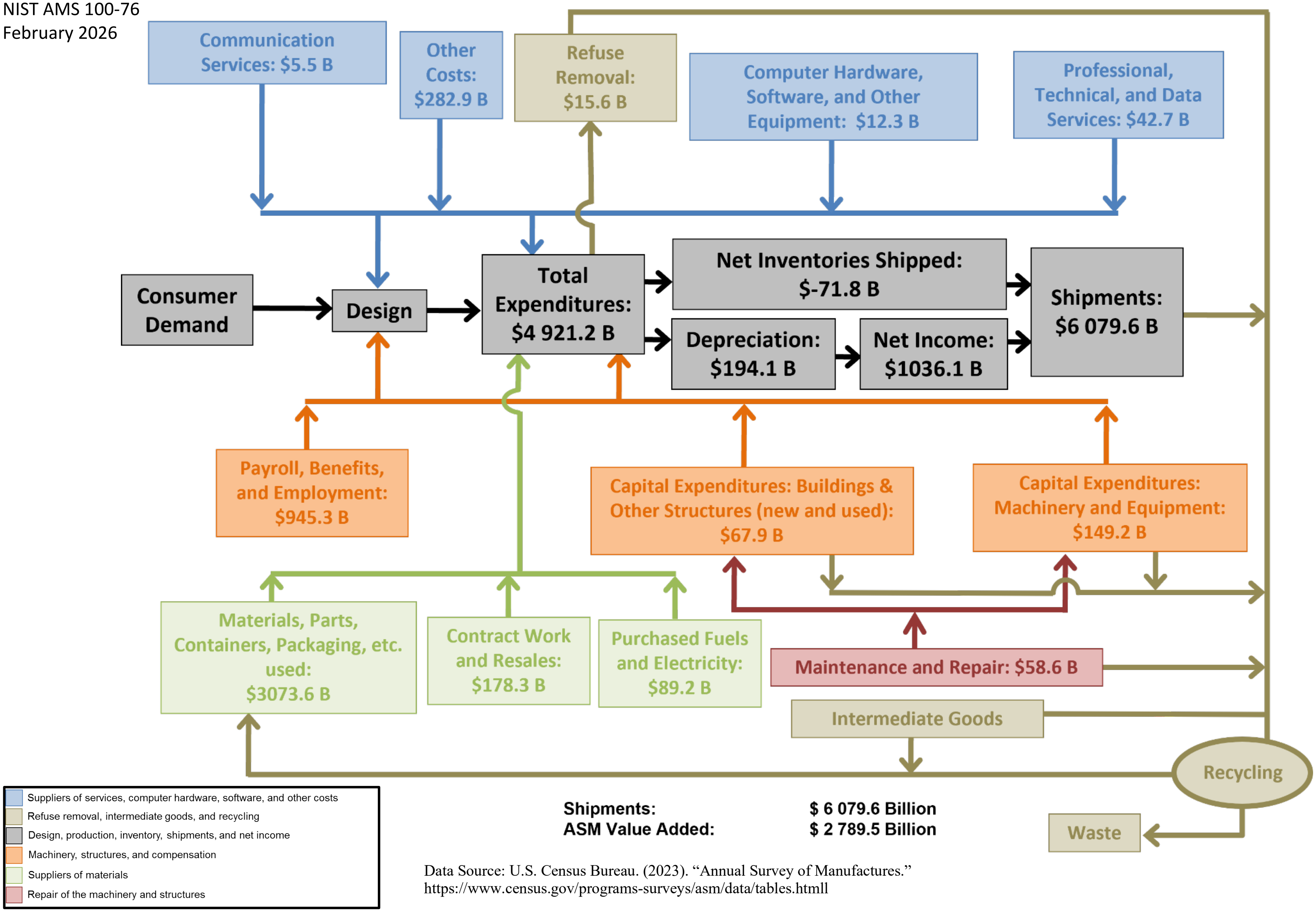
3.1. Expenditures, Depreciation, Replacements, and Losses

Using data from the Annual Survey of Manufactures (U.S. Census Bureau 2023), Table 3.1 presents and Figure 3.1 maps the purchases that the manufacturing industry made for production, which is disaggregated into five categories: suppliers of services,

Table 3.1: Supply Chain Entities and Contributions, Annual Survey of Manufactures, 2021

	2021 ($Billions 2021)
I. Services, Computer Hardware, Software, and Other Expenditures	
a. Communication Services	5.5
b. Computer Hardware, Software, and Other Equipment	12.3
c. Professional, Technical, and Data Services	42.7
d. Other Expenditures	282.9
e. TOTAL	**343.4**
II. Refuse Removal Expenditures	**15.6**
III. Machinery, Structures, and Compensation Expenditures	
a. Payroll, Benefits, and Employment	945.3
b. Capital Expenditures: Structures (including rental)	67.9
c. Capital Expenditures: Machinery/Equipment (including rental)	149.2
d. TOTAL	**1162.4**
IV. Suppliers of Materials Expenditures	
a. Materials, Parts, Containers, Packaging, etc… Used	3073.6
b. Contract Work and Resales	178.3
c. Purchased Fuels and Electricity	89.2
d. TOTAL	**3341.2**
V. Maintenance and Repair Expenditures	**58.6**
VI. Shipments	
a. Expenditures	4921.2
b. Net Inventories Shipped	-71.8
c. Depreciation	194.1
d. Net Income	1036.1
E. TOTAL	**6079.6**
VII. Value Added estimates	
a. Value added calculated VI.E-VI.b-VI.A+III.a	2175.6
b. ASM Value added	2789.5
c. BEA value added	2496.8

Note: Colors correspond with those in Figure 3.1
Source: U.S. Census Bureau. (2023). "Annual Survey of Manufactures."
https://www.census.gov/programs-surveys/asm.html



Data Source: U.S. Census Bureau. (2023). "Annual Survey of Manufactures." https://www.census.gov/programs-surveys/asm/data/tables.htmll

Figure 3.1: Manufacturing Supply Chain, 2021

computer hardware, software, and other costs (blue); refuse removal (gold); machinery, structures, and compensation (orange); repair of the machinery and structures (red); and suppliers of materials (green). These items all feed into the design and production of manufactured goods which are inventoried and/or shipped (gray). The depreciation of capital and net income is also included in Figure 3.1, which affects the market value of shipments. In addition to the stakeholders, there are also public vested interests, the end users, and financial service providers to be considered.

Some of the costs of production are caused by losses due to waste or defects. Unfortunately, there is limited data and information on these losses. The research that does exist is often case studies within various industries and countries, which provide only limited insight to U.S. national trends. Tabikh estimates from survey data in Sweden that the percent of planned production time that is downtime amounts to 13.3 % (Tabikh 2014). According to NIST's Manufacturing Cost Guide, downtime amounts to 8.3 % of planned production time and amounts to $245 billion for discrete manufacturing (i.e., NAICS 321-339 excluding NAICS 324 and 325) (Thomas 2020). In addition to downtime, defects result in additional losses. IndustryWeek's best plants report estimates that among those considered as high performers, the plant defect rate was 25 934 parts per million or 2.6 % with a high of 357 964 or 35.8 % and a low of 8617 or 0.9 % (IndustryWeek 2024). The Manufacturing Cost Guide estimates that defects amount to between $32.0 billion and $58.6 billion for discrete manufacturing (i.e., NAICS 321-339 excluding NAICS 324 and 325), depending on the method used for estimation (Thomas 2020).

The USGS estimates that 15 % of steel mill products end up as scrap in the manufacturing process (Fenton 2001). Other sources cite that at least 25 % of liquid steel and 40 % of liquid aluminum does not make it into a finished product due primarily to metal quality (25 % of steel loss and 40 % of aluminum loss), the shape produced[1] (10 % to 15 % of loss), and defects in the manufacturing processes (5 % of loss) (Allwood 2012). Material losses mean there is the possibility of producing the same goods using less material, which could have rippling effects up and down the supply chain. There would be reductions in the burden of transportation, material handling, machinery, inventory costs, and energy use along with many other activities associated with handling and altering materials.

Another source of losses can be found in cybercrime where criminals can disrupt production and/or steal intellectual property. The Manufacturing Cost Guide estimates that manufacturers lost between $8.9 billion and $38.6 billion due to cybercrime. Manufacturing costs also accumulate in assets such as buildings, machinery, and inventory. In addition to the estimates provided in Figure 2.13, Figure 2.14, Figure 2.15, and Figure 2.16, data on assets is published periodically in the Economic Census. As seen in Table 3.2, total depreciable assets amount to $3.3 trillion with $2.6 trillion being machinery and equipment. The adoption of new technologies often requires new assets (e.g., machinery). During the 2017 year, 4.9 % of depreciable assets were new with an

[1] The steel and aluminum industry often produce standard shapes rather than customized shapes tailored to specific products. This results in needing to cut away some portion of material, which ends up as scrap.

Table 3.2: Depreciable Assets and the Rate of Change, 2017 ($million 2017)

		Buildings and Structures	Machinery and Equipment	Total
A	Gross value of depreciable assets (acquisition costs), beginning of year	661 841*	2 645 636*	3 307 476
B	Capital Expenditures (added to assets)	33 705	134 733	168 438
C	Retirements (subtracted from assets)	11 597*	46 358*	57 955
D	Gross value of depreciable assets (acquisition costs, end of year) [A + B - C]	683 949	2 734 011	3 417 960
E	Percent of depreciable assets that are new (end of year) [B/D]			4.9%

* Assumes that the proportions of buildings and structures or machinery and equipment are the same as that for capital expenditures.

Data Source: U.S. Census Bureau. (2020) 2017 Economic Census. EC1731BASIC: Manufacturing Summary Statistics. https://www.census.gov/data/tables/2017/econ/economic-census/naics-sector-31-33.html

overall growth of 3.3 % after accounting for retirements. This rate provides some insight into the rate of change for assets.

3.2. Supply Chains

Direct and Indirect Manufacturing: As previously mentioned, to achieve economy-wide efficiency improvements, researchers have suggested that "the supply chain must become the focus of policy management, in contrast to the traditional emphasis on single technologies/industries" (Tassey 2010). As seen in Table 3.3, there is an estimated

Table 3.3: Direct and Indirect Manufacturing Value Added, 2023 ($Billion)

Industry and NAICS Code	Direct Value Added	Indirect Value Added	Total Direct and Indirect Value Added	Total as % of Total GDP
Total GDP			27 720.7	100%
31-33: Manufacturing	2 597.5	1 899.6	4 497.1	16.2%
311FT: Food and beverage and tobacco products	329.8	650.8	980.6	3.5%
324: Petroleum and coal products	204.8	562.8	767.6	2.8%
325: Chemical products	467.3	265.1	732.4	2.6%
3361MV: Motor vehicles, bodies and trailers, and parts	160.4	378.6	539.0	1.9%
333: Machinery	184.1	215.0	399.2	1.4%
332: Fabricated metal products	177.1	200.2	377.3	1.4%
334: Computer and electronic products	251.0	55.6	306.6	1.1%
3364OT: Other transportation equipment	169.4	137.1	306.4	1.1%
326: Plastics and rubber products	93.9	182.0	275.8	1.0%
331: Primary metals	81.7	138.5	220.2	0.8%
339: Miscellaneous manufacturing	99.7	77.2	177.0	0.6%
322: Paper products	72.9	85.2	158.1	0.6%
335: Electrical equipment, appliances, and components	70.1	80.1	150.2	0.5%
327: Nonmetallic mineral products	72.3	68.9	141.2	0.5%
321: Wood products	58.9	73.4	132.3	0.5%
323: Printing and related support activities	44.9	46.8	91.7	0.3%
337: Furniture and related products	30.3	47.0	77.3	0.3%
313TT: Textile mills and textile product mills	16.3	27.7	44.1	0.2%
315AL: Apparel and leather and allied products	12.6	15.0	27.6	0.1%

* The sum of the 3-digit NAICS does not equal total manufacturing due to overlap in supply chains.

Data Source: BEA. (2025c). Input-Output Accounts Data. https://www.bea.gov/industry/input-output-accounts-data

Note: These values are calculated by using the Excel solver to estimate final demand for each set of NAICS codes such that the total requirements table multiplied by the final demand estimate equals the industry output. All other industries are set to zero in the final demand.

$2597.5 billion in manufacturing value added with an additional $1899.6 billion in indirect value added from other industries for manufacturing, as calculated using input-output analysis.[2] Direct and indirect manufacturing accounts for 16.2 % of total GDP. In 2023, the U.S. imported approximately 18.7 % of its intermediate goods, as seen in Table 3.4. As a proportion of output and imports (i.e., a proportion of the total inputs), intermediate imports represented 11.6 %. As can be seen in Table 3.4, these proportions change over the years but have a range within several percentage points.

One might notice that a note from the Federal Reserve estimates that 30 % of intermediate inputs are imported after accounting for indirect imports, such as imports into the service sector that serves manufacturing (De Michelis and Somale 2023). Note that Table 3.4 excludes indirect imports. Measuring imports can be complex and have different aspects. In the Federal Reserve note, De Michelis and Somale are discussing imports in the context of risk (e.g., national security) and measure it using the BEA input-output tables. When discussing indirect effects in terms of national manufacturing competitiveness, it is important to consider that U.S. products are embedded in U.S. imports. That is, the U.S. exports items that are integrated into products that are then imported into the United States. Given that the BEA input-output data is a national dataset and given the nature of input-output analysis, the BEA data likely does not fully account for the embedded U.S. products in U.S. imports. An assessment using the World Input-Output Data (WIOD) provides some insight, though. According to NIST Technical Note 1810, U.S. imports accounted for 15 % of the 2009 manufacturing supply chain and was among the lowest of the 40 nations examined (Thomas 2014). This analysis accounts for direct and indirect effects. Further, an analysis of 2016 WIOD data using NIST's MCG Tool (Thomas 2020) shows that 83.0 % of direct and indirect value added associated with U.S. manufacturing originates from the U.S. (see Table 3.6) with Canada being the next largest origin. Moreover, understanding the origin of the products produced in the U.S. is complex and caution is needed before acting based on such assessments.

Table 3.4: Imported Intermediate Manufacturing ($millions)

Year	Intermediate Manufacturing*	Intermediate Imports for Manufacturing**	Total Manufacturing Output	Intermediate Imports as a Percent of Intermediates	Intermediate imports as a Percent of Total Industry Output
2003	2 500 802	418 981	3 927 323	16.8%	10.7%
2008	3 647 449	843 495	5 302 618	23.1%	15.9%
2013	3 924 679	817 917	5 719 130	20.8%	14.3%
2018	3 738 355	745 657	5 805 971	19.9%	12.8%
2023	4 307 721	803 928	6 905 201	18.7%	11.6%

Source Data: Bureau of Economic Analysis. (2025c). Input-Output Accounts Data. https://www.bea.gov/industry/input-output-accounts-data
* Commodities used by industries
** From the import matrix

[2] These values are calculated by using the Excel solver to estimate final demand for each set of NAICS codes such that the total requirements table multiplied by the final demand estimate equals the industry output. All other industries are set to zero in the final demand.

Table 3.5: Imported Intermediate Manufacturing, by Subsector ($million)

	Intermediate Manufacturing*	Intermediate Imports for Manufacturing**	Total Manufacturing Output	Intermediate Imports as a Percent of Intermediates	Intermediate imports as a Percent of Total Industry Output
324: Petroleum and coal products	539 301	179 478	744 115	33.3%	24.1%
3361MV: Motor vehicles, bodies, trailers, and parts	591 396	143 246	751 825	24.2%	19.1%
331: Primary metals	234 438	48 118	316 121	20.5%	15.2%
333: Machinery	248 064	53 308	432 199	21.5%	12.3%
335: Elect. equipment, appliances, and components	90 593	18 417	160 686	20.3%	11.5%
3364OT: Other transportation equipment	220 311	43 264	389 694	19.6%	11.1%
325: Chemical products	465 500	103 096	932 768	22.1%	11.1%
313TT: Textile mills and textile product mills	32 691	5 008	49 014	15.3%	10.2%
337: Furniture and related products	48 372	7 736	78 651	16.0%	9.8%
326: Plastics and rubber products	199 765	28 153	293 619	14.1%	9.6%
322: Paper products	128 977	16 406	201 921	12.7%	8.1%
332: Fabricated metal products	241 555	32 500	418 679	13.5%	7.8%
334: Computer and electronic products	90 928	24 601	341 914	27.1%	7.2%
315AL: Apparel and leather and allied products	12 156	1 633	24 741	13.4%	6.6%
323: Printing and related support activities	46 932	5 510	91 798	11.7%	6.0%
321: Wood products	106 473	9 665	165 335	9.1%	5.8%
311FT: Food and beverage and tobacco products	850 973	66 236	1 180 818	7.8%	5.6%
339: Miscellaneous manufacturing	74 778	9 735	174 519	13.0%	5.6%
327: Nonmetallic mineral products	84 517	7 813	156 784	9.2%	5.0%

Source Data: Bureau of Economic Analysis. (2025c). Input-Output Accounts Data. https://www.bea.gov/industry/input-output-accounts-data
* Commodities used by industries
** From the import matrix

Table 3.6: Percent of U.S. Manufacturing Industry Supply Chain, by Country of Origin (2014)

Country	US Manufacturing Supply Chain (percent)
USA	83.0
CAN	3.1
CHN	1.8
MEX	1.5
DEU	0.8
JPN	0.8
GBR	0.5
KOR	0.5
RUS	0.4
ROW	7.6

Data Source: Thomas, Douglas. (2020). Manufacturing Cost Guide. https://www.nist.gov/services-resources/software/manufacturing-cost-guide

A frequently invoked axiom suggests that roughly 80 % of a problem is due to 20 % of the cause, a phenomenon referred to as the Pareto principle (Hopp and Spearman 2008). That is, a small portion of the cause accounts for a large portion of the problem. Joseph Juran proposed that the Pareto principle could be applied to an organization's operations (Six Sigma Daily 2018). For instance, 80 % of defects would be the result of 20 % of the causes. Identifying that small portion of the cause (i.e., the 20 %) can facilitate making large efficiency improvements in operations. Manufacturing industry NAICS codes are categories of production activities. A larger industry (i.e., one in the top 20 %) suggests that there is more of a particular type of activity and/or the activities are more costly; thus, an increase in productivity in a larger industry would either reduce a costly activity or reduce an activity that occurs at high frequency. The result is a greater impact than might otherwise be achieved. Additionally, statistical evidence suggests that a dollar of research and development in a large cost supply chain entity has a higher return on investment than a small cost one (Thomas 2018). Table 3.7, Table 3.8, and Table 3.9 provide the supply chain items for all of U.S. manufacturing, U.S. high tech manufacturing, and U.S. process manufacturing, respectively. For all of manufacturing, professional and business services is the largest contributor to manufacturing, excluding manufacturing itself. Mining is the second largest and wholesale trade is third. The high-tech manufacturing industries are greyed out in Table 3.8 while the process industries are greyed out in Table 3.9. Excluding the greyed-out items, wholesale trade is the largest supply chain item for high tech manufacturing while oil and gas extraction is that for process manufacturing.

Table 3.7: Domestic U.S. Manufacturing Supply Chain, 2023 Value Added.

Description	$Billion	% of Total
Manufacturing	2597.5	57.8%
Wholesale trade	356.5	7.9%
Professional and business services	349.9	7.8%
Mining	292.5	6.5%
Finance, insurance, real estate, rental, and leasing	271.4	6.0%
Agriculture, forestry, fishing, and hunting	193.7	4.3%
Transportation and warehousing	164.2	3.7%
Utilities	62.0	1.4%
Information	60.5	1.3%
Government	59.6	1.3%
Construction	24.6	0.5%
Other services, except government	23.7	0.5%
Arts, entertainment, recreation, accommodation, and food services	21.1	0.5%
Retail trade	19.0	0.4%
Educational services, health care, and social assistance	0.9	0.0%
	4497.1	100.0%

Data Source: Bureau of Economic Analysis. (2025c). Input-Output Accounts Data. https://www.bea.gov/industry/input-output-accounts-data

Note: Calculated using methods described in Table 3.2; however, the BEA industry-by-commodity after redefinitions input-output data with 15 total industries was used.

Table 3.8: 2022 Domestic Supply Chain Entities for Discrete High-Tech Manufacturing (NAICS 333-336), Value Added (VA) ($Billion)

NAICS and Description	VA	% of Total	NAICS and Description	VA	% of Total
3361MV: Motor vehicles, bodies and trailers, and parts	*751825.0*	*22.3%*	493: Warehousing and storage	8512.4	0.3%
333: Machinery	*432198.9*	*12.8%*	441: Motor vehicle and parts dealers	8201.8	0.2%
3364OT: Other transportation equipment	*389694.2*	*11.6%*	482: Rail transportation	8158.2	0.2%
334: Computer and electronic products	*341914.2*	*10.1%*	GSLG: State and local general government	7745.5	0.2%
42: Wholesale trade	238634.1	7.1%	722: Food services and drinking places	7018.3	0.2%
331: Primary metals	237766.4	7.1%	339: Miscellaneous manufacturing	7002.8	0.2%
335: Electrical equipment, appliances, and components	*160686.0*	*4.8%*	313TT: Textile mills and textile product mills	6685.4	0.2%
332: Fabricated metal products	117422.1	3.5%	562: Waste management and remediation services	5694.9	0.2%
325: Chemical products	66012.0	2.0%	4A0: Other retail	4180.4	0.1%
55: Management of companies and enterprises	56182.7	1.7%	481: Air transportation	4025.5	0.1%
326: Plastics and rubber products	54308.7	1.6%	GFE: Federal government enterprises	4021.4	0.1%
5412OP: Miscellaneous professional, scientific, and technical services	53343.0	1.6%	511: Publishing industries, except internet (includes software)	4004.3	0.1%
561: Administrative and support services	47671.8	1.4%	721: Accommodation	3135.6	0.1%
ORE: Other real estate	41417.0	1.2%	111CA: Farms	2932.9	0.1%
484: Truck transportation	36252.4	1.1%	311FT: Food and beverage and tobacco products	2659.5	0.1%
521CI: Federal Reserve banks, credit intermediation, and related activities	33733.6	1.0%	323: Printing and related support activities	2646.5	0.1%
524: Insurance carriers and related activities	31871.8	0.9%	711AS: Performing arts, spectator sports, museums, and related activities	2593.5	0.1%
532RL: Rental and leasing services and lessors of intangible assets	31086.5	0.9%	113FF: Forestry, fishing, and related activities	2278.1	0.1%
22: Utilities	24085.1	0.7%	485: Transit and ground passenger transportation	1873.6	0.1%
322: Paper products	21677.0	0.6%	486: Pipeline transportation	1473.6	0.0%
514: Data processing, internet publishing, and other information services	17833.3	0.5%	315AL: Apparel and leather and allied products	1308.8	0.0%
327: Nonmetallic mineral products	16689.1	0.5%	512: Motion picture and sound recording industries	1102.4	0.0%
212: Mining, except oil and gas	16670.7	0.5%	483: Water transportation	1077.2	0.0%
523: Securities, commodity contracts, and investments	15834.9	0.5%	337: Furniture and related products	919.6	0.0%
487OS: Other transportation and support activities	15239.0	0.5%	213: Support activities for mining	861.1	0.0%
324: Petroleum and coal products	14454.2	0.4%	713: Amusements, gambling, and recreation industries	683.0	0.0%
321: Wood products	13179.0	0.4%	452: General merchandise stores	472.1	0.0%
81: Other services, except government	12900.2	0.4%	61: Educational services	271.7	0.0%
5415: Computer systems design and related services	12722.5	0.4%	623: Nursing and residential care facilities	91.6	0.0%
23: Construction	11988.7	0.4%	621: Ambulatory health care services	76.3	0.0%
5411: Legal services	11419.8	0.3%	445: Food and beverage stores	61.3	0.0%
GFGN: Federal general government (nondefense)	10796.0	0.3%	525: Funds, trusts, and other financial vehicles	43.7	0.0%
GSLE: State and local government enterprises	10656.8	0.3%	624: Social assistance	0.9	0.0%
513: Broadcasting and telecommunications	10578.2	0.3%	622: Hospitals	0.2	0.0%
211: Oil and gas extraction	10523.2	0.3%	HS: Housing	0.0	0.0%

Note: Calculated using methods described in Table 3.3.
Data Source: Bureau of Economic Analysis. (2025c). Input-Output Accounts Data. https://www.bea.gov/industry/input-output-accounts-data

Table 3.9: 2022 Domestic Supply Chain Entities for Process Manufacturing (NAICS 331, 324-325), Value Added (VA) ($Billion)

NAICS and Description	VA	% of Total	NAICS and Description	VA	% of Total
325: Chemical products	*932 767.4*	*23.6%*	GFGN: Federal general government (nondefense)	12 707.9	0.3%
324: Petroleum and coal products	744 114.9	18.8%	5411: Legal services	12 296.8	0.3%
211: Oil and gas extraction	459 437.0	11.6%	513: Broadcasting and telecommunications	10 615.6	0.3%
331: Primary metals	316 120.5	8.0%	335: Electrical equipment, appliances, and components	10 501.5	0.3%
326: Plastics and rubber products	293 619.1	7.4%	GSLG: State and local general government	10 451.9	0.3%
42: Wholesale trade	206 064.5	5.2%	321: Wood products	9 591.7	0.2%
55: Management of companies and enterprises	82 306.3	2.1%	562: Waste management and remediation services	8 885.5	0.2%
332: Fabricated metal products	62 451.2	1.6%	313TT: Textile mills and textile product mills	8 006.5	0.2%
5412OP: Miscellaneous professional, scientific, and technical services	59 135.5	1.5%	722: Food services and drinking places	7 658.3	0.2%
ORE: Other real estate	47 540.7	1.2%	4A0: Other retail	5 847.1	0.1%
561: Administrative and support services	44 442.5	1.1%	113FF: Forestry, fishing, and related activities	4 664.1	0.1%
22: Utilities	43 642.9	1.1%	GFE: Federal government enterprises	4 307.3	0.1%
484: Truck transportation	42 014.3	1.1%	481: Air transportation	3 971.2	0.1%
521CI: Federal Reserve banks, credit intermediation, and related activities	37 746.3	1.0%	721: Accommodation	3 263.7	0.1%
532RL: Rental and leasing services and lessors of intangible assets	34 664.4	0.9%	511: Publishing industries, except internet (includes software)	3 256.8	0.1%
333: Machinery	34 565.7	0.9%	711AS: Performing arts, spectator sports, museums, and related activities	2 877.8	0.1%
212: Mining, except oil and gas	31 682.3	0.8%	323: Printing and related support activities	2 832.8	0.1%
524: Insurance carriers and related activities	31 565.9	0.8%	339: Miscellaneous manufacturing	2 686.3	0.1%
486: Pipeline transportation	28 039.0	0.7%	483: Water transportation	2 614.1	0.1%
111CA: Farms	25 296.9	0.6%	441: Motor vehicle and parts dealers	2 248.6	0.1%
23: Construction	22 860.4	0.6%	485: Transit and ground passenger transportation	1 992.4	0.1%
322: Paper products	22 362.3	0.6%	3364OT: Other transportation equipment	1 386.9	0.0%
213: Support activities for mining	22 318.7	0.6%	512: Motion picture and sound recording industries	1 162.6	0.0%
334: Computer and electronic products	21 458.4	0.5%	337: Furniture and related products	814.0	0.0%
487OS: Other transportation and support activities	17 730.3	0.4%	713: Amusements, gambling, and recreation industries	754.9	0.0%
GSLE: State and local government enterprises	17 532.8	0.4%	452: General merchandise stores	289.7	0.0%
482: Rail transportation	15 920.6	0.4%	61: Educational services	275.3	0.0%
311FT: Food and beverage and tobacco products	15 891.6	0.4%	315AL: Apparel and leather and allied products	239.3	0.0%
5415: Computer systems design and related services	15 367.0	0.4%	623: Nursing and residential care facilities	108.9	0.0%
81: Other services, except government	14 648.8	0.4%	445: Food and beverage stores	100.4	0.0%
514: Data processing, internet publishing, and other information services	14 454.9	0.4%	621: Ambulatory health care services	95.5	0.0%
3361MV: Motor vehicles, bodies and trailers, and parts	14 072.6	0.4%	525: Funds, trusts, and other financial vehicles	44.7	0.0%
523: Securities, commodity contracts, and investments	13 983.0	0.4%	624: Social assistance	1.0	0.0%
327: Nonmetallic mineral products	13 465.7	0.3%	622: Hospitals	0.2	0.0%
493: Warehousing and storage	12 829.0	0.3%	HS: Housing	0.0	0.0%

Note: Calculated using methods described in Table 3.3.
Data Source: Bureau of Economic Analysis. (2025c). Input-Output Accounts Data. https://www.bea.gov/industry/input-output-accounts-data

4. Employment, Compensation, Profits, and Productivity

Section 2 focused on measuring the size of the manufacturing industry and comparing it internationally while Section 3 discussed supply chains and expenditures. This section shifts to examining benefits to stakeholders along with some of the non-financial costs that are born out to them.

4.1. Employment

The Annual Survey of Manufactures estimates that there were 11.2 million employees in the manufacturing industry in 2021, which is the most recent data available (see Table 4.1). The Current Population Survey estimates that there were 15.6 million manufacturing employees in 2023 and the Current Employment Statistics estimates 12.8 million employees in 2024, the most recent data available (see Table 4.2 and Table 4.3). According to data in Table 4.2, manufacturing accounted for 9.3 % of total employment. Approximately, 35.0 % of manufacturing employment was production workers with an addition 20.3 % being management, business, and financial operations occupations along with 16.7 % being professional and related occupations. As seen in Table 4.3, manufacturing employment has a 5-year compound annual growth rate of 0.1 %, which is less than that for total private employment. The source data for the estimates from Table 4.2 and Table 4.3 each have their own method for how the data was

Table 4.1: Employment, Annual Survey of Manufactures

NAICS	Description	2020	2021
311	Food manufacturing	1 509 076	1 509 329
312	Beverage and tobacco product manufacturing	214 712	224 136
313	Textile mills	78 736	77 854
314	Textile product mills	97 569	96 965
315	Apparel manufacturing	65 696	62 491
316	Leather and allied product manufacturing	25 213	25 055
321	Wood product manufacturing	395 339	398 867
322	Paper manufacturing	328 945	330 425
323	Printing and related support activities	372 745	351 849
324	Petroleum and coal products manufacturing	105 383	100 428
325	Chemical manufacturing	758 902	778 136
326	Plastics and rubber products manufacturing	768 225	773 438
327	Nonmetallic mineral product manufacturing	386 482	384 716
331	Primary metal manufacturing	346 423	317 946
332	Fabricated metal product manufacturing	1 339 334	1 296 417
333	Machinery manufacturing	1 008 247	996 694
334	Computer and electronic product manufacturing	776 220	758 833
335	Electrical equipment, appliance, and component manufacturing	334 391	341 237
336	Transportation equipment manufacturing	1 535 704	1 534 161
337	Furniture and related product manufacturing	347 017	333 078
339	Miscellaneous manufacturing	510 868	513 924
TOTAL		11 305 227	11 205 979

Data Source: U.S. Census Bureau. (2023). "Annual Survey of Manufactures." https://www.census.gov/programs-surveys/asm/data/tables.html

Table 4.2: Employment by Industry, by Occupation (2024): Current Population Survey

Percent of Total Industry Employment

	Total employed	Management, professional, and related occupations: Management, business, and financial operations occupations	Management, professional, and related occupations: Professional and related occupations	Service occupations: Protective service occupations	Service occupations: Service occupations, except protective	Sales and office occupations: Sales and related occupations	Sales and office occupations: Office and administrative suppor occupations	Natural resources construction, and maintenance occupations: Farming, fishing, and forestry occupations	Natural resources construction, and maintenance occupations: Construction and extraction occupations	Natural resources construction, and maintenance occupations: Installation, maintenance, and repair occupations	Production, transportation, and material, moving occupations: Production occupations	Production, transportation, and material, moving occupations: Transportation and material moving occupations
Agriculture and related	2 254	42.3%	3.0%	0.5%	4.5%	0.9%	3.0%	37.7%	0.4%	1.7%	1.7%	4.3%
Mining, quarrying, and oil and gas extraction	575	20.9%	12.3%	0.7%	1.7%	2.1%	5.9%	0.0%	32.3%	7.0%	8.9%	8.0%
Construction	12 027	20.9%	3.0%	0.1%	0.4%	1.6%	4.5%	0.0%	59.5%	5.3%	1.8%	2.8%
Manufacturing	15 023	20.3%	16.7%	0.2%	1.7%	4.0%	7.0%	0.1%	2.3%	4.3%	35.0%	8.5%
Wholesale and retail trade	19 510	9.2%	6.9%	0.4%	3.8%	43.7%	10.2%	0.3%	0.7%	3.3%	3.7%	17.9%
Transportation and utilities	9 838	11.1%	5.5%	0.7%	1.7%	1.5%	21.3%	0.1%	2.1%	5.5%	4.3%	46.3%
Information	2 821	27.0%	42.8%	0.1%	1.7%	7.6%	11.5%	0.0%	0.5%	6.6%	1.2%	1.0%
Financial activities	10 887	45.4%	11.4%	0.5%	2.0%	20.7%	16.1%	0.0%	0.4%	1.7%	0.5%	1.2%
Professional and business services	21 323	28.8%	33.2%	2.9%	15.0%	3.2%	9.9%	0.1%	0.7%	1.6%	1.5%	3.2%
Education and health services	37 130	11.3%	57.2%	0.6%	19.4%	0.4%	8.8%	0.0%	0.2%	0.5%	0.4%	1.2%
Leisure and hospitality	14 108	16.6%	7.5%	1.7%	56.9%	6.8%	5.8%	0.0%	0.3%	0.9%	1.2%	2.4%
Other services	7 743	11.9%	14.0%	0.2%	36.5%	4.2%	7.3%	0.1%	0.8%	15.3%	5.4%	4.3%
Public administration	8 107	21.6%	28.4%	21.9%	6.4%	0.5%	14.6%	0.2%	1.4%	1.7%	1.2%	2.0%
Total	161 346											

Note: Shading aids in identifying high/low percentages where green is high and red is low.
Source: Bureau of Labor Statistics. (2025a) Current Population Survey. "Table 17: Employed Persons by Industry, Sex, Race, and Occupation." <http://www.bls.gov/cps>

acquired and its own definition of employment. The Current Population Survey considers an employed person to be any individual who did any work for pay or profit during the survey reference week or were absent from their job because they were ill, on vacation, or taking leave for some other reason. It also includes individuals who completed at least 15 hours of unpaid work in a family-owned enterprise operated by someone in their household. In contrast, the Current Employment Statistics specifically exclude proprietors, self-employed, and unpaid family or volunteer workers. Therefore, the estimates from the Current Employment Statistics are lower than the Current Population Survey estimates. Additionally, the Current Employment Statistics include temporary and intermittent employees. The Annual Survey of Manufactures considers an employee to include all full-time and part-time employees on the payrolls of operating establishments during any part of the pay period being surveyed excluding temporary staffing obtained through a staffing service. It also excludes proprietors along with partners of unincorporated businesses.

Between January 2005 and January 2010, manufacturing employment declined by 19.7 %, as seen in Figure 4.1. As of August 2025, employment was still 10.6 % below its 2005 level. In times of financial difficulty, large purchases are often delayed or determined to be unnecessary. Thus, as would be expected, during the late 2000's recession durable goods declined more than nondurable goods. The other major decline in manufacturing employment was during the pandemic. Between January 2019 and April of 2020, manufacturing employment declined 10 percentage points to be 20.2 % below its 2005 level. By September 2021, manufacturing employment had risen to 13.1 % below its 2005 level. However, at that time there were a substantial number of job openings in manufacturing as seen in Figure 4.1. Since then, job openings have declined and manufacturing employment has settled to between -10.6 % and -9.7 % during the last year (i.e., August 2024 to August 2025).

4.2. Labor Hours, Injuries, and Fatalities

The employees that work in manufacturing offer their time and, in some cases, risk their personal safety in return for compensation. In terms of safety, the number of fatal injuries decreased 3.7 % between 2022 and 2023 (see Table 4.4). Nonfatal injuries decreased as did the injury rate (see Table 4.5). The incident rate for nonfatal injuries in manufacturing remains higher than that for all private industry. As illustrated in Figure 4.2, fatalities, injuries, and the injury rate have a five-year compound growth rate of 2.7 %, -3.7 %, and -3.8 % respectively.

Table 4.3: Manufacturing Employment (Thousands): Current Employment Statistics

	Total Private	Manufacturing	Durable Goods	Nondurable Goods
2017	124 257	12 407	7 708	4 699
2018	126 454	12 653	7 911	4 742
2019	128 292	12 780	8 002	4 778
2020	120 200	12 127	7 533	4 594
2021	124 312	12 311	7 638	4 673
2022	130 330	12 767	7 923	4 844
2023	133 074	12 873	8 023	4 849
2024	134 584	12 817	7 966	4 851
5 Year Compound Annual Growth	1.0%	0.1%	-0.1%	0.3%

Source: Bureau of Labor Statistics. (2025b) Current Employment Statistics. http://www.bls.gov/ces/home.htm

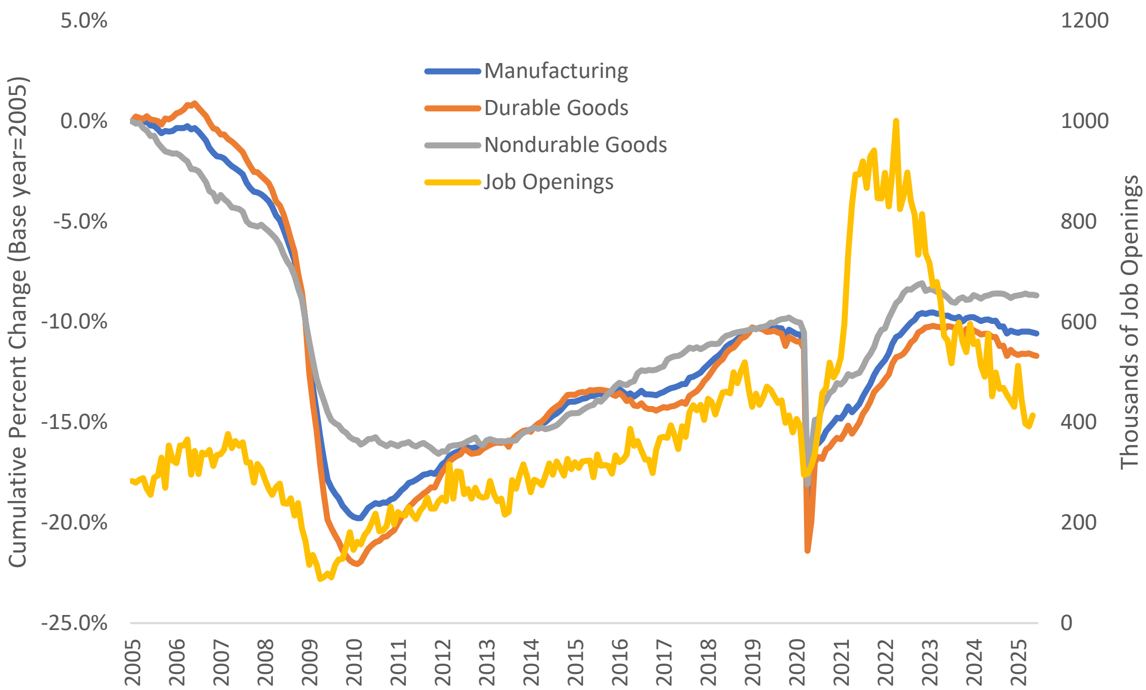


Figure 4.1: Cumulative Change in Percent in Manufacturing Employment (Seasonally Adjusted) and Number of Job Openings (seasonally Adjusted), 2005-2023

Source: Bureau of Labor Statistics. (2025b) Current Employment Statistics. http://www.bls.gov/ces/ and Bureau of Labor Statistics. (2025c) Job Openings and Labor Turnover Survey. https://www.bls.gov/jlt/

Table 4.4: Fatal Occupational Injuries by Event or Exposure

		Total	Violence and other injuries by persons or animals	Transportation Incidents	fires and explosions	Falls, slips, trips	exposure to harmful sub-stances or environments	Contact with objects and equipment
2022	Total	5486	849	2066	107	865	839	738
	Manufacturing	404	44	98	19	45	79	118
2023	Total	5283	740	1942	104	885	820	779
	Manufacturing	391	40	80	–	57	71	120
Percent Change	Total	-3.7%	-12.8%	-6.0%	-2.8%	2.3%	-2.3%	5.6%
	Manufacturing	-3.2%	-9.1%	-18.4%	–	26.7%	-10.1%	1.7%

Source: Bureau of Labor Statistics. (2025d). Census of Fatal Occupational Injuries. "Industry by Event or Exposure." <https://www.bls.gov/iif/fatal-injuries-tables.htm>

Table 4.5: Total Recordable Cases of Nonfatal Injuries and Illnesses

		2022	2023	Percent Change
Manu-facturing	Incident Rate per 100 full time workers*	3.2	2.8	-12.5%
	Total Recordable Cases (thousands)	396.8	355.8	-10.3%
Private Industry	Incident Rate per 100 full time workers	2.7	2.4	-11.1%
	Total Recordable Cases (thousands)	2804.2	2569.0	-8.4%

Source: Bureau of Labor Statistics. 2025e. Injuries, Illness, and Fatalities Program. http://www.bls.gov/iif/

* The incidence rates represent the number of injuries and illnesses per 100 full-time workers and were calculated as: (N/EH) x 200,000, where

N = number of injuries and illnesses

EH = total hours worked by all employees during the calendar year

200,000 = base for 100 equivalent full-time workers (working 40 hours per week, 50 weeks per year)

During the late 2000s recession, the average number of hours worked per week declined, as seen in Figure 4.3. Unlike employment, however, the number of hours worked per week returned to its pre-recession levels or slightly higher. Average wages increased significantly during the late 2000's recession and 2020 decline of GDP, as can be seen in Figure 4.4. This is likely because low wage earners are disproportionately impacted by employment reductions, which suggests that high wage earners not only receive more pay, but also have more job security. Average hours also dropped during the pandemic and has largely returned to pre-recession levels. Like the late 2000's recession, during the pandemic wages increased while hours and employment decreased.

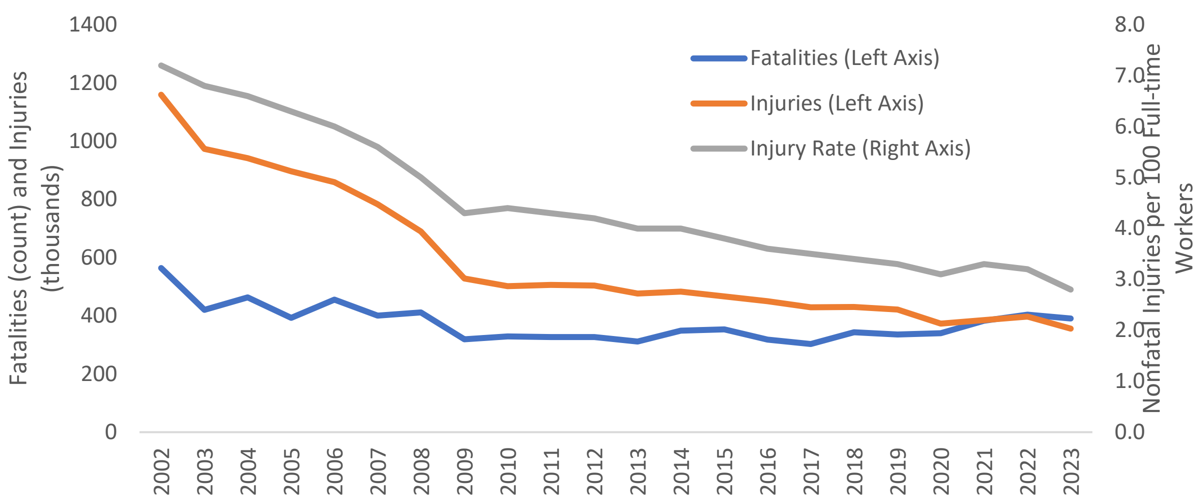


Figure 4.2: Manufacturing Fatalities and Injuries

Source: Bureau of Labor Statistics. (2025e). Injuries, Illness, and Fatalities Program. http://www.bls.gov/iif/
Source: Bureau of Labor Statistics. (2025d) Census of Fatal Occupational Injuries. "Industry by Event or Exposure." <http://stats.bls.gov/iif/oshcfoi1.htm>

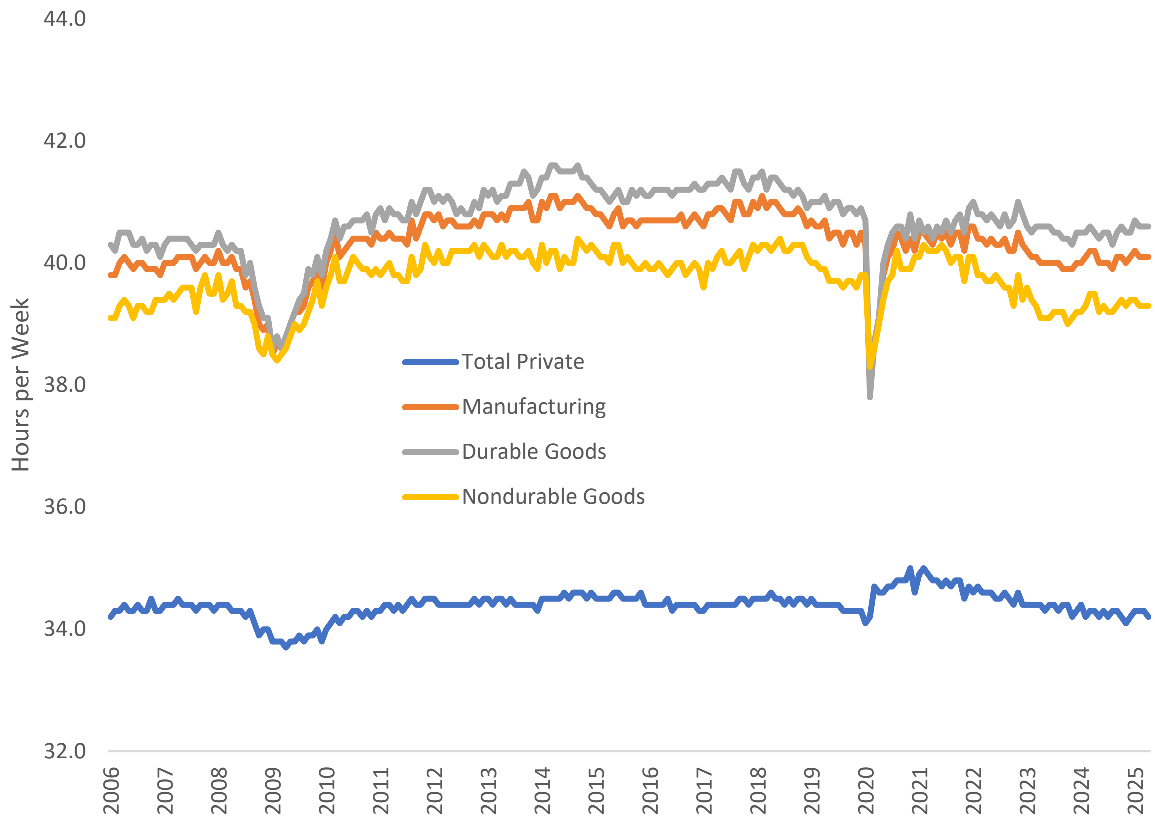


Figure 4.3: Average Weekly Hours for All Employees (Seasonally Adjusted)

Source: Bureau of Labor Statistics. (2025b) Current Employment Statistics. http://www.bls.gov/ces/home.htm

4.3. Wages, Compensation, Profits, and Inflation

The compound annual growth rate in constant dollars for private sector wages was -0.2 % between June 2020 and June 2025 and was -0.4 % for manufacturing, as illustrated in Figure 4.4. As illustrated in Figure 4.5, employee compensation in manufacturing, which includes benefits, has had a five-year compound annual growth of -1.2 %. While manufacturing compensation has had a negative trend, that of private industry has had a positive trend with a five-year compound annual growth rate of 0.8 %. Hourly compensation in manufacturing, which includes benefits, still exceeds that of the total private industry; however, the difference has narrowed significantly. In the first quarter of 2007, hourly compensation in manufacturing was 17.2 % higher than the private sector; however, in the first quarter of 2025 it was only 1.0 % higher.

As illustrated in Figure 4.6, the prices received by producers for all manufacturing between July 2020 and July 2022 increased 33.4 % while in the fifteen years prior to that (i.e., June 2005 to June 2020) it only increased 30.1 % total. Thus, more than 15 years of price increases were pressed into just 2 years. The 5-year compound annual growth in manufacturing prices was 5.8 %. As seen in Figure 4.7, price increases due to economic restrictions in 2020 were not observed until approximately a year later and lasted for two years. In August of 2025, 82 % of respondents for a survey of manufacturers indicated that their operating costs recently increased with 62 % saying it was an increase of 6 % or more, and 46 % indicating that the increase was 11 % or higher (Endeavor 2025). It may be sometime before consumers see these prices increases)

For those that invest in manufacturing, corporate profits have had a five-year compound annual growth of 9.6 %, as illustrated Figure 4.8, and nonfarm proprietors' income for manufacturing has had a five-year compound annual growth rate of 12.6 %, as illustrated in Figure 4.9.

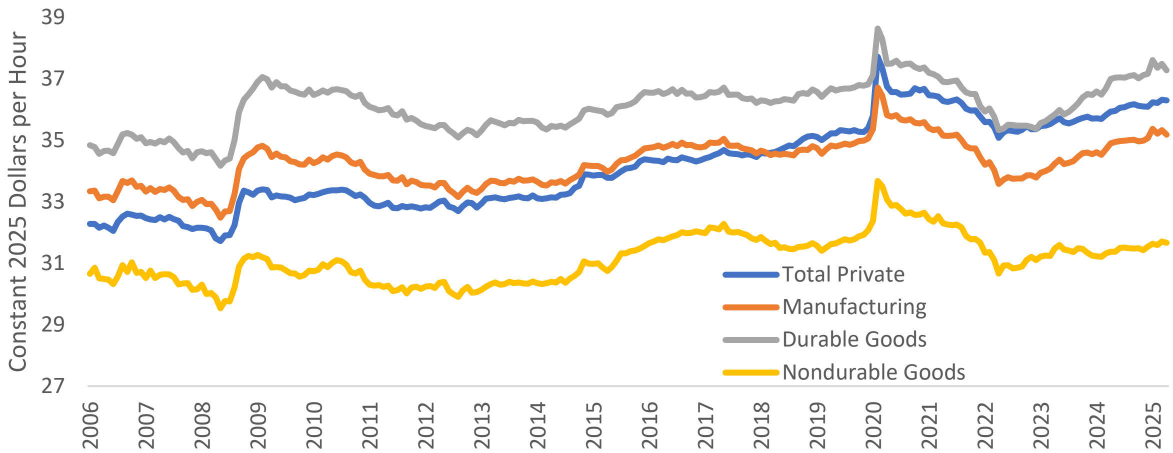


Figure 4.4: Average Hourly Wages for Manufacturing and Private Industry (Seasonally Adjusted)

Source: Bureau of Labor Statistics. (2025b) Current Employment Statistics. http://www.bls.gov/ces/home.htm
Adjusted using the CPI for all consumers. Bureau of Labor Statistics. (2025i). Consumer Price Index. https://www.bls.gov/cpi/data.htm

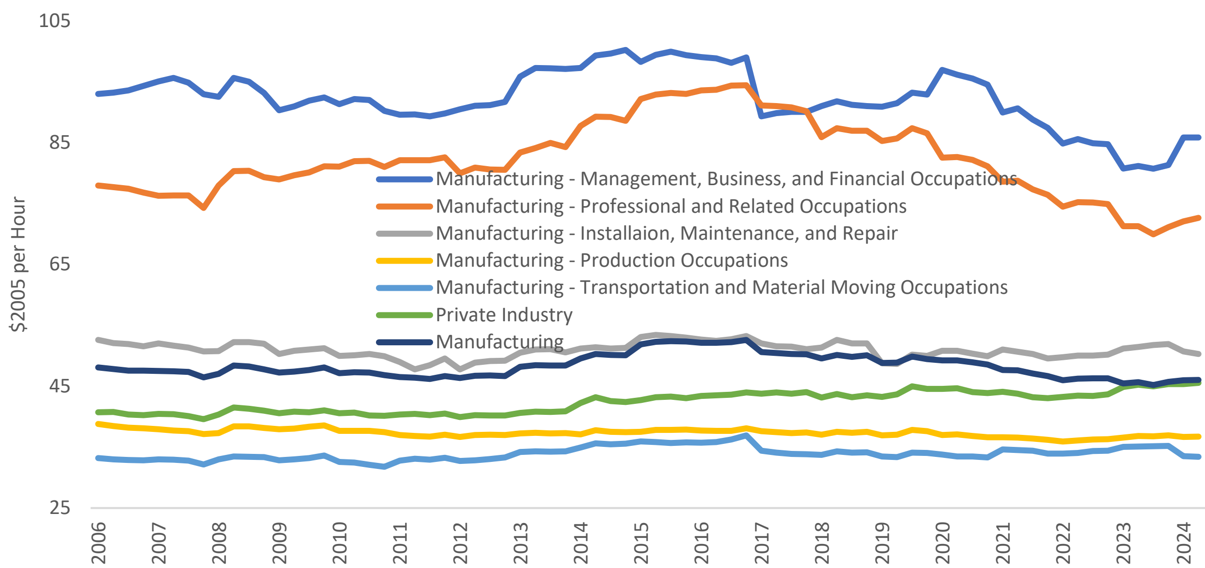


Figure 4.5: Employee Compensation (Hourly)

Source: Bureau of Labor Statistics. (2025f) National Compensation Survey. http://www.bls.gov/ncs/
Adjusted using the Consumer Price Index for all consumers from the Bureau of Labor Statistics.

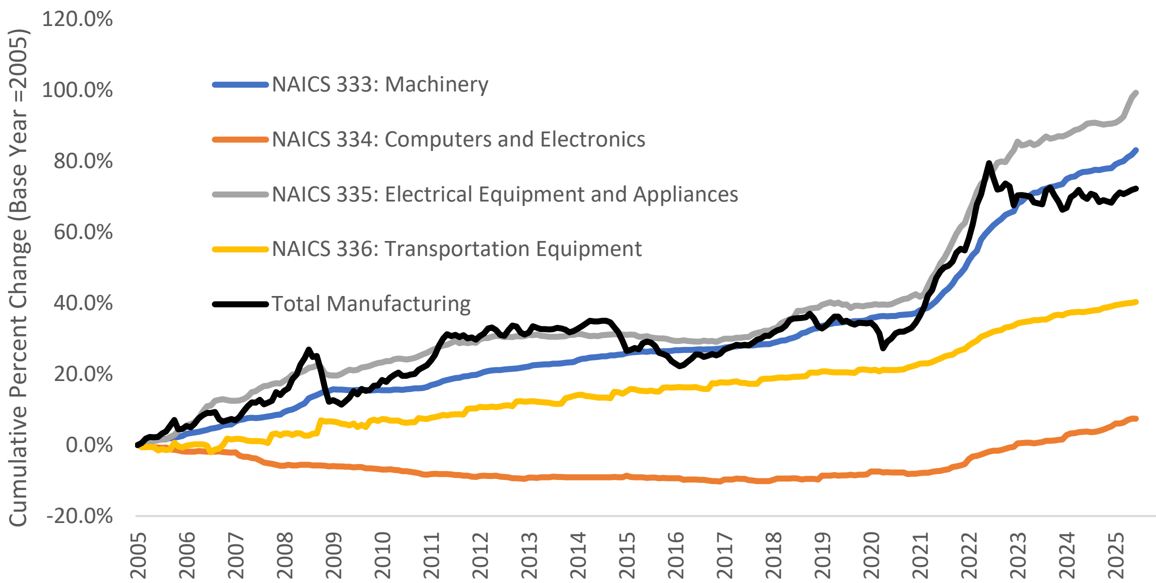


Figure 4.6: Inflation - Cumulative Percent Change in the Producer Price Index (Selling Price Received), 2005-2025

Source: Bureau of Labor Statistics. (2025h). Producer Price Index. https://stats.bls.gov/ppi/databases/

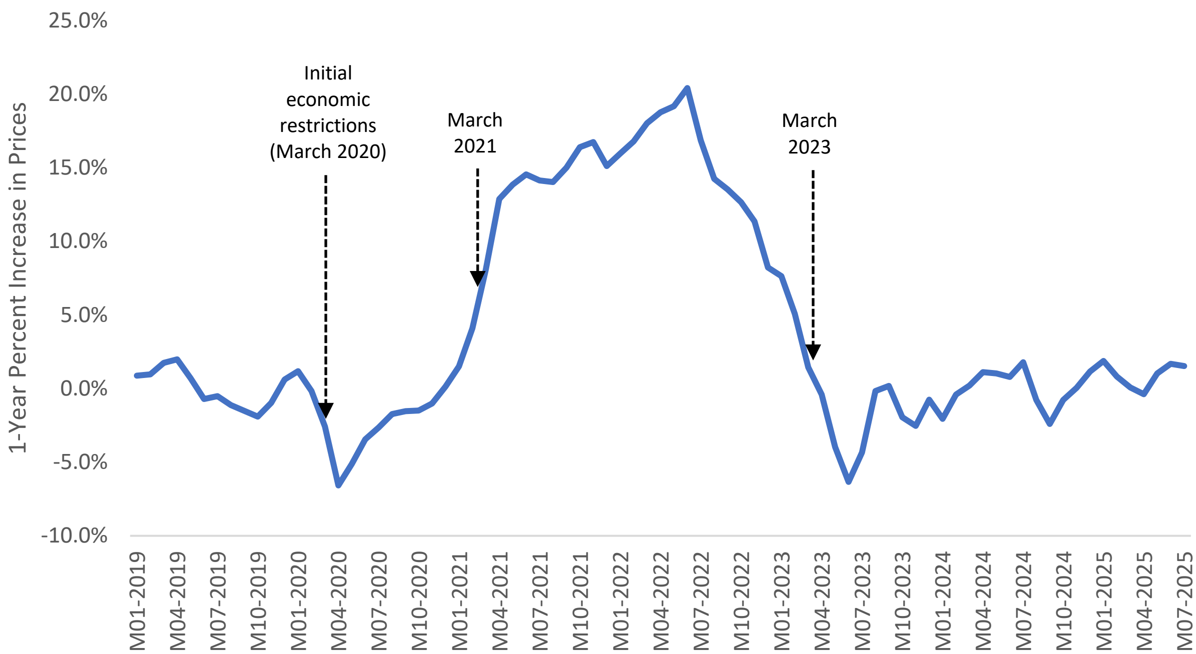


Figure 4.7: Rolling 1-Year Percent Change in the Producer Price Index for U.S. Manufacturing

Source: Bureau of Labor Statistics. (2025h). Producer Price Index. https://stats.bls.gov/ppi/databases/

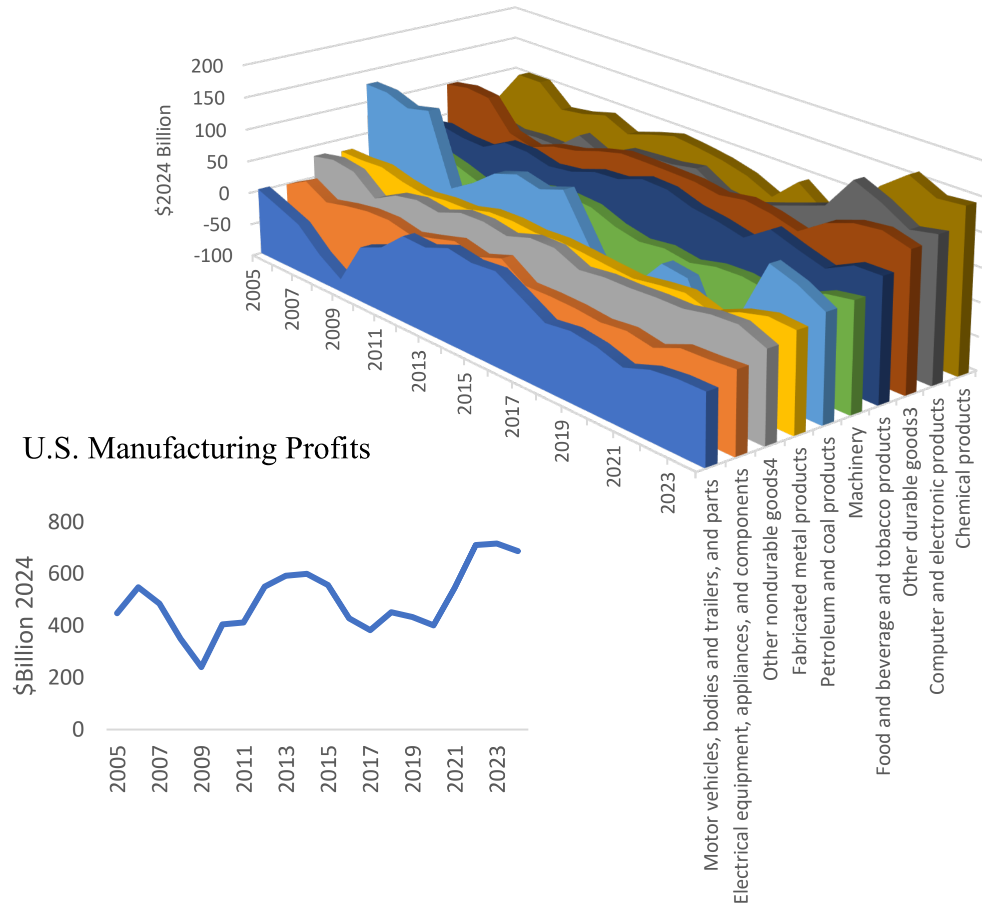


Figure 4.8: Profits for Corporations

Source: Bureau of Economic Analysis. (2025d) Income and Employment by Industry. Table 6.16D. Corporate Profits by Industry. https://apps.bea.gov/iTable/index_nipa.cfm.

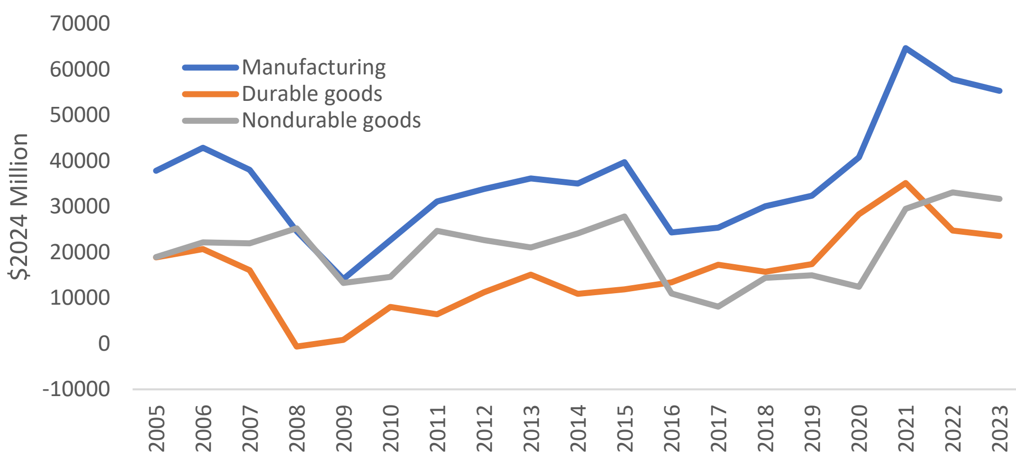


Figure 4.9: Nonfarm Proprietor's Income

Source: Bureau of Economic Analysis. (2025d) Income and Employment by Industry. Table 6.12D. Nonfarm Proprietors' Income. https://apps.bea.gov/iTable/index_nipa.cfm.

4.4. Productivity

An important aspect of manufacturing is the efficiency and productivity with which resources are used. Sustained increases in real GDP per capita only occur as a result of increases in productivity and/or efficiency (Krugman and Wells 2006; Greenlaw et al. 2022). Both private sector and public sector research and development have a key role in economic growth. For instance, an OECD study shows that an increase of 1 % in business research and development (R&D) generates 0.13 % in productivity growth while a 1 % increase in public R&D generates 0.17 % in productivity growth (Guellec and Bruno 2001). A number of other papers suggest that public R&D has as high or higher overall per dollar impact as that of the private sector (Ziesemer 2004; Herzer 2021); thus both are important for economic growth. Below are metrics for productivity with metrics related to research and development being presented in section 5.

The Bureau of Labor Statistics provides an index of labor productivity and total factor productivity. Labor productivity for manufacturing decreased between 2022 and 2023 by 1.0 %, as illustrated in Figure 4.10. The five-year compound annual growth is -0.7 %. The Bureau of Labor Statistics total factor productivity metric measures "the efficiency at which combined inputs are used to produce output of goods and services" (Bureau of Labor Statistics 2023). For U.S. manufacturing, total factor productivity decreased 3.2 % from 2022 to 2023 and has a 5-year compound annual growth rate of -0.7 %, as illustrated in Figure 4.11. In general, productivity in the U.S. is relatively high compared to other countries. As illustrated in Figure 4.12, the U.S. is ranked ninth in output per hour for all goods and services among 142 countries using data from the Conference Board (2023) – note that this is for all goods/services.

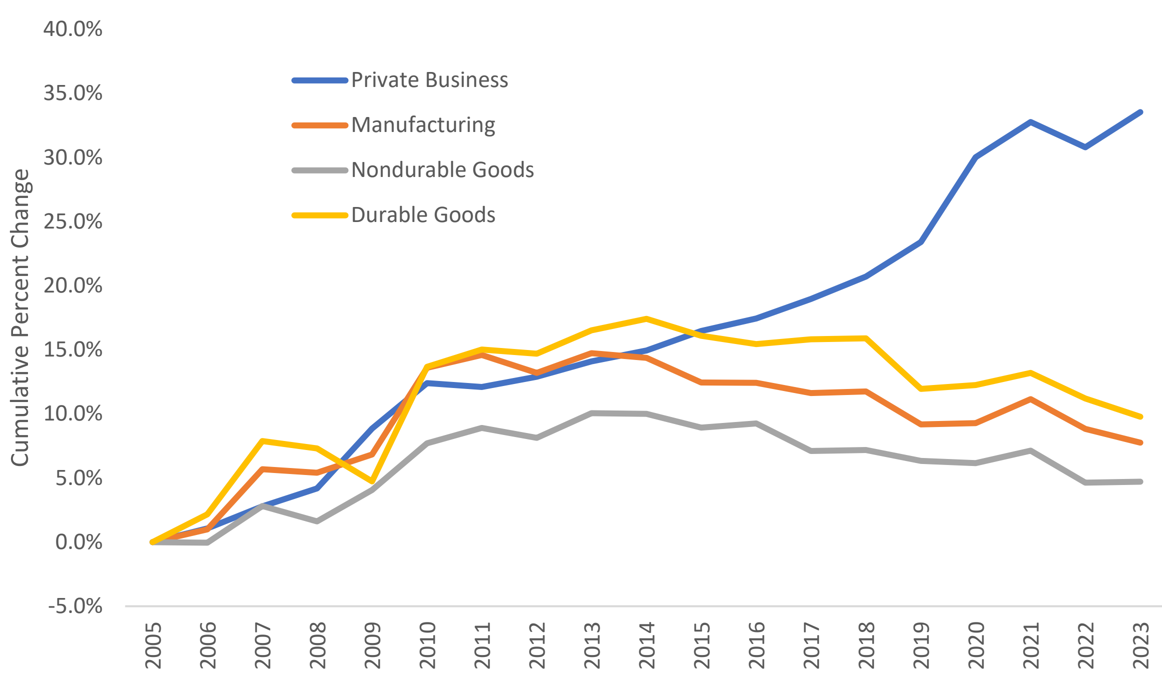


Figure 4.10: Manufacturing Labor Productivity Index (2017 Base Year = 100)

Source: Bureau of Labor Statistics. (2025g) Productivity. https://www.bls.gov/mfp/

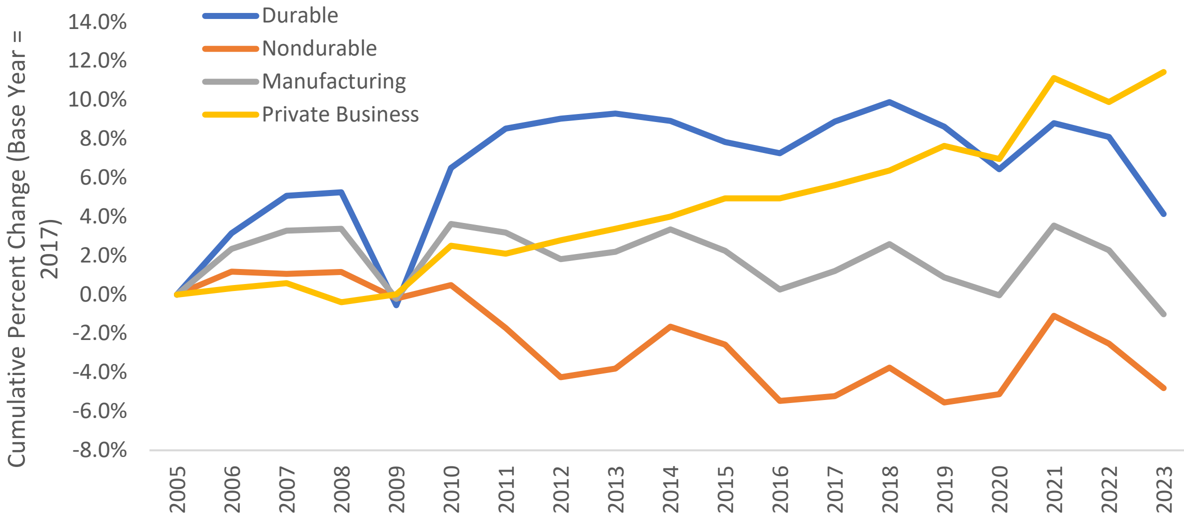


Figure 4.11: Manufacturing Total Factor Productivity Index

Source: Bureau of Labor Statistics. (2025g) Productivity. https://www.bls.gov/mfp/

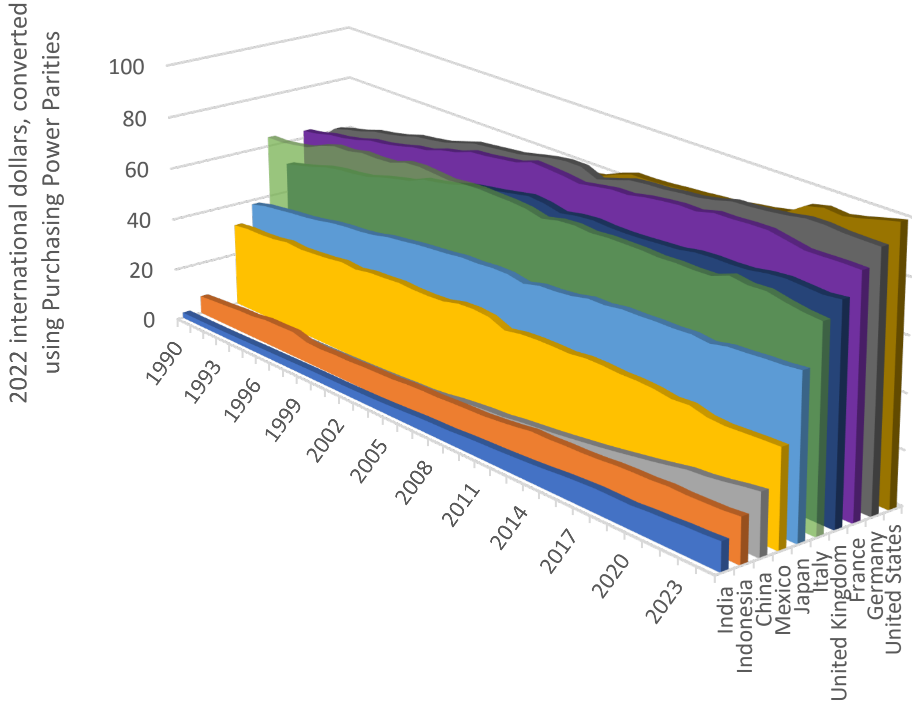


Figure 4.12: Output per Labor Hour (Top Ten Largest Manufacturing Countries from Figure 2.3)

Source: Conference Board. (2025) Total Economy Database: Output, Labor and Labor Productivity. https://www.conference-board.org/data/economydatabase/index.cfm?id=27762

5. Research, Innovation, and Factors for Conducting Business

Creating a successful manufacturing facility involves bringing together many resources in an efficient and innovative way. Similarly, cultivating and advancing national manufacturing activity requires bringing many resources together in just the right way. Manufacturers need skilled and knowledgeable labor, innovators, quality inputs, means for transporting goods, communication systems, energy, and access to customers. Measuring and comparing each of these presents a challenge. This section will present measures of innovation and factors that facilitate manufacturing.

5.1. Measures of Research and Innovation

Measuring and comparing innovation between countries is problematic, as there is no standard metric for measuring this activity. Four measures are often discussed regarding innovation: number of patent applications, research and development expenditures, number of researchers, and number of published journal articles. As seen in Figure 5.1, the U.S. ranked 4th in 2021 in resident patent applications per million people, which puts it above the 95th percentile among 113 countries. Using patent applications as a metric can be problematic though, as not all innovations are patented and some patents might not be considered innovation. The U.S. ranked 3rd in research and development expenditures as a percent of GDP in 2022, which puts it above the 95th percentile (see Figure 5.2) among 75 nations. BEA data on U.S. research and development is broken out in Figure 5.3. As is illustrated, manufacturing accounts for 31.4 % of U.S. value added research and development and for employment it is 27.9 %. The 4-year compound annual

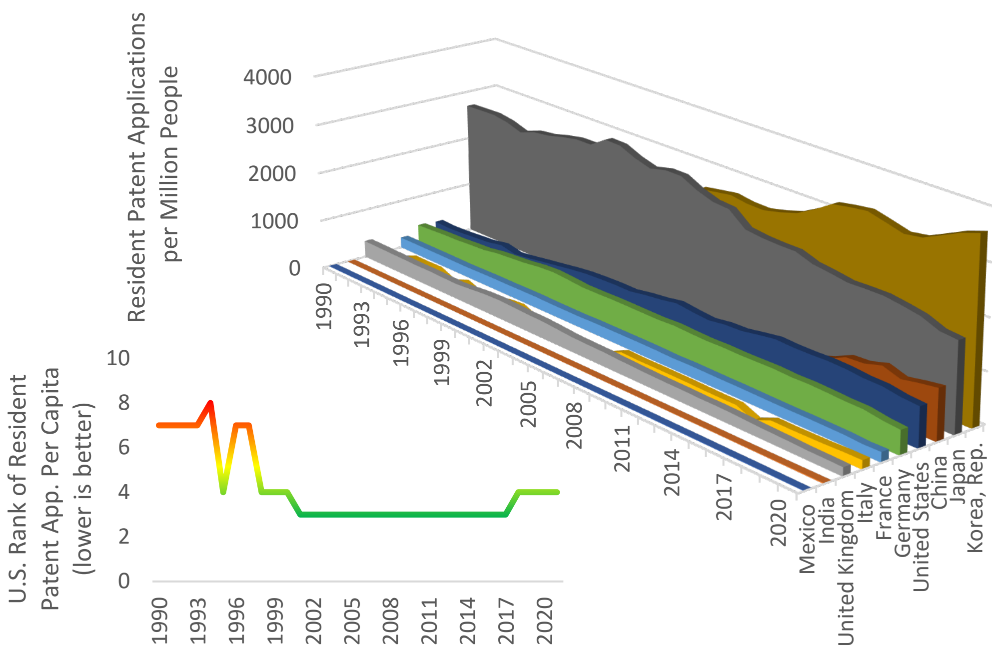


Figure 5.1: Patent Applications (Residents) per Million People, Top Ten Largest Manufacturing Countries (1990-2021)

World Bank. 2025. World Development Indicators. https://data.worldbank.org/products/wdi

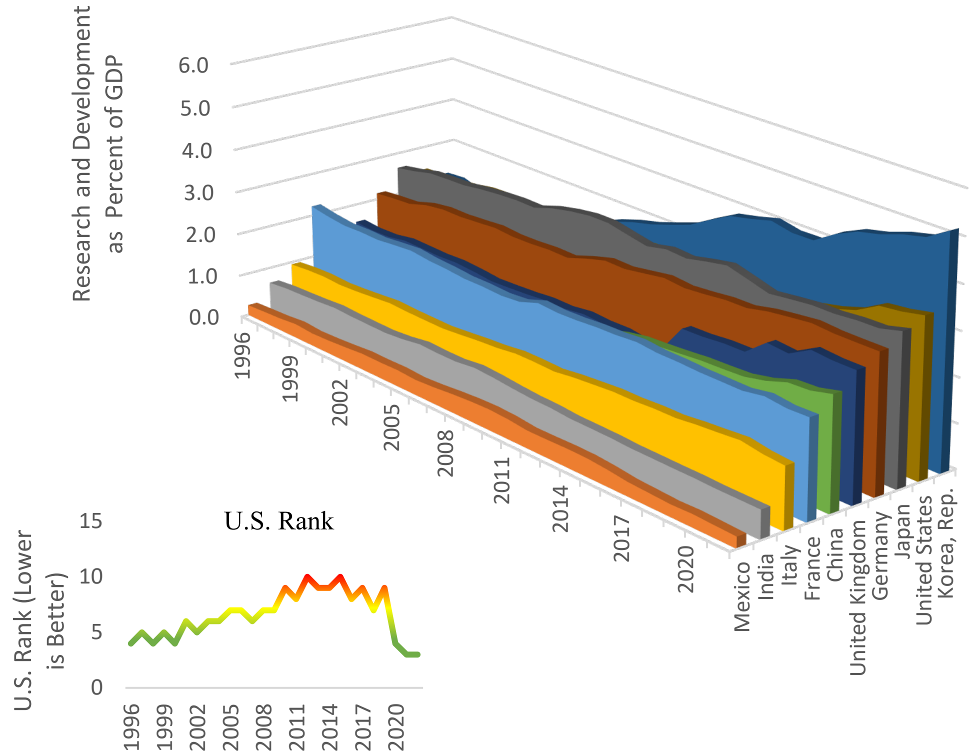


Figure 5.2: Research and Development Expenditures as a Percent of GDP, Top Ten Largest Manufacturing Countries

Source: World Bank. 2025. World Development Indicators. https://data.worldbank.org/products/wdi
* Missing data was interpolated

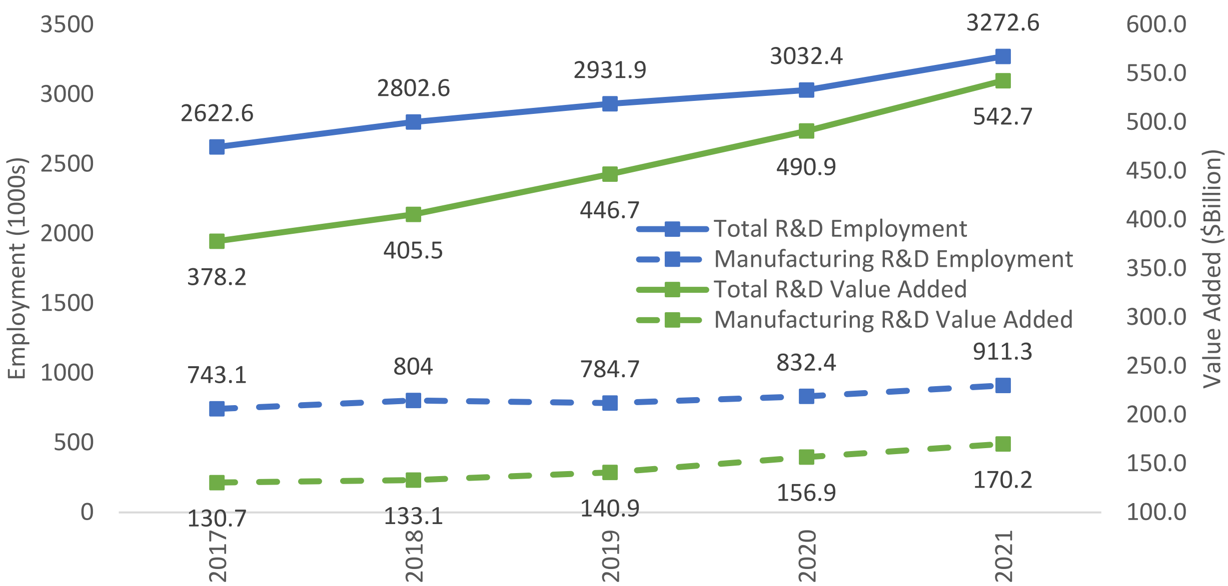


Figure 5.3: U.S. Research and Development Value Added and Employment

Source: Bureau of Economic Analysis. (2025e). "Research and Development Satellite Account." https://www.bea.gov/data/special-topics/research-and-development-satellite-account

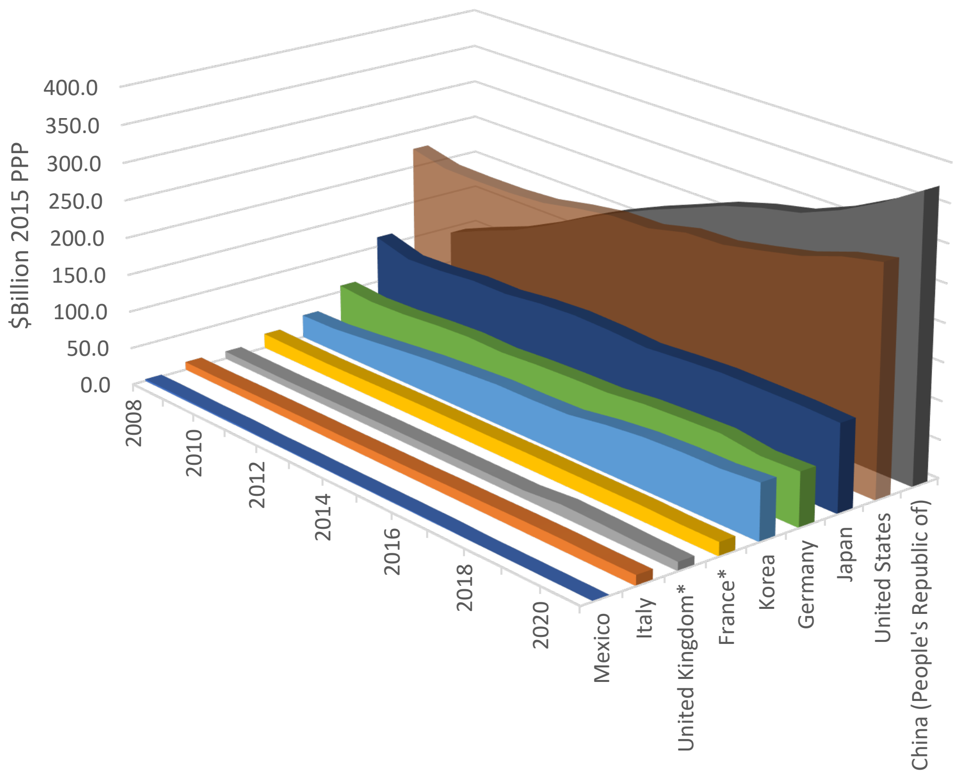


Figure 5.4: Manufacturing Enterprise Research and Development Expenditures (PPP Converted $Billion 2015), Top 10 Largest Manufacturing Countries for which Data is Available

Source: OECD. (2024a) Business Enterprise R-D Expenditure by Industry (ISIC 4). http://stats.oecd.org/#
*Missing values were interpolated

growth in manufacturing research and development employment is 5.2 % and for value added is 6.8 %. Although manufacturing represents a disproportionate amount of research and development, it is growing slower than that for all industries.

As seen in Figure 5.4, U.S. enterprise research and development expenditures in manufacturing increased 3.9 % between 2020 and 2021, has a 5-year compound annual growth rate of 3.9 % (not shown), and the 2021 value amounts to 13.4 % of manufacturing value added. Despite an increasing trend in researchers per million people, the U.S. rank decreased to 21st in 2021, putting it just above the 75th percentile (see Figure 5.5) out of 81 countries. In journal articles per million people it ranked 27th in 2022 out of 216 countries, and China had more articles than the U.S. (see Figure 5.6) (World Bank 2024). Germany, Japan, South Korea, and China ranked 29th, 42nd, 21st, and 48th, respectively (not shown) in journal articles per capita. Exports are also frequently seen as a measure of competitiveness. The U.S. was the second largest exporter in 2023, as illustrated in Figure 5.7.

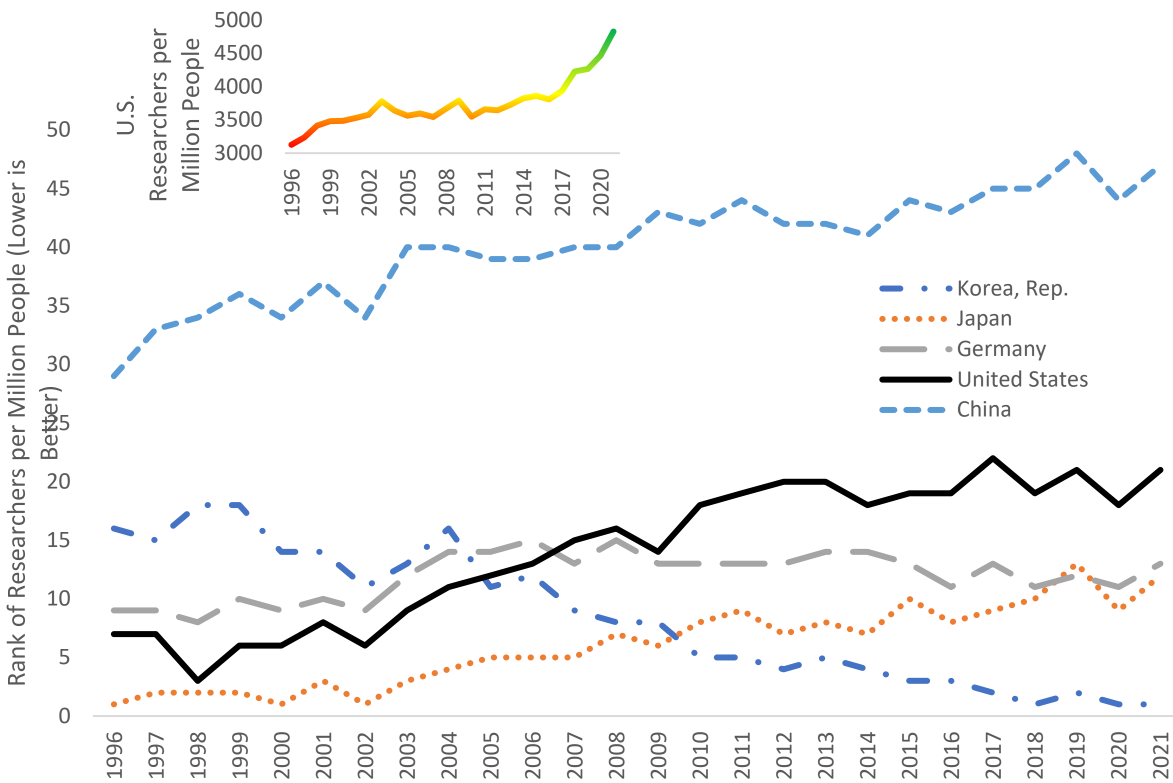


Figure 5.5: Researchers per Million People, Ranking

World Bank. 2025. World Development Indicators. https://data.worldbank.org/products/wdi

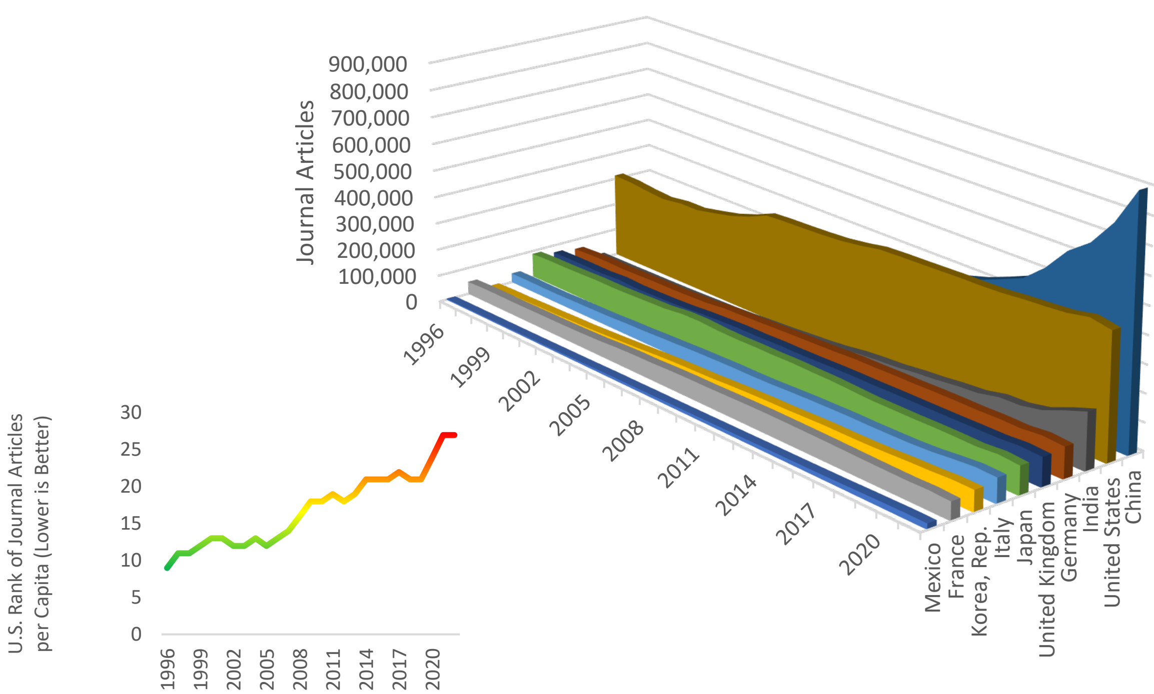


Figure 5.6: Journal Articles, Top 10 Countries

World Bank. 2025. World Development Indicators. https://data.worldbank.org/products/wdi

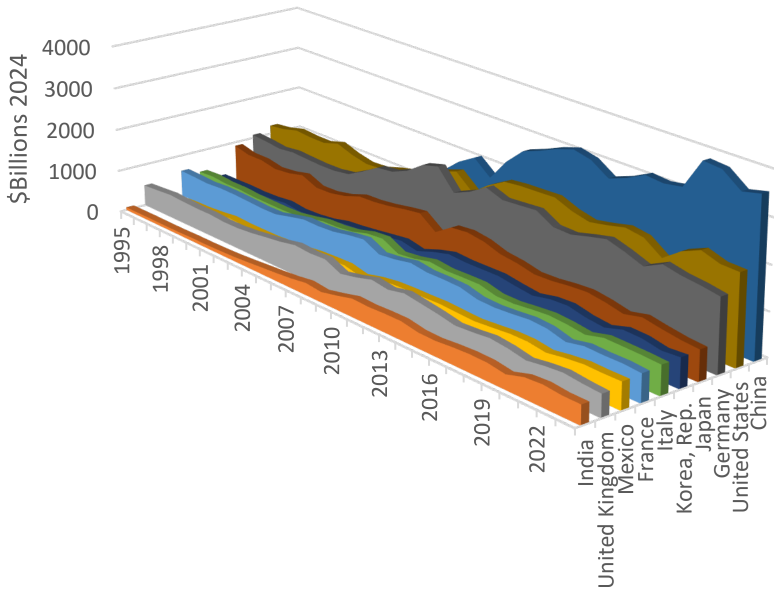


Figure 5.7: Merchandise Exports, Top Ten Exporters

World Bank. 2025. World Development Indicators. https://data.worldbank.org/products/wdi
NOTE: Adjusted using the Consumer Price Index for all consumers from the Bureau of Labor Statistics.

5.2. Factors that Facilitate Innovation and Production

In addition to some of the previously mentioned metrics, a number of indices have been developed to assess national competitiveness. Developing, cultivating, and maintaining a competitive national manufacturing industry requires harmonizing inputs into a well-crafted system. When traffic backs up, electricity grids fail, harbors slow down, or there is a shortage of skilled labor, national manufacturing suffers. This section discusses metrics that examine factors outside of the factories but affect production.

The IMD World Competitiveness Index provides insight into the U.S. innovation landscape. Figure 5.8 provides the U.S. ranking for 20 measures of competitiveness. This provides some indicators to identify opportunities for improvement in U.S. economic activity. In 2025, the U.S. ranked low in prices, public finance, societal framework, and attitudes and values among other things. Overall, the U.S. ranked 13th in competitiveness for conducting business while Germany, Japan, and China ranked 19th, 35th, and 16th, respectively (IMD 2024). Between 2016 and 2025, 85 % or 17 of the 20 rankings went down for the U.S.

The 2016 Deloitte Global Manufacturing Competitiveness Index uses a survey of CEOs to rank countries based on their perception. The U.S. was ranked 2nd out of 40 nations with China being ranked 1st. High-cost labor, high corporate tax rates, and increasing investments outside of the U.S. were identified as challenges to the U.S. industry. Manufacturers indicated that companies

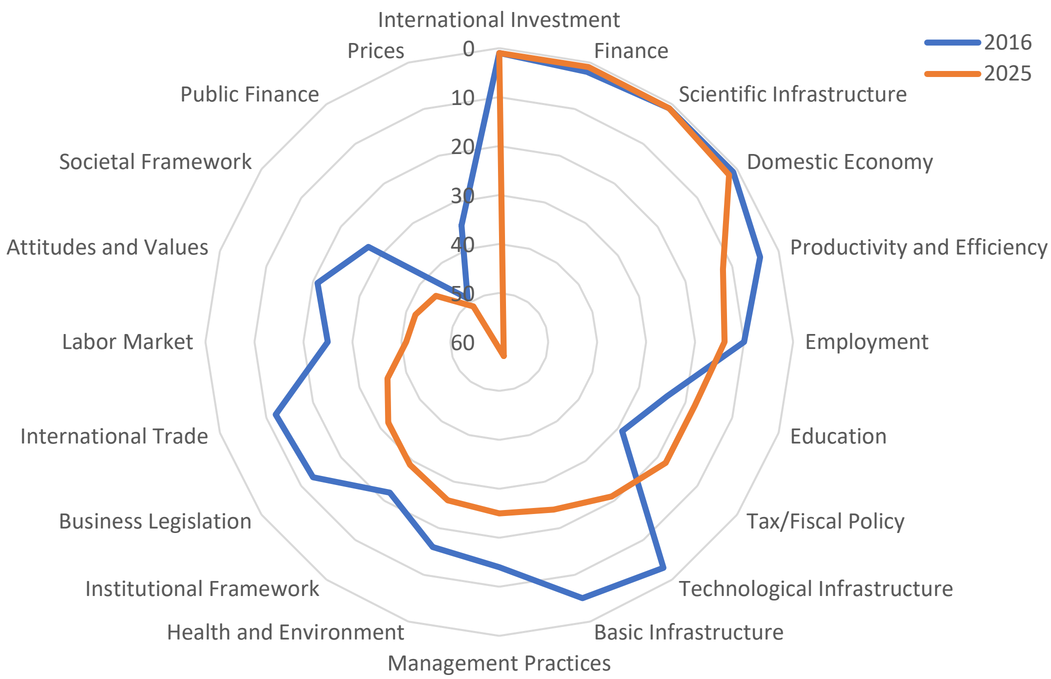


Figure 5.8: IMD World Competitiveness Rankings for the US: Lower is Better (i.e., a Rank of 1 is Better than a Rank of 69) – 69 countries ranked

Source: IMD. (2025). IMD World Competitiveness Country Profile: U.S. https://worldcompetitiveness.imd.org/countryprofile/US

were building high-tech factories in the U.S. due to rising labor costs in China, shipping costs, and low-cost shale gas (Deloitte 2016). According to the Deloitte Global Manufacturing Competitiveness Index, advantages to U.S. manufacturers included its technological prowess and size, productivity, and research support. China was ranked 1st with advantages in raw material supply, advanced electronics, and increased research and development spending. China has challenges in innovation, slowing economic growth, productivity, and regulatory inefficiency.

The World Economic Forum's Global Competitiveness Report uses 12 items to assess the competitiveness of a number of economies, which includes the set of "institutions, policies and factors that determine a country's level of productivity." The U.S. was ranked 5th overall with various rankings in the 12 "pillars" that underly the ranking. The U.S. rankings for each of the pillars was not readily available; however, the 2019 rankings are illustrated in Figure 5.9. Within the 12 "pillars," there were lower rankings in health, macroeconomic stability, and information/communication technology adoption (World Economic Forum 2020). The index uses a set of 90 factors to produce the 12 items in Figure 5.9. A selection of those that are relevant to standards, technology, and information dissemination are presented in Table 5.1. Those that have poorer rankings might be opportunities for improvement.

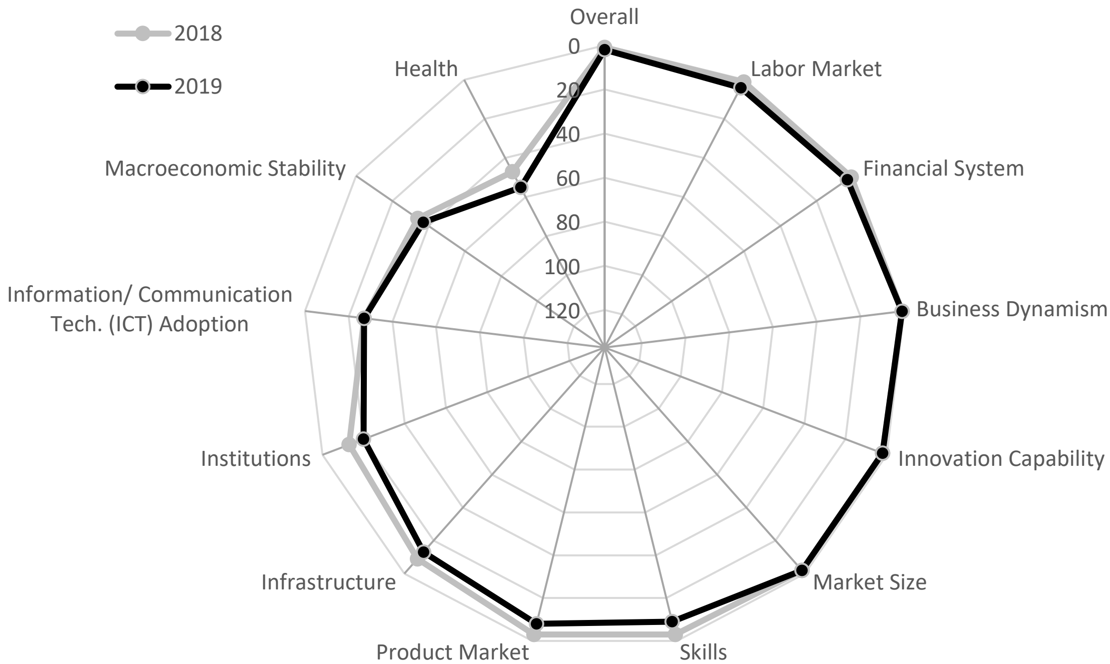


Figure 5.9: World Economic Forum 2019 Global Competitiveness Index: U.S. Pillar Rankings: Lower is Better

Source: World Economic Forum. (2020). The Global Competitiveness Report 2019. https://www.weforum.org/publications/the-global-competitiveness-report-2020/

Among those selected in Table 5.1, the U.S. ranks below the 90th percentile in both of the *crime* items, 2 of the 8 *transport* items, 6 of the 9 *utility* items, *labor-health*, 2 of the 9 *human capital* items, both *barrier to entry* items, and 2 of the 10 *innovation* items. The challenge for labor is further illustrated in a survey of original equipment manufacturers which indicated that they would increase onshoring by 30 % if the U.S. workforce had higher skills and were in abundant supply (Moser and Anemogiannis 2025). This effect was estimated to be more impactful than a number of other measures. The top reasons for onshoring were cited as being "the benefit of having manufacturing located near engineering" (45 % of respondents), which is a kind of synergy, and "a reduction in freight and duty costs" (45 % of respondent). Another 38 % indicated "they would avoid any potential geopolitical risk" and 49 % indicated it was due to supply chain disruptions and/or robust supply chain.

The Global Innovation Index "captures the innovation ecosystem performance of 133 economies and tracks the most recent global innovation trends" (World Intellectual Property Organization 2024). This index ranks the U.S. overall as 3rd in innovation and in subcategories it has the following rankings: Institutions: 17th, Human Capital and Research: 12th, Infrastructure: 30th, Market Sophistication: 1st, Business Sophistication: 2nd, and Knowledge and Technology Outputs 4th (World Intellectual Property Organization 2024). The U.S. contains 20 of the top 100 science and technology clusters while China has 26 and Germany has 8 (World Intellectual Property Organization 2024).

Table 5.1: World Economic Forum Competitiveness Index Indicators – Selection of those Relevant to Standards, Technology, and Information Dissemination Solutions, Rankings Out of 141 Countries (Lower is Better)

Pillar	Component	US Rank	Application
1	Organized crime	69	Crime
1	Terrorism incidence	83.3	Crime
1	Intellectual property protection	12	IP Protection
2	Road connectivity index	1	Transport
2	Quality of roads	17	Transport
2	Railroad density (km of roads/square km)	48	Transport
2	Efficiency of train service	12	Transport
2	Airport connectivity	1	Transport
2	Efficiency of air transport services	10	Transport
2	Liner shipping connectivity index	8	Transport
2	Efficiency of seaport services	10	Transport
2	Electrification rate (% of population)	2	Utilities
2	Electric power transmission and distribution losses (% output)	23	Utilities
2	Exposure to unsafe drinking water (% of population)	14	Utilities
2	Reliability of water supply	30	Utilities
3	Mobile-cellular telephone subscriptions (per 100 people)	54	Utilities
3	Mobile-broadband subscriptions (per 100 people)	7	Utilities
3	Fixed-broadband internet subscriptions (per 100 people)	18	Utilities
3	Fibre internet subscriptions (per 100 people)	45	Utilities
3	Internet users (% of population)	26	Utilities
5	Healthy life expectancy	54	Labor - Health
6	Mean years of schooling	7	Human Capital
6	Extent of staff training	6	Human Capital
6	Quality of vocational training	8	Human Capital
6	Skillset of graduates	5	Human Capital
6	Digital skills among population	12	Human Capital
6	Ease of finding skilled employees	1	Human Capital
6	School life expectancy (expected years of schooling)	30	Human Capital
6	Critical thinking in teaching	9	Human Capital
6	Pupil-to-teacher ratio in primary education	45	Human Capital
11	Cost of starting a business (% GNI per capita)	24	Barriers to Entry
11	Time to start a business (days)	31	Barriers to Entry
11	Companies embracing disruptive ideas	2	Innovation
12	State of cluster development	2	Innovation
12	International co-inventions (applications/million people)	19	Innovation
12	Multi-stakeholder collaboration	2	Innovation
12	Scientific publications (H index)	1	Innovation
12	Patent applications (per million people)	13	Innovation
12	R&D expenditures (% of GDP)	11	Innovation
12	Quality of research institutions	1	Innovation
12	Buyer sophistication	4	Innovation
12	Trademark applications (per million people)	32	Innovation

Pillars: 1) Institutions, 2) Infrastructure, 3) Information and communication technology adoption, 4) macroeconomic policy, 5) Health, 6) Skills, 7) Product market, 8) Labor market, 9) Financial system, 10) Market size, 11) Business dynamism, and 12) Innovation capability.
Applications: The application categories were developed for this report in order to identify items that might be relevant to manufacturing

The Competitive Industrial Performance Index, published by the United Nations Industrial Development Organization, ranks countries based on 3 dimensions: 1) capacity to produce and export manufactured goods; 2) technological deepening and upgrading; and 3) world impact (United Nations Industrial Development Organization. 2020). The U.S. ranked 6th overall, as seen in Figure 5.10. Germany ranked first followed by China.

The Annual Survey of Entrepreneurs makes inquiries on U.S. entrepreneurs concerning the negative impacts of eight items:

- Access to financial capital
- Cost of financial capital
- Finding qualified labor
- Taxes
- Slow business or lost sales
- Late or nonpayment from customers
- Unpredictability of business conditions
- Changes or updates in technology
- Other

As seen in Figure 5.11, there are four items where more than a 25 % of the firms indicated negative impacts, including taxes, slow business or lost sales, unpredictability of business conditions, and finding qualified labor (U.S. Census Bureau and National Center for Science and Engineering Statistics 2023). In recent years, unpredictability has increased as illustrated in Figure 5.12.

Countries are sometimes compared to or alluded to as brands. According to a survey on country reputation of products published by Statista (see Figure 5.13), the U.S. ranks 10th among 49 total countries. Another ranking from Ipsos (see Table 5.2), the U.S. ranks 7th. The high ranking of the U.S. supports the idea that manufacturers in the U.S. tend to compete based on differentiation rather than cost competition. This is further illustrated in a survey of U.S. contract manufacturers on reshoring where 61 % of respondents indicated that customers order from them instead of offshoring due to *quality/rework/warranty*, which was the top response (Moser and Anemogiannis 2025). This is consistent with the U.S. being a differentiator. The second highest response was *delivery time* (54 %) and *supply chain disruptions* (50 %). The top reasons for reshoring was related to *supply chain disruption and robustness* (<=49 %) with the second being to *have engineering near manufacturing* (45 %) (see Table 5.3). It may not seem like it, but this is consistent with the U.S. being a differentiator as those purchasing items based on cost would tend to include those who have already offshored. If they decide to reshore, it is likely to be related to costs such as those that come with supply chain disruption. According to Moser and Anmogiannis (2025), 32 % of original equipment manufacturers were planning to offshore products in the next two years and when asked to select two reasons, responses include: *cost* (69 %), *availability of products or components* (39 %), *workforce availability* (31 %), *process knowledge* (28 %), *workforce skills* (18 %), and *other* (15 %). These answers tend to be consistent with the U.S. being a differentiator rather than a cost competitor, as those choosing to offshore are primarily doing so because of cost.

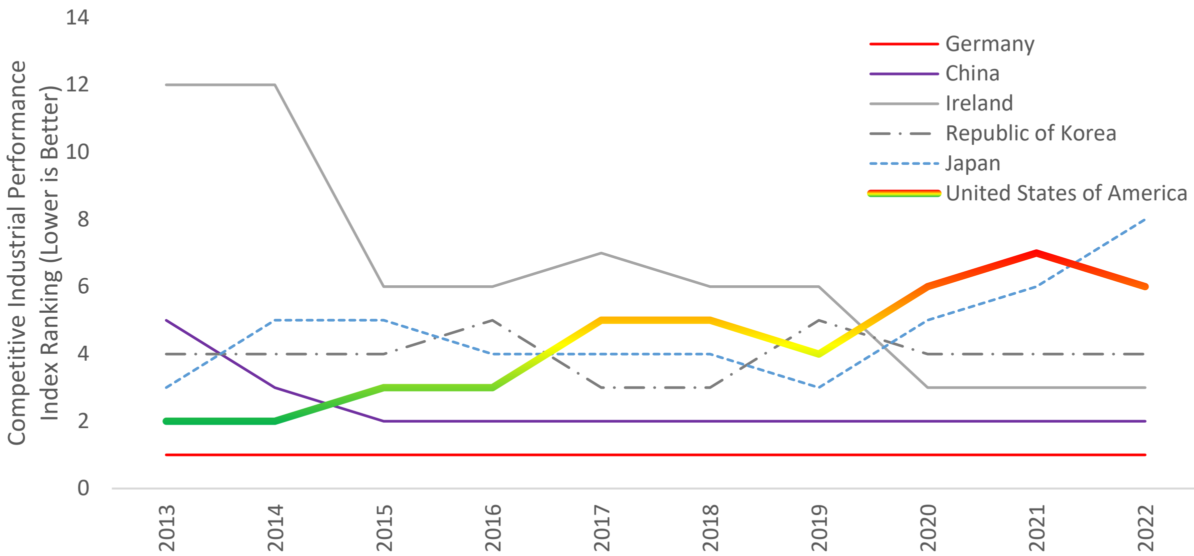


Figure 5.10: Rankings from the Competitive Industrial Performance Index 2024, 150 Total Countries

Source: United Nations Industrial Development Organization. (2025). Competitive Industrial Performance Index. https://stat.unido.org/analytical-tools/country-analytics?country=840&codes=IND_%2CHI_IND

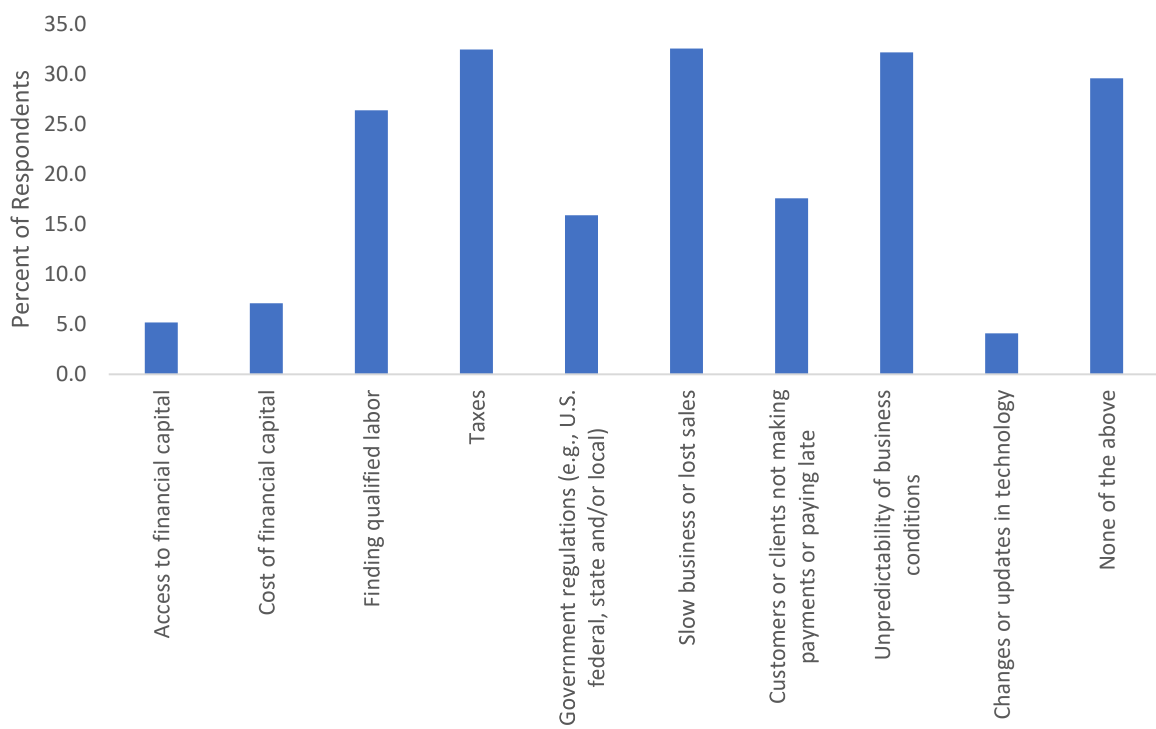


Figure 5.11: Factors Impacting U.S. Business (Annual Survey of Entrepreneurs), 2022

Source: U.S. Census Bureau and National Center for Science and Engineering Statistics. 2023 Annual Business Survey. https://www.test.census.gov/programs-surveys/abs/data/tables.html

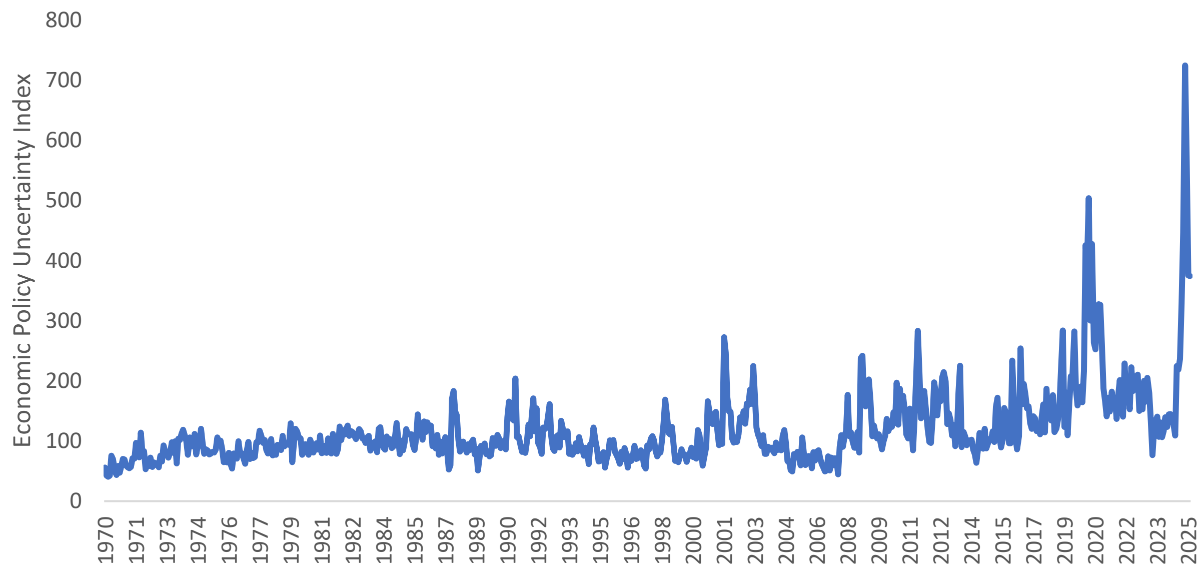


Figure 5.12: U.S. Economic Policy Uncertainty Index

Source: Baker, Scott R; Bloom, Nick; Davis, Steven. (2025). “Economic Policy Uncertainty Index.” https://www.policyuncertainty.com/us_monthly.html

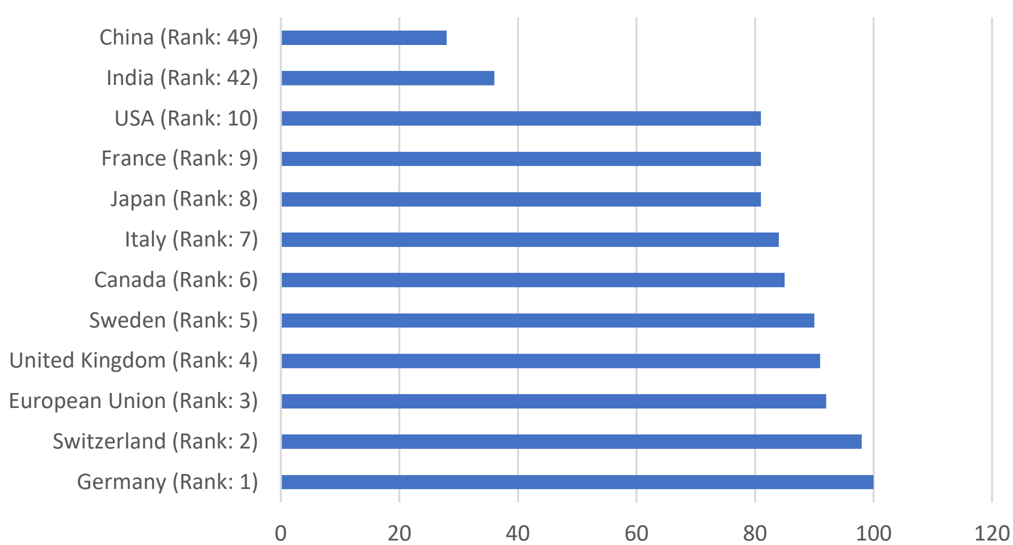


Figure 5.13: Made-in-Country Index, 2017

Source: Loose, Nicolas. (2017). “Made-in-Country Index 2017.” https://www.statista.com/page/Made-In-Country-Index

2024 rank	Country
1	Japan
2	Germany
3	Italy
4	Switzerland
5	United Kingdom
6	Canada
7	United States
8	Sweden
9	Australia
10	France

Table 5.2: Anholt-Ipsos National Brands Index, 2024

Source: Anholt-Ipsos. (2024). "Nation Brands Index 2024." https://placebrandobserver.com/anholt-nation-brands-index-nbi-2024/

Table 5.3: Original Equipment Manufacturer's Reasons for Reshoring

Top reason to reshore to U.S. (pick 3)	Percent of Respondents
*Supply chain Disruption and robustness**	*<=49%*
Supply chain disruptions	28%
Robust supply chain	21%
Benefit of having manufacturing near engineering	45%
Reduction in freight and duty costs	45%
Avoid any potential geopolitical risk	38%
Proximity to customer market	35%
Quality/Rework/Warranty	32%
Intellectual property risk	21%
Image/brand of "Made in USA"	17%
Automation/Technology/Lean	10%
Skilled workforce availability	7%
Social/ethical concerns	7%
Section 301 tariffs	4%
3D printing/additive	4%
Manufacturing	4%
Energy/utility costs	4%
Government incentives	4%

Source: Moser, Harry; Anemogiannis, Kathy Nunnally. (2025). Reshoring Survey Report. Reshoring Initiative and Regions Recruiting.
https://reshorenow.org/content/pdf/2025_Reshoring_Survey_Report_Portrait-compressed.pdf
*This category sums two supply chain categories, which likely have overlapping respondents.

6. Manufacturing Industry Forecasts and Outlooks

Previous sections focused on the current or past state of U.S. manufacturing. This section discusses manufacturing outlook. The National Association of Manufacturers reported that those with a positive outlook dropped from 69.7 % in the first quarter of 2025 to 55.4 % in the second quarter, as seen in Figure 6.1. There was a significant drop in outlook and expected growth in sales during the recent pandemic. Note that there is missing data due to disruptions caused by the pandemic.

As seen in Table 6.1, at the three digit NAICS level 36.8 % of manufacturing industries (7 out of 19 industries) have forecasted employment growth greater than or equal to that of *total* employment for all industries and only 5.3 % of industries (1 out of 19) are forecasted to have growth in output greater than or equal to that of the *total* for all industries (1.9 %) with the growth for total manufacturing projected to be 1.2 % or just 63.2 % of that for the total. Table 6.2 shows the top 20 % of occupations by employment, which includes 85.9 % of those employed in manufacturing.

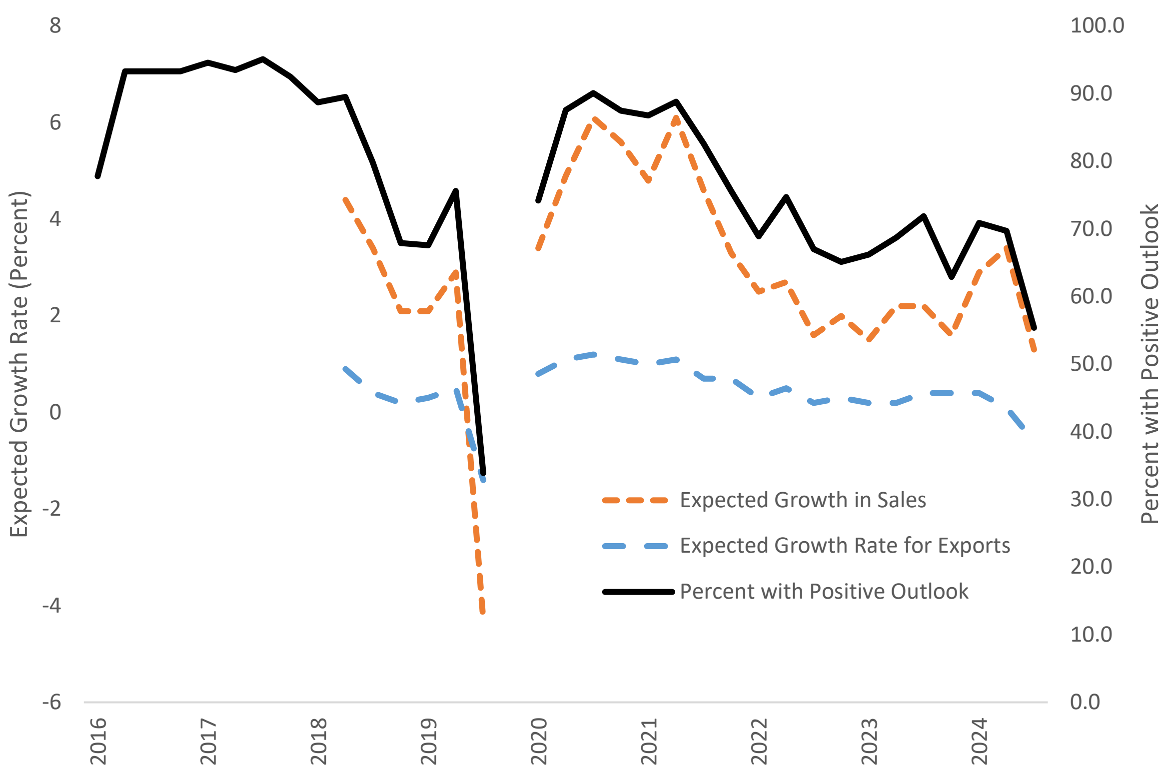


Figure 6.1: Positive Outlook, Expected Growth in Sales (12 Months), and Expected Growth in Exports (12 Months)

Source: National Association of Manufacturers. (2025). Manufacturers' Outlook Survey. 2016-2025. https://nam.org/manufacturers-outlook-survey/

Table 6.1: Forecasted Growth in Employment and Output, Rate and Rank by Industry

2023 National Employment Matrix title	2023 National Employment Matrix code	Compound annual rate of change, employment, 2023–2033	Compound annual rate of change, output, 2023–2033
Total		0.4	1.9
Manufacturing	31-330	0.1	1.2
Food manufacturing	311000	0.6	1.7
Beverage and tobacco product manufacturing	312000	2.2	0.9
Textile mills and textile product mills	313-40	-1.3	-0.2
Apparel, leather and allied product manufacturing	315-60	-2.8	-0.7
Wood product manufacturing	321000	-0.1	1.0
Paper manufacturing	322000	-1.5	0.2
Printing and related support activities	323000	-2.0	-1.0
Petroleum and coal products manufacturing	324000	-0.3	1.3
Chemical manufacturing	325000	0.4	1.5
Plastics and rubber products manufacturing	326000	0.4	0.4
Nonmetallic mineral product manufacturing	327000	0.3	0.2
Primary metal manufacturing	331000	-0.3	1.5
Fabricated metal product manufacturing	332000	-0.1	0.6
Machinery manufacturing	333000	0.0	0.4
Computer and electronic product manufacturing	334000	0.6	2.2
Semiconductor and other electronic component manufacturing	334400	1.3	3.2
Electrical equipment, appliance, and component manufacturing	335000	1.5	1.0
Transportation equipment manufacturing	336000	-0.5	1.4
Motor vehicle manufacturing	336100	0.6	3.1
Motor vehicle body and trailer manufacturing	336200	0.2	1.5
Motor vehicle parts manufacturing	336300	-2.4	-1.7
Aerospace product and parts manufacturing	336400	0.2	1.5
Furniture and related product manufacturing	337000	-0.6	0.3
Miscellaneous manufacturing	339000	0.4	1.7

Source: Bureau of Labor Statistics. 2024. “Table 2.11 Employment and output by industry (Employment in thousands of jobs; Output in billion of chained 2017 dollars).” Employment Projections. https://www.bls.gov/emp/tables/industry-employment-and-output.htm

Table 6.2: Employment (2023) and Forecasted Growth (2023-2033), By Occupation

Code	Occupation Title	Manufacturing Industry Employment	Growth (All Industries): 2023-2033
00-0000	All Occupations	12 767 670	4.0
11-0000	Management Occupations	858 440	7.3
13-0000	Business and Financial Operations Occupations	649 670	6.9
15-0000	Computer and Mathematical Occupations	312 540	12.9
17-0000	Architecture and Engineering Occupations	783 540	6.8
19-0000	Life, Physical, and Social Science Occupations	151 200	7.5
21-0000	Community and Social Service Occupations	200	8.1
23-0000	Legal Occupations	6 690	3.7
25-0000	Educational Instruction and Library Occupations	550	1.6
27-0000	Arts, Design, Entertainment, Sports, and Media Occupations	83 120	4.2
29-0000	Healthcare Practitioners and Technical Occupations	12 090	8.6
31-0000	Healthcare Support Occupations	1 110	15.2
33-0000	Protective Service Occupations	12 360	2.0
35-0000	Food Preparation and Serving Related Occupations	135 350	4.3
37-0000	Building and Grounds Cleaning and Maintenance Occupations	77 340	3.1
39-0000	Personal Care and Service Occupations	1 960	6.4
41-0000	Sales and Related Occupations	404 580	-2.0
43-0000	Office and Administrative Support Occupations	966 830	-3.5
45-0000	Farming, Fishing, and Forestry Occupations	31 070	-1.9
47-0000	Construction and Extraction Occupations	216 350	5.6
49-0000	Installation, Maintenance, and Repair Occupations	691 520	5.3
51-0000	Production Occupations	6 218 770	-1.0
53-0000	Transportation and Material Moving Occupations	1 152 370	4.8

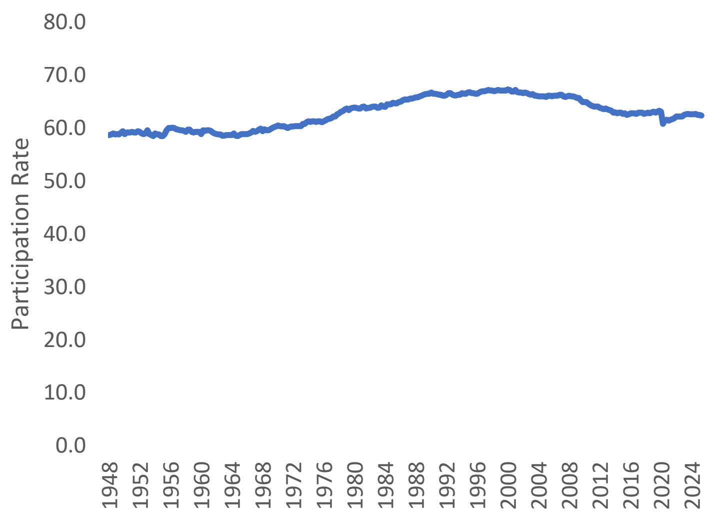
Employment Source: Bureau of Labor Statistics. 2024. "Table 2.11 Employment and output by industry (Employment in thousands of jobs; Output in billion of chained 2017 dollars)." Employment Projections. https://www.bls.gov/emp/tables/industry-employment-and-output.htm
Growth Source: Bureau of Labor Statistics. "Table 1.10 Occupational separations and openings, projected 2023–33 (Numbers in thousands)."

7. Methods for Advancing Manufacturing Competitiveness

From the data presented in previous sections along with observations in other publications, there are a number of potential means for advancing U.S. competitiveness, as discussed below. Note that strategic and/or supportive tax policies, subsidies, and monetary policies are important and are widely debated in other venues; however, the specifics of these issues are beyond the scope of this discussion.

7.1. Limited Resources and Targeting Investments

Like other countries, the U.S. has limited and scarce resources. One resource that is heavily discussed or referenced is labor. While the U.S. was the third most populous country in 2023, it only accounted for approximately 4.3 % of the global population. Meanwhile, the most populous nation, India, accounted for 17.8 % and China accounted for 17.6 %. The U.S. is near the forefront of production for its population size, as it ranks third in manufacturing value added per capita among the top 10 manufacturing countries. Among all nations for which data is available, it ranked 13th while China ranked a distant 35th. Despite having a high per capita manufacturing value added, China produces more than twice as much due in part to its much larger labor pool. It is also important to note that although the labor force participation rate has fluctuated over time (see Bureau of Labor Statistics. (2025j). Labor Force Statistics from the Current Population Survey. https://www.bls.gov/cps/data.htm Figure 7.1), historic increases in the rate were likely driven by demographics (e.g., baby boomer generation) and women entering the labor force; thus, labor is a scarce and limited resource that will be difficult to increase through the participation rate. Even if the labor pool can be increased, manufacturers still need to compete with other industries for workers.



Bureau of Labor Statistics. (2025j). Labor Force Statistics from the Current Population Survey. https://www.bls.gov/cps/data.htm

Figure 7.1: Labor Force Participation Rate

In addition to scarce resources, there are natural tendencies that affect investment in manufacturing. For instance, the relationship between gross domestic product, consumption, government spending, investment, and net exports (shown below) has not only the explicit relationship shown below but also the implicit relationship between investment and net exports where investment equals savings minus net exports:

GDP	C	G	I	NX	
		Government Consumption Expenditures and Gross Investment ($Billion)		Net Exports	
Gross Domestic Product ($Billion)	Personal Consumption Expenditures ($Billion)		Gross Private Domestic Investment ($Billion)	Exports ($Billion)	Imports ($Billion)

$$\$29\,184.9 = \$19\,825.3 + \$4\,989.7 + \$5\,272.9 + (\$3\,180.2 - \$4\,083.3)$$

Moreover, changes in one item can interact with the others in more than one way, possibly in unexpected ways; thus, strategies that reliably advance manufacturing competitiveness are likely to take various interactions into account.

Any country that aims to maintain or gain hegemony in manufacturing, will likely need to attain high returns – both financial and non-financial – for its investments in competitiveness, as other countries are aiming for the same positioning, as demonstrated by the “Made in China” initiative (U.S. – China Economic and Security Review Commission 2025). Further, given limited resources, it seems unlikely that the U.S. can be the sole manufacturing nation or be the largest manufacturer for all products. One possible strategy for a country might be to target a selection of industries, which can avoid the overextension or dispersing of resources across too many initiatives and losing the focus needed for competitiveness. One group of potential industries are those related to national security. As discussed previously, the U.S. tends to be a differentiator, suggesting that product quality and performance are key drivers for national competitiveness; thus, another category of targeted products might be those where quality and performance have significant value. These might include high-technology products or complex machinery and electronic products. A third set of products might be those critical items in the supply chain for either of the first two groups (i.e., national security products or those where quality and/or performance are highly valued). Other less critical supply chain items might be managed through various policy instruments to reduce the risk of disruption.

Finally, incentives or structural changes that relate to GDP that are intended to increase manufacturing activity need to be cautiously deliberated to avoid triggering self-defeating conditions. For instance, manufacturers must compete for scarce investment dollars with other industries and other opportunities, including competing with non-productive investments (e.g., speculation) that tend not to increase production of goods/services. Structural changes can change incentives for various investment opportunities in unintended ways. Although the specifics of these items are beyond the scope of this report, it is important to note that structural shifts can have unintended consequences.

7.2. Forecasting and Strategic Planning

An Endeavor Business Media publication on reshoring states that "there's an opportunity… to be… strategic about [reshoring]… Think about which supply chains, which players, and how to think holistically about not only infrastructure but also follow-on…." (Endeavor Business Media 2024). This statement emphasizes being strategic from the initial stages of an investment in advancing manufacturing industry competitiveness to the final stages can result in advancing competitiveness. There are a number of processes that often occur when research is successful in advancing the manufacturing industry, which can include the following:

- Development of R&D project proposals
- Proposal evaluations and selection
- R&D execution
- Implementation of findings and results
- Dissemination of findings and results across manufacturers
- Impact evaluation and recalibration of methods

Generally, each of these processes involve different types of expertise, making the whole undertaking somewhat complex.

Economics role serves three purposes in advancing national manufacturing competitiveness: 1) motivates the adoption of innovations through more informed decision making; 2) guides public investments by identifying high impact projects/investment; 3) justifies investments by showing that they had impact. These items relate to the "proposal evaluations" and "impact evaluation" from above. Harnessing economics for deliberate purposes can align private decision making and public action toward the highest-return opportunities, reduce uncertainty and avoid low-return investments, and demonstrate measurable impacts on productivity, resilience, and long-term competitiveness.

Typically, every investment (e.g., R&D investments) or even every purchase involves making a prediction. When companies or governments invest in research, when an individual purchases a car or house, or even when purchasing basic items such as food, typically there is a prediction being made. When the decision maker chooses whether to invest or purchase an item, they are predicting whether the benefits of the purchase/investment will exceed the costs. There are a number of approaches for making predictions and they are often associated with different levels of accuracy and different levels of effort/cost to develop the prediction.

There are multiple challenges in ensuring that relevant outcomes are being predicted. For instance, one might be tempted to only measure or predict intermediate outcomes of investments in manufacturing competitiveness, such as patents, research articles, or technology readiness levels. Although these are important, they do not represent the primary end purpose which is generally considered to be to decrease the costs, losses, and negative externalities of producing goods and/or increasing their quantity/quality/performance. In order to compare and contrast investments, these items are frequently measured in dollars. Moreover, to reliably increase manufacturing competitiveness, it is likely necessary to develop systematic strategies that include high accuracy investment analyses. It is important to note that investment analyses are often made at broad levels, such as when tens of billions of dollars are being allocated; however, methods currently used for allocating investments at more granular levels can often be less clear. High accuracy predictions/forecasts have the potential for significantly increasing impact/returns, as has been demonstrated by a number of organizations. It is likely that higher accuracy forecasts/predictions at more granular levels (e.g., investments less than $1 million) will facilitate increasing impact for advancing manufacturing competitiveness.

It has been shown that some methods for making forecasts have greater accuracy than others. The Intelligence Advanced Research Projects Activity (IARPA), part of the Office of the Director of National Intelligence, set out to improve American intelligence, which often includes making forecasts such as estimating the probability of an Israeli strike on Iranian nuclear facilities. To determine and improve the performance of their intelligence forecasts they created a forecasting tournament (Tetlock and Gardner 2015). In conclusion, some methods are far more accurate than others, even to the point of outperforming professional intelligence analysts with access to classified information. Unfortunately, these methods are frequently underutilized

Forecast accuracy is improved in the presence of feedback. That is, when predictions can be confirmed/refuted. This also implies that forecasts need to be testable or confirmable. For instance, identifying that benefits of a particular public investment are "large" or "important" is not a testable prediction, as these terms are not clearly defined. That is, at no point in the future can it be refuted or confirmed when compared to the actual events/outcomes that transpire. On the other hand, a forecast that estimates a range of dollar savings from a public investment is a testable prediction. At some point in the future, researchers could collect data, make estimates of savings, and compare it to the prediction.

Creating testable predictions for public investments can facilitate creating a system of continuous improvement. Possible public investment plans for a particular goal (e.g., reducing inefficiencies in manufacturing) are developed/proposed. Predictions of impact are made for each of the options for achieving the goal and they are selected based on those predictions. After the projects are executed, an estimate of the real impact is made for some or all of the executed projects. This estimate is compared to the predicted estimates to recalibrate prediction methods and is used to inform future projects.

7.3. Standards for Manufacturing Competitiveness

There are multiple categories of standards that are likely to facilitate increasing manufacturing competitiveness. The first is a classification of manufacturing industry costs. For a number of reasons there is not a comprehensive classification of costs for manufacturing that includes the various processes in the industry. This lack of a standard makes it difficult to measure and identify high costs that crosscut various subsectors thereby preventing the identification of high return opportunities. It also makes it difficult to assemble and use data to conduct analyses and forecasts for the various investments for advancing manufacturing competitiveness. Further, there is a lack of an accepted standard classification of investments that includes the different types of efficiency/productivity investments, such as investing in energy efficient lighting or machinery maintenance. The lack of a standard makes it difficult to systematically collect data on investments and learn from their impacts. Thus, there is a need for both a cost classification and an investment classification.

To complement cost and investment classifications, there is a need for standard methods for investment analysis that can be applied by non-experts – those who do not have financial or economic backgrounds. As stated previously, every purchase involves making a prediction and because of the vast number of investment and purchasing decisions, many investment decisions are made by those who do not have expertise in conducting investment analyses (e.g., small manufacturers or the head of a maintenance department); thus, there is need for approaches that non-experts or those with limited resources can apply resulting in an increase in accuracy for their forecasts. The classifications and investment analysis methods will aid in fulfilling the need for high impact standards, technologies, methods, tools, and/or guides that reduce production costs, losses, and negative externalities across the industry.

There is a need for standards, technologies, methods, tools, and/or guides that both advance the quality/performance of products and those that facilitate differentiating products. As mentioned previously, the U.S. might be seen as a differentiator, meaning that it tends to compete based on the quality, performance, or reputation of its products rather than their cost. Standards that improve products and allow customers (e.g., consumers or firms that purchase finished or intermediate goods) to differentiate products by their characteristics (e.g., product longevity, repairability, or energy consumption) are likely to advance U.S. competitiveness over those that are cost competitors. This might include standards that differentiate products for consumers or those for manufacturers selecting suppliers of intermediate products. These types of standards will aid customers in making their own forecasts and to select the cost/quality combination that fits their purpose. Without standards that convey quality/performance, costumers are likely to more frequently default to choosing lower cost items due to the uncertainty in the returns for investing in higher quality/performance products. Some successful examples of this include UL safety markings, Energy Star, and third-party reviews.

Although the U.S. is a differentiator, its ranking for the Made-in-Country Index is 10th and for the Ipsos National Brands Index it is 7th; thus, there is room for improvement for its branding. In addition to promoting the U.S. as a brand and maintaining/advancing the narrative on U.S. branding, there is a need to maintain and/or advance standards for "Made in USA" branding. If the standard for this labeling is too loose (i.e., allows widespread usage despite little value from the U.S.) it may result in watering down the label's value and meaning.

7.4. Research, Innovation, and Other Factors for Conducting Business

Manufacturing competitiveness depends on a number of factors that lie outside the walls of a factory. These include an educated and well-trained labor force, efficient transportation networks, efficient and reliable energy, the mitigation of the risk of supply disruption, and research and development. The specific needs of each of these is beyond the scope of this report; however, it is important to acknowledge the criticality of these factors and the need for tailoring them to facilitate a competitive manufacturing industry. The U.S. faces a number of challenges in these areas as illustrated in Section 5.1 on research and innovation and Section 5.2 on factors that facilitate innovation and production. For instance, the U.S. ranking for researchers per million and journal articles per capita have slipped. Further, the rankings from the IMD World Competitiveness Country Profiles shows that the U.S. rankings decreased for 85 % of the items measured with some slipping substantially. For instance, technological infrastructure went from 3rd in 2016 to 21st in 2025 and basic infrastructure went from 5th to 24th.

7.5. Summary

The opportunities for advancing national manufacturing competitiveness that were discussed above can be summarized in the following bullets:

- Advancing competitiveness for a selection of industries rather than all industries can avoid overextension or dispersing of resources across many initiatives and losing the focus needed for competitiveness. Sectors that are either critical to the nation or result in higher incomes/profits provide an opportunity for magnifying returns for competitiveness investments. These industries might include those that are the following:
    - Products critical to national and/or economic security
    - Products where there is great value resulting from differentiation (e.g., product quality)
    - Critical supply chain items for the previous two categories
- Managing the risk posed by supply chain disruption for moderately critical supply chain items to source products from lower risk suppliers can reduce costs and losses due to disruption.
- Developing strategic plans for public investments (e.g., standards, methods, technologies, and tools) can result in high-return systems of improvement. These types of systems include the following:
    - Creating comprehensive plans from the initial stages of project development to dissemination and adoption by manufacturers for granular levels of investment (e.g., investments less than $1 million).
    - Advancing forecast accuracy for granular levels of investment analysis (e.g., those less than $1 million).
    - Developing a system of continuous improvement where predictions of impact are validated to recalibrate prediction methods and inform future projects.
    - Incorporating plans for technology diffusion across the industry.
    - Engage in purpose driven economic analysis that motivates manufacturers to adopt innovations when they are cost effective, guides public investments by identifying the highest impact solutions, and justifies investments by showing impact and/or returns.
- Increasing the accuracy of investment predictions for manufacturing can guide manufacturers in adopting new technologies when they are cost effective and avoiding them when they are not. Increasing accuracy includes the following:
    - Developing and implementing standardized classification systems for collecting/analyzing economic data, including the following:
        - Classification of investments to collect data and systematically study/learn from past investments
        - Classification of manufacturing industry costs to collect/analyze data on the impact of projects and to predict/forecast investment returns

    - Developing and implementing standard methods for investment analysis that can be implemented by non-experts because there are a vast number of investment decisions being made without expert insight.
    - Developing and implementing data tools and information on the various financial aspects of manufacturing that provide information that non-experts can understand.
- Ensuring that structural conditions in the economy (e.g., considering competing impacts) encourage productive investments can increase or magnify the returns for competitiveness investments.
- Producing better products faster and with fewer resources can be achieved by developing and implementing standards, technologies, methods, tools, and/or guides that advance the following:
    - Quality and performance of manufactured products
    - Cost of manufactured products
    - Cost of using manufactured products
- For countries that compete through differentiation (e.g., United States), competitiveness can be strengthened by creating and applying standards that make it easier to distinguish differences in product quality and performance. These standards help producers capture the value (e.g., profits) of higher-quality products. Such differentiation can be based on the following factors:
    - Quality and performance
    - Repairability and access to parts/components
    - Life expectancy
    - Cost of use (e.g., energy and maintenance)
- Advancing and maintaining competitive factors for conducting business can decrease costs and increase efficiency/productivity. These factors include the following:
    - An educated and well-trained labor force
    - An efficient transportation system
    - An efficient and reliable energy system
    - The mitigation of supply chain risks that are beyond the manufacturers control
- In addition to promoting the U.S. as a brand and maintaining/advancing the narrative on U.S. branding, maintaining and/or advancing standards for “Made in USA” branding can avoid diluting value.

8. Discussion

This report provides an overview of the U.S. manufacturing industry. There are 3 aspects of U.S. manufacturing that are considered: (1) how the U.S. industry compares to other countries, (2) the trends in the domestic industry, and (3) the industry trends compared to those in other countries. The U.S. remains a major manufacturing nation; however, other countries are rising rapidly. Manufacturing in the U.S. was significantly impacted by the 2000's recession and the 2020 economy.

The U.S. is a major contributor to global manufacturing, accounting for 15.1 %, making it the second largest, according to the United Nations Statistics Division National Accounts Main Aggregates Database, as seen in Table 8.1. U.S. compound real (i.e., controlling for inflation) annual growth between 1998 and 2023 was 1.6 %, which places the U.S. below the 50th percentile. This growth exceeded that of France, Australia, Japan, and Italy; however, it is slower than that for the world (3.8 %) and that of many emerging economies. It should be expected that the growth in emerging economies will continue to outpace those in developed economies, as they can use underutilized resources to achieve high growth rates.

The largest subsectors of U.S. manufacturing are chemical products; computer and electronic products; food and beverage, and tobacco products; and motor vehicles, bodies/trailers, and parts. China produces more for each of these except for the category that includes motor vehicles. China produces more than the U.S. in 9 of 11 subsectors for manufacturing and its manufacturing value added is on an upward trajectory with little signs of slowing. On a per person basis, the U.S. significantly outperforms China; however, China's populations is more than four times that of the United States. When aggregated together, U.S. and European manufacturing value added exceeds that of Eastern and South-eastern Asia (excluding Japan) for 7 of the 11 subsectors. Computer, electronic, and optical products is among those that Asia produces more value added. For a country such as the U.S. to maintain significant influence in manufacturing, it would likely need to rely in part on allying with other nations.

As suggested by the types of products produced, ranking as a national brand, and research activities (see Table 8.1), the U.S. tends to have strength as a differentiator rather than a cost competitor; that is, evidence suggests the U.S. tends to produce products that require more advanced technology that perform at higher levels, which is probably driven in part by higher education levels. As shown in Table 8.1, Germany, Japan, and to some extent South Korea tend to be differentiators as well. There might be some concern regarding U.S. rankings in some measures of research and innovation. Although the U.S. ranks 3rd in research and development expenditures as a percent of GDP (among the ten largest manufacturing countries), it ranks 21st in researchers per million people, 27th in journal articles per capita, and does not rank first in any item; whereas, Germany, Japan, South Korea, and China all rank first in one of the items. It is important to note that other countries in Table 8.1, which rank high in various metrics, also rank lower in journal articles per capita. Moreover, journal articles per capita may not be a strong measure of manufacturing innovation and/or competitiveness. The ranking of U.S. researchers per million might be more concerning.

An estimated 26.4 % of businesses indicated that finding qualified labor was having a negative impact on their business (Figure 5.11). In the World Economic Forum's Competitiveness Index, the U.S. ranked low in the expected years of schooling (30th) and pupil-to-teacher ratio in primary education (45th). Moreover, some indicators raise concern regarding human capital.

Between 2016 and 2025, 85 % or 17 of the 20 ranked items from the IMD World Competitiveness Country rankings went down for the U.S. Overall, the U.S. ranked 13th in this index. Additionally, the U.S. ranks 10th in the made-in-country index and 7th in the Ipsos National Brands Index, suggesting that U.S. products are seen positively, but is not among the very top, such as the top 3 or top 5. Germany performs quite well as it ranks 1st in the Made-in-country index and 2nd in the Ipsos National Brands index. For the last 10 years, it has also ranked 1st in the Competitive Industrial Performance Index while the U.S. ranks 6th.

Table 8.1: Rankings for a Selection of Metrics and Countries (Lower is Better)

	Metric	U.S.	Germany	Japan	South Korea	China
Branding	Made-in-Country Index	10	1	8	-	49
	Ipsos National Brands Index	7	2	1	-	-
Multi-Item Indices	Competitive Industrial Performance Index	6	1	8	4	2
	IMD Competitiveness Index	13	19	35	27	16
R&D metrics	Patent applications per million people T	2	5	3	4	1
	R&D Expenditures as % of GDP* T	3	8	6	2	12
	Researchers per million	21	13	12	1	47
	Journal articles T	2	4	6	9	1
	Journal articles per capita*	27	29	42	21	48
Output and Growth	Merchandise Exporters T	2	3	5	6	1
	Manufacturing value added	2	4	3	5	1
	Rank in 5-year compound annual growth in manufacturing value added*	142	175	168	114	35
	Manufacturing value added per capita T	4	2	3	1	8

Note: Shading is to aid in identifying high/low values.
* Rankings are not shown elsewhere.
T Among top 10 largest manufacturers

For public advancement of national competitiveness, concentration on a selection of industries can avoid overextension or dispersing of resources across many initiatives and losing the focus needed for competitiveness. Developing strategic plans for public investments (e.g., standards, methods, technologies, and tools) can result in high-return continuous systems of improvement that create increasingly accurate predictions of impact and increasingly higher levels of impact. Producing better products faster and with fewer resources can be achieved by developing and implementing standards, technologies, methods, tools, and/or guides that advance the following: quality and performance of manufactured products, cost of manufactured products, and cost of using manufactured products. For countries that compete through differentiation (e.g., United States), competitiveness can be strengthened by creating and applying standards that make it easier to distinguish differences in product quality and performance. These standards help producers capture the value (e.g., profits) of higher-quality products. Such differentiation can be based on the following factors: quality and performance; repairability and access to parts/components; life expectancy; and cost of use. Together with other strategies, these approaches can enhance manufacturing competitiveness by improving cost efficiency, increasing consumer benefits, and enabling differentiation of products.

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