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Productivity Growth: Trends and Policy Issues

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SUMMARY

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Productivity Growth: Trends and Policy Issues

Productivity is broadly defined as the ratio of output to inputs. With respect to the economy, productivity measures how efficiently goods and services can be produced by comparing the amount of economic output with the amount of inputs (e.g., labor, capital) used to produce goods and services. Gains in efficiency—that is, fewer inputs relative to output—mean growth in productivity. Productivity growth is typically the most consequential determinant of long-term economic and income growth and substantive improvements in individual living standards.

There are two prominent measures of economic productivity: labor productivity (a single-factor productivity measure) and total factor (sometimes called multifactor) productivity (TFP). *Labor productivity* is defined as the ratio of real (inflation-adjusted) output per labor hour. TFP is a measure of productivity that compares real private business sector output to the level of combined inputs (labor and capital for sector estimates and additionally energy, materials, and purchased services for industry estimates) used to produce goods and services.

Policy can affect productivity growth by affecting its determinants: human capital, physical capital, technological growth, and other efficiency gains. One-time improvements in the determinants will lead to one-time increases in productivity. Sustained improvements and increases in the determinants are required for longer-term increases in the growth rate of productivity. Examples of policies that can impact productivity growth include those related to immigration, education, taxes, public investment, interest rates, patent law, industry support, technology, and trade.

Recent trends in productivity growth have generally been positive, with an uptick in growth during the current business cycle (beginning in 2020) as compared to the previous business cycle. Over a longer-term horizon, productivity growth has been decelerating, matched by a long-term deceleration in real economic growth. Hypotheses to explain this downturn in productivity growth include a decline or uneven pattern in innovation, lingering but temporary effects from the 2008 financial crisis, issues in the way that productivity measures are calculated, barriers to competition, increasing income inequality, decelerating population growth and an aging population, and bottlenecks within and between sectors.

Given that lagging long-term economic growth is due, in part, to trends in productivity growth, policymakers may be interested in economic events and policies that could accelerate productivity growth over the long term. While there are many policies and shocks that can affect productivity growth, economists have highlighted a few recent developments and policy tools that could affect such a change. Congress may consider what role it could or should play in each area.

First, the United States has long used industrial policy—policies that promote chosen domestic industries through specific patterns of trade and domestic production—and opinions vary on whether these policies raise or reduce productivity growth. Such policies have included tariffs and industry-specific public investment and subsidies. Industrial policy could reduce productivity growth by distorting competition and efficiency or crowding out private investment, depending on how it is implemented and which specific industries or firms are targeted. On the other hand, it could increase productivity if it fills in gaps where private investment is too low because the market has not fully priced in the benefits of a particular economic activity.

Second, certain trends resulting from the COVID-19 pandemic could have contributed to upticks in productivity growth since 2020. These include increased telework and rates of business formation. There is significant debate as to whether increased telework during and since the pandemic resulted in increases in productivity and whether any growth effects would be permanent. Higher rates of business formation are typically associated with increases in productivity, and rates are still elevated compared to pre-pandemic.

Third, some have lauded artificial intelligence (AI)—which has become front and center of many policy debates in recent years with the more widespread use of generative models—as a potentially transformative technology that could spur productivity growth in a way not seen since the information technology boom of the 1990s. There is some evidence to suggest that AI can improve labor productivity, particularly on a task-based scale, but work-based AI usage is likely not widespread enough at this point to provide any immediate boost.

Contents

Figures

Tables

Contacts

Introduction

An economy is a system within which actors make, sell, and buy goods and services. This report focuses on the making part, known as "production." The U.S. economy is a comparatively large and strong economy in large part, because of how much it is able to produce. The U.S. economy, as is true of any economy, can be constrained by its factors of production—how much land, labor, and capital are available as inputs in the production process. More inputs clearly produce more output, but how can an economy sustainably increase its output when it has only so many workers, so much land, so many machines? In short, it can employ those inputs more efficiently. *Productivity* describes just that: how efficiently inputs produce output.

Productivity, and how quickly it grows, is incredibly important to the economy over the long run. However, it is also one of the more amorphous and difficult to measure economic indicators. As a result, it tends not to be a focal point in short-term economic and policy discussions. This report highlights the importance of productivity and the ways in which Congress has a key role to play in future productivity growth. As with most policy goals, Congress may face trade-offs in targeting productivity. Unlike many policy goals, productivity goals may be accomplished using a wide array of policies employed separately or in tandem. The actions Congress takes now with regard to productivity can play a pivotal role in the future health of the economy and those living within it.

This report provides background on productivity and how it is measured, discusses the broad policy options available to Congress to affect productivity growth, and analyzes productivity trends and related policy issues. The report concludes with further questions that Congress faces in relation to the content of the report and considerations for policymakers moving forward.

Background: What Is Productivity and Why Is It So Important?

Productivity is broadly defined as the ratio of output to inputs. With respect to the economy, productivity measures how efficiently goods and services can be produced by comparing the amount of economic output with the amount of inputs (e.g., labor, capital) used to produce goods and services.

Productivity Growth and Long-Term Economic Growth

Economist Paul Krugman famously said, "Productivity isn't everything. But in the long run, it is almost everything."[1] Economists believe productivity growth to be a primary driver of long-term economic and income growth and improvements in living standards.[2] As productivity increases, society can produce more goods and services with the same level of resources, which, all else

[1] See, for example, Christopher Colford, "Productivity for Prosperity: 'In the Long Run, It Is Almost Everything,'" *World Bank Blogs*, November 15, 2016, https://blogs.worldbank.org/en/psd/productivity-prosperity-long-run-it-almost-everything.

[2] Standard models suggest that productivity growth (and technological growth) accounts for most of long-term economic growth, but there has been some debate. For example, see Dale W. Jorgenson et al., *Educational Attainment and the Revival of U.S. Economic Growth*, National Bureau of Economic Research (NBER), December 18, 2018, p. 25, https://www.nber.org/system/files/chapters/c13695/c13695.pdf.

equal, increases incomes and access to goods and services, including access to additional leisure time.

A one-time increase in productivity will contribute to a one-time increase in the size of the economy. Similarly, a sustained increase in productivity—a positive productivity growth rate—will contribute to a sustained increase in the size of the economy—a positive economic growth rate. (Economic growth is most typically measured using gross domestic product [GDP], a measure of total spending or total production in the domestic economy.) For this reason, sustained increases in productivity (or a positive productivity growth rate) and ideally a high, positive growth rate are crucial for the health of the long-term economy and the individuals participating in it.

Short-Term vs. Long-Term Economic Growth

The determinants of short- and long-term economic growth differ. While economists often look at measures such as GDP in gauging the short- and long-term health of the economy, they typically ask slightly different questions about such measures. Short-term growth can be demand-driven, while long-term growth is largely supply-driven. For example, fluctuations in spending can lead to short-term changes in GDP (a measure of total spending). However, a change in spending—even a dip severe enough to cause a recession—does not affect the long-term trajectory of the economy. Long-term growth is about the productive capacity of the economy—how many goods and services the economy is able to supply. This long-term growth rate is ultimately determined by the amount and efficiency of labor, capital, and innovation. Productivity affects growth through supply-side factors and, therefore, is a factor in long-term growth. Productivity can affect both short- and long-term growth, with a one-time increase in productivity potentially causing a one-time increase in production and sustained productivity growth leading to continual increases in the productive capacity of the economy.

As a result of the differing determinants of short- and long-term growth, policies that enhance short-term growth can, at times, be a drag on longer-term growth and vice versa. Policymakers may often be faced with trade-offs between the two.

Measuring Productivity

There are two prominent measures of economic productivity: labor productivity (a single-factor productivity measure) and total factor (sometimes called multifactor) productivity (TFP). Both measures are calculated by the Bureau of Labor Statistics (BLS). Labor productivity and TFP are concepts from economic theory; the BLS measurements are statistics that approximate these concepts. Estimates of productivity are available by major sectors and subsectors (including business, nonfarm business, nonfinancial corporations, total manufacturing, durable goods manufacturing, and nondurable goods manufacturing) as well as major and detailed industries.[3]

Some of the most commonly cited productivity measures, such as labor productivity, are for the nonfarm business sector. Nonfarm business sector output is defined as GDP excluding outputs from farms, general government, nonprofit institutions, and private households. Nonfarm businesses accounted for roughly 76% of GDP in 2024 (not adjusted for inflation).[4]

[3] For detailed discussion of methodologies for major sector and subsectors and detailed industries data, see Bureau of Labor Statistics (BLS), "Productivity Measures: Business Sector and Major Subsectors," *Handbook of Methods*, https://www.bls.gov/opub/hom/msp/home.htm; and BLS, "Industry Productivity Measures," *Handbook of Methods*, https://www.bls.gov/opub/hom/inp/home.htm. For productivity data, see BLS, "Productivity," https://www.bls.gov/productivity/data.htm.

[4] BLS, "Technical Notes," June 5, 2025, https://www.bls.gov/news.release/prod2.tn.htm.

Labor Productivity

Labor productivity is defined as the ratio of real (inflation-adjusted) output per labor hour worked. Growth in labor productivity depends upon how real output and hours worked change in relation to each other. For example, labor productivity could grow because output increases, hours worked decreases, or some combination of the two.[5] BLS releases estimates on a quarterly basis.

Total Factor Productivity

The TFP measure compares real private business sector output[6] to the level of combined inputs (labor and capital for sector estimates and additionally energy, materials, and purchased services for industry estimates) used to produce goods and services.[7] BLS releases estimates of TFP annually.

TFP, unlike labor productivity, differentiates among workers with respect to educational attainment and work experience. Therefore, changes in labor force composition that increase workers' efficiency (e.g., increased work experience) would be registered not as an increase in TFP but as an increase in labor productivity. Likewise, increases in the capital stock would boost BLS's labor productivity measure but not the measure of TFP. TFP is designed to measure factors that are not inputs already specifically accounted for in the theoretical frameworks—including labor, capital, energy, and material—used to design productivity calculations. Such factors include technological change, efficiency improvements, returns to scale, and reallocation of resources, among others.[8] Determining how these other factors affect growth and are affected by policy can be important for policymakers in considering and shaping economic policies.

Data Limitations

Measuring outputs and inputs, and thus productivity, involve challenges. Adjusting nominal output figures for inflation can be complicated, especially during periods of rapid technological progress when the introduction of new products and services and improvements in their quality complicate measuring inflation.[9] Depending on the construction of the price index, estimates may understate or overstate actual real output.

Gaps in the data available to BLS also complicate the measurement of labor inputs. The primary source of labor data includes figures only for total number of employees and average weekly hours of production and nonsupervisory workers. BLS has to estimate the number of hours worked by nonproduction and supervisory workers. Additionally, labor hours for the self-employed and unpaid family workers (work for a family business for no pay) must be forecasted from Internal Revenue Service data that lag by about three years. As new types of work, such as gig work, become more popular, there may be additional challenges in estimating labor hours.

BLS faces additional challenges when determining the value of capital inputs for TFP. To calculate TFP, BLS uses the total value of the services provided by productive capital in the economy rather than the amount of physical capital. BLS uses a number of assumptions to first determine the level of productive capital in the economy by applying depreciation schedules to physical capital based on its age. Then BLS must determine the value of the

[5] BLS, "What's the Difference Between Labor Productivity and Total Factor Productivity?," https://www.bls.gov/productivity/educational-material/labor-productivity-total-factor-productivity-comparison.htm.

[6] BLS defines the private business sector as all privately owned establishments that are operated for profit. It does not include government enterprises. See, BLS, "Productivity Glossary," https://www.bls.gov/productivity/glossary.htm.

[7] BLS, "What's the Difference Between Labor Productivity and Total Factor Productivity?"

[8] BLS, "Productivity Measures."

[9] If changing quality and new products are not taken into account and adjusted for, inflation could be overstated. If a product improves in quality, for example, more utility can be obtained from that product, which would decrease the cost of living, all things equal. If the increase in price of that product is entirely attributed to inflation as opposed to the increase in quality, this will overstate inflation. Statistical agencies do typically attempt to adjust for quality in inflation measures. For example, see BLS, "Quality Adjustment in the CPI," https://www.bls.gov/cpi/quality-adjustment/.

services provided by that level of capital. Estimates of TFP are likely less precise than estimates of labor productivity due to the additional assumptions incorporated into estimating TFP.

Another limitation with respect to TFP is that it is measured as a residual of a production function (an equation that illustrates the output and its determinants), meaning it is equal to whatever changes in output are not explained by changes in capital and labor.[10] Given that TFP is a residual, it is not directly observed. Therefore, any errors in measuring capital and labor will result in errors in the measurement of TFP.

Policy Options to Affect Productivity Growth

"Productivity policy" does not exist in the way that tax, immigration, education, trade, or many other categories of policy do, as policy tends to not be enacted with the explicit goal of increasing productivity growth. However, productivity is often considered to some extent as part of other policy areas. Additionally, even if policymakers never considered productivity growth, many policies would still directly affect it, highlighting how important such policy decisions can be for the economy.[11] This section discusses the specifics of how such general types of policies affect productivity growth.

Policy can affect productivity growth by affecting its determinants: human capital, physical capital, technological growth, and other efficiency gains. This section details some of the general types of policies that can affect each determinant. It is not necessarily all inclusive and does not discuss specific legislation. This section also focuses on the effects of certain policies on productivity growth and its determinants—but not other ways they could affect the economy. Unless otherwise noted, the sections on human capital and physical capital refer to labor productivity, and the sections on technological growth and efficiency gains refer to TFP.

Human Capital

Improvements in the abilities and efficiency of individual workers, often referred to as increases in human capital, allow each individual worker to produce more goods and services per hour and therefore increase labor productivity. Increases in human capital generally result from increased education, work experience, on-the-job training, and so on.

Any federal policy that could affect the composition or distribution of worker skill and knowledge levels could affect the productivity growth rate. For example, immigration policy can alter the composition (as well as the size) of the labor force. According to the 2024 BLS report on foreign-born workers, native-born and foreign-born workers differ in what types of jobs each group tends to be employed in.[12] In 2024, foreign-born workers were more likely than native-born workers to work in service; natural resources, construction, and maintenance; and production, transportation, and material moving occupations. They were less likely to work in management, professional, and related and sales and office occupations. To the extent that the skillsets and knowledge of foreign-born workers better align with the occupations in which they over-index, an increase in immigration, could, on net, result in an increase in productivity. There is debate about this topic, but some research has shown evidence for increased productivity on the whole,

[10] BLS, "Productivity Measures."

[11] For example, two pieces of major legislation in the 117th Congress, the Infrastructure and Investment Jobs Act (P.L. 117-58) and the Inflation Reduction Act of 2022 (P.L. 117-169), both had notable components that directly impact productivity growth, such as physical infrastructure and research and development spending.

[12] BLS, *Foreign-Born Workers: Labor Force Characteristics—2024*, May 20, 2025, https://www.bls.gov/news.release/pdf/forbrn.pdf.

although with the potential for decreased capital intensity and increased adoption of unskilled-biased technology.[13]

Education policy generally—and worker education and training programs specifically—can affect the knowledge and skills base of workers, thereby affecting productivity. Education rates, the overall level of education of workers, and workers' skills development can all affect human capital and productivity. Theory suggests that, on average, the higher the level or degree of educational attainment—be that through traditional schooling or specific worker training programs—the higher the labor productivity. More education and training can, for example, allow workers to more efficiently engage with the tools and technology they use to produce goods and services. A recent study suggests that policies aimed at raising educational performance could result in long-term productivity gains across economies, including in the United States.[14]

Physical Capital

Increases in the level of physical capital, such as structures and equipment, available to workers also result in productivity growth. Physical capital complements labor, allowing workers to produce goods and services faster. The level of physical capital in the economy depends on investment spending on new physical capital and how quickly physical capital is worn out. When investment spending on new capital exceeds the depreciation of old capital, the total amount of physical capital in the economy increases.

Policies that affect the amount of physical capital in the economy can affect productivity growth. There are several ways that policies could affect the amount of physical capital. First, a policy could result in direct public investment in physical capital. Second, a policy could affect the rate of private capital investment. Third, because investment is financed through saving, a policy could affect the national—public and private—saving rate or the trade balance, either of which would, in theory and absent other changes, affect the investment rate.[15]

While many potential policies could directly or indirectly affect public and private investment in capital, some of the overarching types could include tax, infrastructure, and interest rate policies. Tax policies can change incentives to save or invest, although the extent to which this occurs is dependent on the specifics of the policy and the types of individuals, transactions, or corporations it targets. Tax policy can affect government saving directly—if government revenue decreases while spending stays the same, government saving decreases—but evidence suggests the effects on private saving may not be as pronounced.[16] Additionally, individual firms may respond to changes in tax policy differently in their capital investment behavior, although evidence suggests that, on the whole, investment rates are negatively related to corporate tax rates.[17]

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[13] Giovanni Peri, *The Effect of Immigration on Productivity: Evidence from US States*, NBER, November 2009, https://www.nber.org/papers/w15507; and Penn Wharton Budget Model, "The Effects of Immigration on the United States' Economy," June 27, 2016, https://budgetmodel.wharton.upenn.edu/issues/2016/1/27/the-effects-of-immigration-on-the-united-states-economy.

[14] Balázs Égert et al., "Quantifying the Effect of Policies to Promote Educational Performance on Macroeconomic Productivity," Organisation for Economic Co-operation and Development (OECD), December 22, 2023, p. 38, https://www.oecd.org/en/publications/quantifying-the-effect-of-policies-to-promote-educational-performance-on-macroeconomic-productivity_b00051cc-en.html.

[15] In standard macroeconomic classical theory, investment is a function of interest rates and equals national saving minus net exports. See Gregory Mankiw, *Macroeconomics*, 11th ed. (Worth Publishers, 2022), p. 132.

[16] CRS Report R48092, *Can Tax Policy Increase Saving?*, by Jane G. Gravelle and Donald J. Marples.

[17] Tibor Hanappi et al., "How Does Corporate Taxation Affect Business Investment? Evidence from Aggregate and (continued...)

Infrastructure policy can result in direct investment in capital from both public and private sources. Infrastructure does not have a set definition but typically refers to "long-lived, capital-intensive systems and facilities."[18] Public infrastructure spending on physical capital—such as structures, equipment, and software—is generally thought to complement private capital investment.[19] As a result, economists tend to agree that increases in federal physical infrastructure spending increase private sector productivity, although the degree to which productivity is affected is dependent on the specific types of infrastructure projects funded.[20]

Finally, capital investment is a function of interest rates, which determine how "expensive" it is to borrow money to fund the replacement, upgrade, or purchase of new capital. Interest rate policy is part of monetary policy, which is under the purview of the Federal Reserve.[21] Congress does not directly set interest rates, although fiscal policy can affect interest rates indirectly. Deficit spending, for example, can result in higher interest rates, as government borrowing increases demand for loanable funds.[22]

Technological Progress

Technological progress is potentially the most important and hardest-to-measure source of productivity growth. For the purposes of this report, technological progress includes innovation that results in new or more efficient technologies. The underlying drivers and policies that fuel technological progress can be less obvious than those that fuel improvements in human and physical capital. One source of technological progress is research and development (R&D), which economists understand to be one of the main drivers of technological breakthroughs. Policy that either directly invests in R&D or incentivizes private R&D (e.g., patent laws, targeted tax incentives or subsidies) can therefore affect productivity.

The empirical link between R&D spending and productivity is fairly well established. Analysis of R&D investment in the United States from 1988 through 2023 shows that R&D has contributed to TFP between 0.08% and 0.38% per year.[23] Other evidence suggests that an increase in R&D appropriations could result in positive productivity growth for at least 15 years.[24]

Other Sources of General Efficiency Gains

Other innovations not directly related to traditional technology can impact productivity growth. For example, efficiency gains from new production processes and organizational structures for

Firm-Level Data," OECD, July 19, 2023, https://www.oecd.org/en/publications/how-does-corporate-taxation-affect-business-investment_04e682d7-en.html.

[18] CRS In Focus IF10592, *Infrastructure Investment and the Federal Government*, by William J. Mallett.

[19] Penn Wharton Budget Model, "Options for Infrastructure Investment: Dynamic Modeling," February 9, 2018, https://budgetmodel.wharton.upenn.edu/issues/2018/2/9/infrastructure-investment-dynamic-modeling.

[20] Congressional Budget Office, Effects of Physical Infrastructure Spending on the Economy and the Budget Under Two Illustrative Scenarios, August 2021, https://www.cbo.gov/publication/57407.

[21] For information on monetary policy, see CRS In Focus IF11751, *Introduction to U.S. Economy: Monetary Policy*, by Marc Labonte.

[22] For more information on the economic impacts of fiscal policy, see CRS Report R45723, *Fiscal Policy: Economic Effects*, by Lida R. Weinstock.

[23] Dominique Guellec and Bruno van Pottelsberghe de la Potterie, "R&D and Productivity Growth: Panel Data Analysis of 16 OECD Countries," OECD, June 14, 2001, https://www.oecd-ilibrary.org/science-and-technology/r-d-and-productivity-growth_652870318341.

[24] Andrew J. Fieldhouse and Karel Mertens, "Government-Funded R&D Produces Long-Term Productivity Gains," Federal Reserve Bank of Dallas, February 13, 2024, https://www.dallasfed.org/research/economics/2024/0213.

companies through increased entrepreneurship, competition, or trade can increase productivity. In economic theory, the economy is able to reach its full productive capacity when all resources are allocated most efficiently. Assumptions of the efficient allocation of resources include perfect competition and free trade.[25]

While the exact mechanisms that translate increases in competition to increases in productivity are not well defined, evidence does still generally show that increases in competition beget increases in productivity. Possible explanations include a reduction in managerial slack, the exit of inefficient establishments, greater specialization, reduction of opportunity costs of business investment, and increased surpluses from innovation to firms.[26]

Phenomena such as increased trade or entrepreneurship can increase competition and productivity. In theory, trade can increase competition among firms, because the number of firms increases when foreign firms are active in the same markets as domestic firms. This could lead to the reallocation of resources toward the most productive firms and incentivize investment in order to better compete.[27] Trade also allows for a country with a *comparative advantage* in producing a good to do so and to import those goods that it does not have relative strength in, allowing for a more efficient pattern of domestic production. Entrepreneurship—the creation and growth of new businesses—can also increase competition among firms, lead to employment growth, and potentially increase R&D and innovation, resulting in increased productivity.[28]

Policies such as antitrust policies can increase competition and productivity.[29] Other types of policies may impact entrepreneurship and the rate of business formation, which, as described, can lead to increased competition. For example, federal programs that support business incubators and accelerators (or other types of federal support for entrepreneurial development activities and regional economic development) may have a positive impact on entrepreneurship and competition.[30]

Recent Developments and Policy Issues

The following sections detail current policy issues and debates regarding productivity, with discussion of productivity data and trends as relevant.

[25] Economic efficiency may not always be the goal of policy. This paper does not make any value judgements about "optimal" societal outcomes. It merely addresses what economic theory would determine to be economically optimal outcomes.

[26] Thomas J. Holmes and James A. Schmitz Jr., "Competition and Productivity: A Review of Evidence," Federal Reserve Bank of Minneapolis, February 2010, https://core.ac.uk/download/pdf/6247637.pdf; and Matthew Backus, "Why Is Productivity Correlated with Competition?," NBER, April 2019, https://www.nber.org/papers/w25748.

[27] European Central Bank, "Does Trade Play a Role in Helping to Explain Productivity Growth?," 2017, https://www.ecb.europa.eu/pub/pdf/other/ebbox201707_01.en.pdf.

[28] See CRS Report R48254, *Entrepreneurship in Regional Economic Development*, by Julie M. Lawhorn and Adam G. Levin; and Chen Yeh, "Why Are Startups Important for the Economy?," Federal Reserve Bank of Richmond, February 2023, https://www.richmondfed.org/publications/research/economic_brief/2023/eb_23-06.

[29] For example, see Laurent Cavenaile et al., "The Dynamic Effects of Antitrust Policy on Growth and Welfare," *Journal of Monetary Economics*, vol. 121 (July 2021), pp. 42-59, https://www.sciencedirect.com/science/article/abs/pii/S0304393221000490.

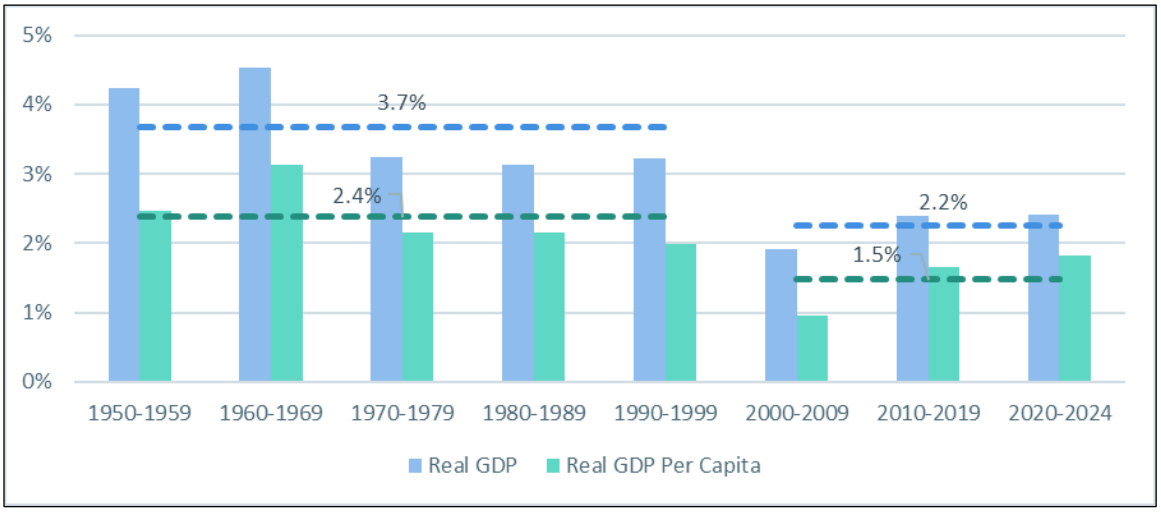
[30] For example, see CRS Report R48254, *Entrepreneurship in Regional Economic Development*, by Julie M. Lawhorn and Adam G. Levin; CRS In Focus IF12793, *Federal Assistance for State and Local Entrepreneurship Development Policies and Recent Legislation*, by Julie M. Lawhorn and Adam G. Levin; and CRS In Focus IF12794, *The Role of Business Incubators and Accelerators in Entrepreneurship Support*, by Adam G. Levin.

Long-Term Economic Growth Slowdown

The growth rate of real GDP and real GDP per capita (population adjusted) has slowed over the long term, as shown in **Figure 1**. Average growth for both figures was relatively high in the 1950s and 1960s, lower in the 1980s and 1990s, and lower still since 2000. While the downward trend has not been precisely consistent from decade to decade, the general pattern has shown decline. Considering longer-term averages across decades highlights this point: Average annual growth from 1950 to 1999 was considerably higher than 2000-2024 for both measures (3.7% vs. 2.2% for real GDP and 2.4% vs. 1.5% for real GDP per capita). Given that long-term economic growth—typically measured using GDP—is a main indicator of the health of the economy and determinant of individual well-being, economists are generally concerned with this downward trend.[31]

Figure 1. Average Growth in Real GDP and Real GDP per Capita by Decade

1950-2024



Source: CRS calculations based on Bureau of Economic Analysis data.

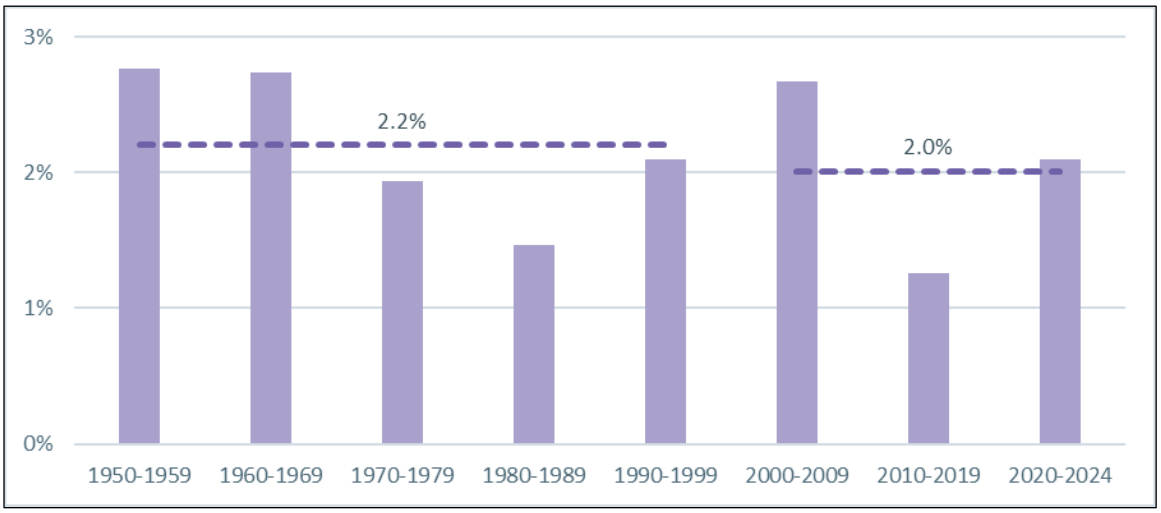
Note: The blue dotted line represents the trend for real GDP, and the green dotted line represents the trend for real GDP per capita.

This downward trend in GDP growth has occurred alongside similar, albeit more volatile, trends in labor productivity and TFP growth (see **Figure 2** and **Figure 3**). Both productivity measures generally showed a dip in the 1970s and 1980s, an increase in the 1990s and early 2000s owing to the technology boom, another dip coinciding with the 2008 financial crisis and subsequent recovery, and then a post-pandemic increase. (The post-pandemic acceleration in productivity growth is discussed in a subsequent section.) Despite this more varied pattern, the trend of lower growth since 2000 holds for both measures. Labor productivity grew at an average annual pace of 2.2% from 1950 to 1999 and 2.0% from 2000 to 2024. The decrease was more apparent for TFP, going from average growth of 1.4% to 0.9%.

[31] For example, see M. Ayhan Kose and Franziska Ohnsorge, "Fall Long-Term Growth Prospects: Trends, Expectations, and Policies," World Bank Group, 2024, https://openknowledge.worldbank.org/server/api/core/bitstreams/369a477f-dc9b-4a8a-895a-3ff6d238de25/content.

Figure 2. Average Growth in Labor Productivity by Decade

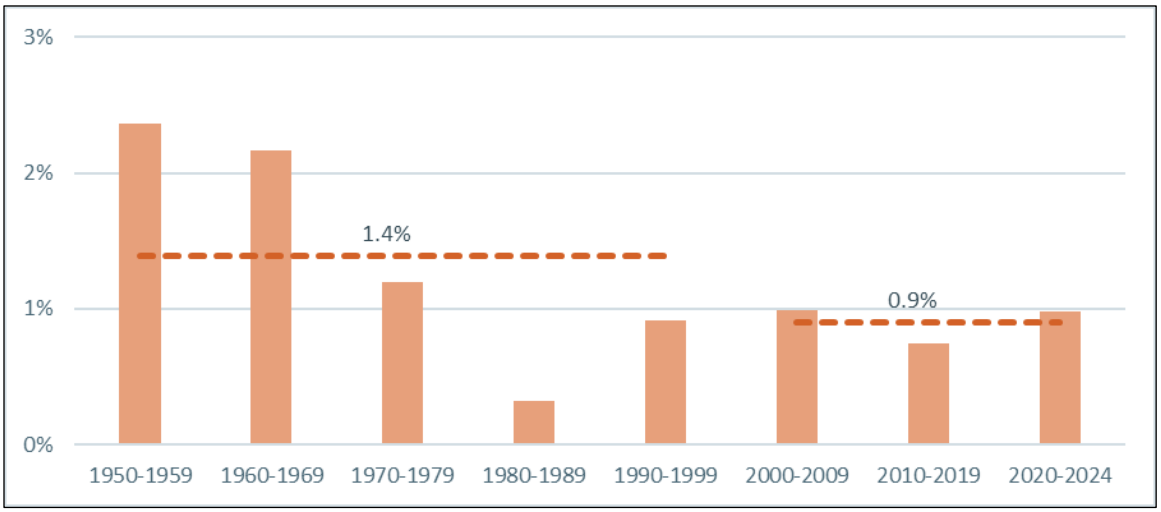
1950-2024



Source: CRS calculations based on Bureau of Labor Statistics data.

Figure 3. Annual Growth and Long-Term Trend in TFP

1950-2024



Source: CRS calculations based on BLS data.

One contributing factor to the decline in long-term GDP growth and per capita growth (which accounts for population deceleration) is the longer-term downward trend in productivity growth. As discussed previously, economic output is the result of the inputs of labor, capital, and productivity growth. BLS breaks down each input's contribution to output growth, as measured by the private business sector. As shown in **Table 1**, productivity growth as measured by TFP has been a significant component of output growth over the three most recently completed business cycles. The deceleration in output growth during the 2007-2019 cycle is largely explained by the deceleration in TFP during this period.

Table 1. Contributions of Capital, Labor, and TFP to Output Growth

	1990-2000	2000-2007	2007-2019
Private Business Output Growth	4.00%	2.80%	2.10%
Capital	1.49 percentage points (pp)	1.18pp	0.91pp
Labor	1.43pp	0.25pp	0.58pp
TFP	1.03pp	1.24pp	0.56pp

Source: Bureau of Labor Statistics (BLS), "Total Factor Productivity Major Industry Contributions to Output," https://www.bls.gov/productivity/highlights/contributions-of-total-factor-productivity-major-industry-to-output.htm.

Notes: Per BLS, "contributions may not sum due to aggregation, rounding, and integration of top line to industry."

A number of hypotheses have been proposed to explain the recent downturn in productivity growth. Some have argued that the current slowdown is simply a return to productivity growth rates from the 1970s and 1980s (from 1970 to 1989, average annual labor productivity growth was 1.7%, and average annual TFP was 0.8%) after significant gains in productivity as a result of the information technology revolution of the 1990s. According to this view, firms reorganized and incorporated these new technologies, causing a spike in productivity growth but then a return to a slower pace.[32]

In the same vein, others suggest that more recent technologies and innovations have been less transformative than the innovations of the 1990s. For example, the advent of smartphones allows an individual to carry a computer at all times, but the productivity gains achieved through this technology are likely smaller than the productivity gains from the widespread availability of computers in the workplace. Some observers disagree that innovation is providing smaller gains and instead argue that innovative firms have not been able to scale up to take advantage of their innovations, resulting in lower productivity growth within these firms' sectors. A new wave of discoveries with more direct impacts on productivity could reverse the slowdown, although the likelihood of this occurring is unknown.[33] One such potential technology, artificial intelligence, is discussed in a subsequent section. Another view contends that innovations do not (and have not) yielded exponential but rather additive growth to productivity, resulting in decelerating growth over time.[34]

Other observers are more optimistic, suggesting that the current slowdown is a temporary phenomenon resulting from lingering aftereffects of the 2008 financial crisis or the tendency of innovation to come in waves.[35] Still others suggest that there is no productivity slowdown; rather, the changing nature of the economy has rendered productivity measures less accurate. This view contends that the current productivity measures are less able to capture productivity gains from advances in digital goods and services. Issues arise because many goods and services that

[32] BLS, "The U.S. Productivity Slowdown: An Economy-Wide and Industry-Level Analysis," April 2021, https://www.bls.gov/opub/mlr/2021/article/the-us-productivity-slowdown-the-economy-wide-and-industry-level-analysis.htm.

[33] BLS, "The U.S. Productivity Slowdown."

[34] Thomas Philippon, *Additive Growth*, NBER, May 2022, https://www.nber.org/papers/w29950.

[35] For example, see John G. Fernald et al., "The Productivity Slowdown in Advanced Economies: Common Shocks or Common Trends?," Federal Reserve Bank of San Francisco, February 1, 2023, https://www.frbsf.org/research-and-insights/publications/working-papers/2023/02/the-productivity-slowdown-in-advanced-economies-common-shocks-or-common-trends/; and BLS, "The U.S. Productivity Slowdown."

individuals once paid for are now provided for free through the internet, which affects estimates of total output. (GDP is a measure of total expenditures.) For example, free calls through videoconferencing applications may replace long-distance phone service. If a larger share of goods and services is now being provided for free through the internet, output growth may understate gains in well-being.[36]

Other explanations for the slowdown in productivity growth include barriers to competition and growing income inequality, population growth decline, and bottlenecks resulting from uneven innovation between and within sectors, among others.[37] The slowdown is likely a result of several factors in combination.

Because the decline in long-term GDP growth is explained, in part, by the similar decline in long-term productivity growth, reversing the trend in productivity growth could directly help to increase long-term GDP growth as well. There are a variety of policy options available to Congress should it wish to address productivity growth specifically, as discussed in the above "Policy Options to Affect Productivity Growth" section. Congress could consider which types of policies may produce the biggest or longest lasting impacts on productivity growth. For example, Congress may choose to focus on fostering technological progress, as much of productivity gains have been attributed in large part to innovations, such as the information technology boom in the 1990s.[38] On the other hand, Congress may wish to focus on fostering recent trends that may be driving productivity gains, such as increases in business formation since 2020.[39]

How Does the United States Compare to Other Countries?

Despite the longer-term downward trend in U.S. productivity growth, the United States ranks relatively high compared to other countries in terms of both labor productivity and TFP.[40] As a result, the United States also has a comparatively high GDP per capita.[41] While the United States may benefit from its relatively high productivity and growth, the more salient point may be that global productivity and growth have been decelerating over time, which will have consequences for the global economy, including the United States. According to the International Monetary Fund (IMF), the deceleration in growth in the 21st century was driven by a global slowdown in TFP, which accounted for more than half of the decline in growth.[42] Discussions in this report, therefore, may be broadly applicable to other economies.

[36] Aaron Betz, "CBO's Economic Forecast: Understanding Productivity Growth," *CBO*, July 16, 2024, https://www.cbo.gov/system/files/2024-07/60515-NABE.pdf.

[37] BLS, "The U.S. Productivity Slowdown"; Hiroshi Inokuma and Juan M. Sanchez, "From Population Growth to TFP Growth," Federal Reserve Bank of St. Louis, May 2024, https://doi.org/10.20955/wp.2023.006; and Daren Acemoglu et al., "Bottlenecks: Sectoral Imbalances and the US Productivity Slowdown," June 27, 2023, https://economics.mit.edu/sites/default/files/2023-06/Bottlenecks%20-%20Sectoral%20Imbalances%20and%20the%20US%20Productivity%20Slowdown_0.pdf.

[38] Robert Shackleton, *Total Factor Productivity Growth in Historical Perspective*, CBO, March 2013, https://www.cbo.gov/sites/default/files/113th-congress-2013-2014/workingpaper/44002_TFP_Growth_03-18-2013_1.pdf.

[39] Luke Pardue, "In Brief: The Recent Rise in US Labor Productivity," Aspen Economic Strategy Group, April 25, 2024, https://www.economicstrategygroup.org/publication/in-brief-us-labor-productivity/.

[40] Klaas de Vries, "US Continues to Lead Global Productivity Race," The Conference Board, April 21, 2022, https://www.conference-board.org/publications/Productivity-April2022; James Marple and Brett Saldarelli, "America's Labor Productivity Sets It Apart," TD, April 30, 2024, https://economics.td.com/us-labor-productivity; and Robert Zymek, "Total Factor Productivity: How Can Economies Do More With Less?," International Monetary Fund (IMF), September 2024, https://www.imf.org/en/Publications/fandd/issues/2024/09/back-to-basics-total-factor-productivity-robert-zymek.

[41] World Bank Group, "GDP per Capita (Current US$)," https://data.worldbank.org/indicator/NY.GDP.PCAP.CD.

[42] IMF, "Slowdown in Global Medium-Term Growth: What Will It Take to Turn the Tide?," in *World Economic Outlook*, April 2024, https://www.imf.org/-/media/Files/Publications/WEO/2024/April/English/ch3.ashx.

In summary, longer-term downward trends in productivity have contributed to a longer-term downward trend in economic growth. Reasons for this productivity slowdown are numerous and debated. As a result of productivity's importance to the economy, policymakers may wish to increase productivity growth. Currently, two of the commonly discussed and debated topics when it comes to how to increase productivity growth are industrial policy and artificial intelligence, which are discussed in the following sections.

Industrial Policy and Its Effects on Productivity

Industrial policy does not have a formal definition, but it generally refers to policies that promote a specific pattern of trade and domestic production, targeting specific industries or economic activities. Such policies could include targeted or industry-specific subsidies, tariffs, and public investment. Industrial policy may have a variety of goals, including strategic competitiveness, national security, and supply chain resilience. This section focuses on one of its goals—boosting productivity. Evaluating its efficacy in achieving these other goals is beyond the scope of this report, and therefore this report draws no conclusions about its overall merits.

Economists debate the effects of industrial policy on the economy. Much of the debate centers around free market dynamics and the role of government intervention. Some economists argue that the economy will grow faster if market forces are able to allocate labor and capital to their most efficient uses (i.e., companies and industries that produce the best products the most efficiently will succeed and grow). Others argue that there could be economic benefits and positive externalities (benefits that are not priced in to the market) to allocating resources to certain activities and that government intervention would allow for those benefits to be realized. For example, advocates of industrial policies sometimes argue that R&D and worker training programs—both of which can increase productivity—are not fully priced into the market and therefore may suffer from a lower rate of private investment than would be ideal, and, thus, public investment in these areas could allow for more optimal economic outcomes.[43] Detractors might argue that while such policies, when broadly applied, could be beneficial, providing these resources only to favored industries could prove distortionary.

Industrial policies have been used throughout U.S. history, and their efficacy can be analyzed based on a variety of factors. However, the U.S. economy has also experienced many structural shifts throughout its history, and therefore how a given policy affected the economy at one point is not necessarily going to be analogous to how it might affect the economy at a different point. Nonetheless, for the purposes of being illustrative, there are likely still some insights to gain in terms of past examples. The Peterson Institute for International Economics found that, between 1970 and 2020, public and private R&D policies produced better outcomes—as measured by competitiveness, job savings, and technological advancement—than did subsidies to targeted firms or protectionist trade measures.[44] Still, not all R&D investment will necessarily produce the technological advancement necessary for productivity growth, just as not all subsidies or trade policies will fail to do so.

More generally, the specifics of any given industrial policy are an important factor in determining how a policy might affect productivity and growth. There is significant debate about the extent to which industrial policies drive innovation. With respect to productivity effects, concerns include that public investment could crowd out private investment and, owing to political capture or other

[43] Gary Clyde Hufbauer and Euijin Jung, "Scoring 50 Years of U.S. Industrial Policy, 1970-2020," Peterson Institute for International Economics, November 2021, p. 6, https://www.piie.com/sites/default/files/documents/piieb21-5.pdf.

[44] Hufbauer and Jung, "Scoring 50 Years of U.S. Industrial Policy," p. 96.

reasons, industry "winners" may not be optimal choices.[45] For example, the IMF argues that in order for industrial policy to produce productivity gains, three criteria must be met:

1. Targeted sectors must generate measurable social benefits.
2. Policies must not discriminate against foreign firms.
3. The government must have appropriate capacity to execute policies.[46]

There is literature suggesting positive productivity effects of some historical industrial policies. For example, there are many studies that find positive effects from historical industrial policies in East Asia. One long-term study on the effects of firm-level subsidies during South Korea's "Heavy and Chemical Industry Drive" in the 1970s found positive welfare effects compared to a no-subsidy baseline owing to long-term productivity effects.[47] However, these international comparisons may be of limited relevance to the United States because of U.S. advantages in its level of development, the size and competitiveness of its domestic market, and the availability of private capital, to name a few.

Industry Targeting: Manufacturing

Even though industrial policies do not exclusively target the manufacturing sector, this sector is commonly referenced in relation to industrial policy and its goals. For example, in the past decade there have been several policies enacted for the purposes of "reshoring" manufacturing either broadly or specifically, including incentives for domestic semiconductor manufacturing in the CHIPS and Science Act (P.L. 117-167) and various tariffs to, in part, "reprioritize U.S. manufacturing."[48] As stated above, these and other policies have other policy goals outside of productivity.

Studies generally find that industrial policies have more consistently economically favorable outcomes when targeting industries and products in which the countries enacting them have competitive advantages or are already relatively high in productivity.[49] This raises the question of whether the U.S. manufacturing sector (and its industry-level subcomponents) exhibit relatively high levels of productivity growth or not.[50] As shown in **Figure 4** below, there has been a

[45] Naveen Siddiqui and Andrew Lautz, "Industrial Policy: Path to U.S. Competitiveness or Pitfall?," Bipartisan Policy Center, October 3, 2023, https://bipartisanpolicy.org/blog/industrial-policy-path-to-u-s-competitiveness-or-pitfall/.

[46] Era Dabla-Norris et al., "Industrial Policy Is Not a Magic Cure for Slow Growth," IMF, April 10, 2024, https://www.imf.org/en/Blogs/Articles/2024/04/10/industrial-policy-is-not-a-magic-cure-for-slow-growth.

[47] Jaedo Choi and Andrei A. Levchenko, *The Long-Term Effects of Industrial Policy*, NBER, May 2024, https://www.nber.org/system/files/working_papers/w29263/w29263.pdf.

[48] See CRS Report R47558, *Semiconductors and the CHIPS Act: The Global Context*, by Karen M. Sutter, Emily G. Blevins, and Alice B. Grossman; and The White House, "Fact Sheet: President Donald J. Trump Declares National Emergency to Increase Our Competitive Edge, Protect Our Sovereignty, and Strengthen Our National and Economic Security," April 2, 2025, https://www.whitehouse.gov/fact-sheets/2025/04/fact-sheet-president-donald-j-trump-declares-national-emergency-to-increase-our-competitive-edge-protect-our-sovereignty-and-strengthen-our-national-and-economic-security/.

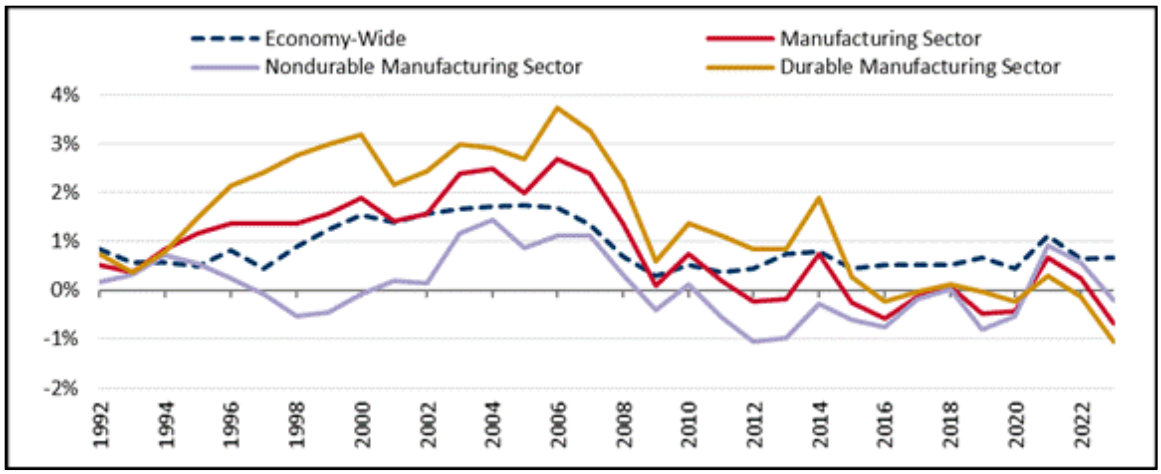
[49] For example, see Tim Sargent, "How Does Industrial Policy Impact Output, Hours and Productivity? The Canadian Experience," *International Productivity Monitor*, Fall 2024, https://www.csls.ca/ipm/47/Sargent_final.pdf; and Sandra Baquie et al., "Industrial Policies—Handle with Care," IMF, March 21, 2025, https://www.elibrary.imf.org/view/journals/006/2025/002/article-A001-en.xml.

[50] Other relevant factors to consider include the size of the manufacturing sector and trends in manufacturing productivity contributions to output. In recent years, manufacturing value added as a percentage of GDP has fluctuated around 10%. See Bureau of Economic Analysis, "GDP by Industry," https://www.bea.gov/data/gdp/gdp-industry. Manufacturing TFP contributions to private business output have decreased across the most recent business cycles, with an average of 0.64 percentage points for 1990-2000 and 2000-2007 but dropping to be a drag on output more (continued...)

slowdown in TFP both generally and for manufacturing since the 2007-2009 recession.[51] Average TFP growth for the manufacturing sector largely outpaced total TFP prior to the 2007-2009 recession but largely underperformed compared to total TFP thereafter.[52] This trend was not consistent across durable and nondurable subsectors, with durable higher than both total manufacturing and economy-wide TFP for most of the period and nondurable the inverse. Manufacturing and both of its subsectors have showed lower average growth than total TFP since 2015, and all three showed a negative five-year average growth rate in 2023.

Figure 4. Five-Year Rolling Average of Annual TFP Growth

1992-2023



Source: CRS calculations based on Bureau of Labor Statistics major sector and major industry total factor productivity data.

Notes: A five-year rolling average is calculated by averaging five years' worth of data ending in the year in question. For example, the five-year rolling average for 1992 was calculated by taking the average of the data points in 1988, 1989, 1990, 1991, and 1992. Rolling averages remove some of the volatility of the data and can allow for an easier visual representation of long-term underlying trends.

That there has been a slowdown since the 2007-2009 recession in manufacturing sector productivity does not necessarily mean that all manufacturing industries have shown this trend. While annual average TFP growth for manufacturing is lower than overall TFP growth since 2010 (-0.03% as compared to 0.07% as shown in **Table 2** below), two manufacturing industries outperformed both measures: TFP for the apparel and leather and applied products manufacturing

recently at -0.07 and -0.10 for 2007-2019 and 2019-2023, respectively. See BLS, "Total Factor Productivity Major Industry Contributions to Output," https://www.bls.gov/productivity/highlights/contributions-of-total-factor-productivity-major-industry-to-output.htm.

[51] For the purposes of this section, TFP is used instead of labor productivity to capture changes and trends in overall efficiency. Labor productivity in the manufacturing sector followed a similar pattern to TFP over the period in question, however, so the analysis between the two may not meaningfully differ. For a time series of labor productivity in the manufacturing sector see Federal Reserve Bank of St. Louis, "Manufacturing Sector: Labor Productivity (Output per Hour) for All Workers," https://fred.stlouisfed.org/series/OPHMFG#. For outside analysis of sectoral labor productivity, see Charles Atkins et al., "Rekindling US Productivity for a New Era," McKinsey Global Institute, February 16, 2023, https://www.mckinsey.com/mgi/our-research/rekindling-us-productivity-for-a-new-era.

[52] A number of studies have shown the post-recession slowdown in manufacturing productivity. For example, see Danial Lashkari and Jeremy Pearce, "The Mysterious Slowdown in U.S. Manufacturing Productivity," *Liberty Street Economics*, Federal Reserve Bank of New York, July 11, 2024, https://libertystreeteconomics.newyorkfed.org/2024/07/the-mysterious-slowdown-in-u-s-manufacturing-productivity/.

industry grew an average 2.5% per year since 2010, and TFP for the computer and electronic products manufacturing industry grew an average 1.2% per year over the same period.

Table 2. Average Annual TFP for Manufacturing Industries Since the 2007-2009 Recession

Industry	2010-2023 Average TFP Growth
All Sectors	*0.07%*
Total Manufacturing Sector	*-0.03%*
Food and beverage and tobacco products	-0.3%
Textile mills and textile product mills	0.3%
Apparel and leather and applied products	2.5%
Wood products	-0.8%
Paper products	-0.1%
Printing and related support activities	0.3%
Petroleum and coal products	0.3%
Chemical products	-0.8%
Plastics and rubber products	-0.4%
Nonmetallic mineral products	0.3%
Primary metal products	-0.5%
Fabricated metal products	0.0%
Machinery	0.0%
Computer and electronic products	1.2%
Electrical equipment	-0.3%
Furniture and related products	-0.1%
Miscellaneous manufacturing	0.1%

Source: CRS calculations based on Bureau of Labor Statistics, "Major Sector and Major Industry TFP Data," https://www.bls.gov/productivity/data.htm.

Notes: Table sorted by three-digit North American Industry Classification System (NAICS) codes. NAICS codes are used to organize and classify businesses into sectors and industries within the economy. For more details, see Bureau of the Census, "North American Industry Classification System," https://www.census.gov/naics/.

As compared to all other industries, how do manufacturing industries compare in terms of TFP growth since the 2007-2009 recession? When considering the "extremes" of TFP growth over this period—top 10 most and least productive industries as measured by average annual TFP growth—manufacturing industries show up at both ends of the spectrum. As detailed in **Table 3** below, the apparel and leather and applied products and computer and electronic products manufacturing industries are relatively more productive than other manufacturing industries and also most other industries. At the other end, chemical products, wood products, primary metal products, and plastics and rubber products manufacturing industries are relatively less productive than most other industries.

Table 3. Major Industries with the Highest and Lowest Average Annual TFP Growth Since the 2007-2009 Recession

2010-2023

Top 10 Highest TFP Growth Industries	Average Annual Growth Rate	Bottom 10 Lowest TFP Growth	Average Annual Growth Rate
Support activities for mining	5.6%	Federal reserve banks, credit intermediation, and related activities	-1.5%
Oil and gas extraction	4.4%	Securities, commodity contracts, and other financial investments and related activities	-1.2%
Air transportation	2.7%	Water transportation	-1.0%
Publishing industries, except internet (includes software)	2.7%	Chemical products*	-0.8%
Apparel and leather and applied products*	2.5%	Mining, except oil and gas	-0.8%
Accommodation	1.7%	Wood products*	-0.8%
Transit and ground transportation	1.5%	Warehousing and storage	-0.6%
Rental and leasing services and lessors of nonfinancial and intangible assets	1.4%	Other transportation and support activities	-0.6%
Computer and electronic products*	1.2%	Primary metal products*	-0.5%
Real estate	1.1%	Plastics and rubber products*	-0.4%

Source: CRS calculations based on BLS, *Major Sector and Major Industry TFP Data*, https://www.bls.gov/productivity/data.htm.

Notes: * = manufacturing subgroup. Three-digit NAICS code level industries included.

Based on the data, industrial policies aimed at manufacturing could have mixed results owing to the varied nature of manufacturing industries. The success of policies in producing productivity gains may be determined by the specifics of the proposal and how it is implemented, as well as the specific types of manufacturing targeted.

Artificial Intelligence: A Silver Bullet?

When it comes to productivity, artificial intelligence (AI) is often proposed as a possible solution to produce long-term productivity and growth gains.[53] AI broadly refers to algorithms and techniques that aim to give computer systems the ability to learn new concepts or tasks and to

[53] This report discusses the effects of AI only on productivity and does not discuss other ways in which AI could impact the economy, such as potential employment or inequality impacts. For more information on other such impacts, see CRS In Focus IF12762, *The Macroeconomic Effects of Artificial Intelligence*, by Lida R. Weinstock and Paul Tierno.

reason and solve complex problems in a manner that mimics human intelligence.[54] *Generative AI* refers to AI systems that can generate content—such as written material, art, or computer code—from prompts using advanced techniques that helps models better understand how data elements influence and depend on one another.[55]

While various forms of AI technologies have been used for decades, the recent popularization of generative AI products such as ChatGPT have spurred further research and debate about how these technologies could impact the economy. AI potentially has wide-ranging uses in the production of goods and services and could have significant impacts for productivity growth. Nonetheless, there is debate about the extent to which AI could prove to be a transformational force. Studying the potential impacts of AI on productivity growth and economic growth may be of interest to policymakers given the recent slowdown in both. A transformative technology could limit the number and scope of growth-oriented policies necessary to produce long-term shifts in productivity growth. On the other hand, if AI were unlikely to produce such a shift, Congress may choose to focus more on growth-oriented policies.

Economists generally agree that the main avenue by which AI is likely to affect the economy is labor productivity specifically, although this section also discusses potential impacts on TFP. Many estimates suggest that AI can affect task productivity notably, although these effects may differ across skill levels and tasks.[56] In general, studies tend to conclude that AI increases task productivity and performance, although some studies have found that errors made by AI can be counterproductive.[57] For example, Goldman Sachs estimates that, given widespread adoption of AI over 10 years, labor productivity growth could increase by 1.5 percentage points annually.[58] The Federal Reserve Bank of St. Louis estimates that time savings from generative AI result in workers being 33% more productive per hour of use, resulting in a 1.1% increase in total labor productivity.[59]

AI could also impact TFP. If the adoption of AI results in an increased pace of research and development, this would increase the growth rate of TFP and long-run economic growth.[60] One study suggests that in the short run (10 years), the effects of AI on TFP would be a roughly 0.53% cumulative increase.[61]

Several sources expect that it may take some time for the effects of AI to meaningfully show up in productivity data, owing in part to the pace and formality of adoption. More informal use of AI

[54] For a list of CRS products detailing various aspects of AI, refer to CRS Insight IN12458, *Artificial Intelligence: CRS Products*, by Laurie Harris and Rachael D. Roan.

[55] For more information about AI, see CRS In Focus IF10608, *Overview of Artificial Intelligence*, by Laurie Harris.

[56] Stanford University Institute for Human-Centered Artificial Intelligence, "Artificial Intelligence Index Report 2025," April 2025, p. 269, https://hai.stanford.edu/assets/files/hai_ai_index_report_2025.pdf.

[57] Yujie Sun et al., "AI Hallucination: Towards a Comprehensive Classification of Distorted Information in Artificial Intelligence-Generated Content," *Humanities and Social Sciences Communications*, vol. 11 (September 27, 2024), https://www.nature.com/articles/s41599-024-03811-x.

[58] Goldman Sachs, "AI Is Showing 'Very Positive' Signs of Eventually Boosting GDP and Productivity," May 13, 2024, https://www.goldmansachs.com/insights/articles/AI-is-showing-very-positive-signs-of-boosting-gdp.

[59] Alexander Bick et al., "The Impact of Generative AI on Work Productivity," Federal Reserve Bank of St. Louis, February 27, 2025, https://www.stlouisfed.org/on-the-economy/2025/feb/impact-generative-ai-work-productivity.

[60] There is some evidence of declining efficiency in R&D specifically prior to the pandemic. See Nicholas Bloom et al., "Are Ideas Getting Harder to Find?," *American Economic Review*, vol. 110, no. 4 (April 2020), https://www.aeaweb.org/articles?id=10.1257/aer.20180338.

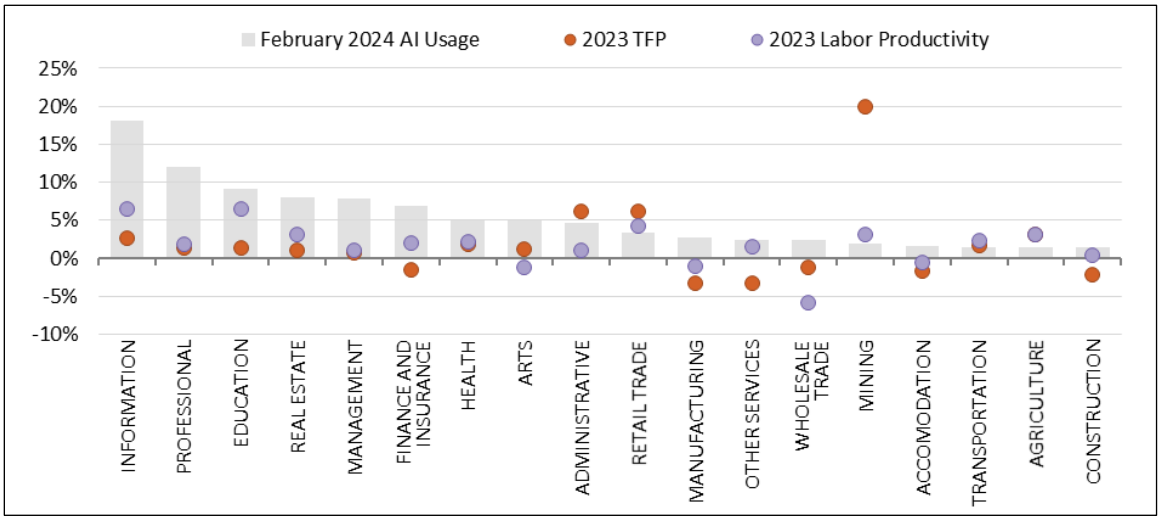
[61] Daron Acemoglu, "The Simple Macroeconomics of AI," NBER, May 2024, https://www.nber.org/papers/w32487.

by workers may increase task productivity but not overall productivity if workers opt to use any time gains as "on-the-job leisure."[62]

How Does AI Usage Compare to Productivity Levels at Present?

While it is still early days for generative AI in the workplace, there are some data on industry-level usage. In a February 2024 supplement to the Business Trends and Outlook Survey, the U.S. Census Bureau asked participating businesses about current and expected AI use. **Figure 5** below shows the percentage of businesses within each sector that claimed to have used AI in the previous two weeks. Usage varied widely across sectors, ranging from 18.1% in the information sector to 1.4% in the agriculture and construction sectors.[63]

Figure 5. Sector AI Use in February 2024 Compared to Sector Productivity Growth in 2023



Source: Bureau of Labor Statistics and Census Bureau, *Business Trends and Outlook Survey AI Supplement*, https://www.census.gov/hfp/btos/downloads/CES-WP-24-16.pdf.

Notes: Sector names have been shortened for the sake of brevity. Each sector corresponds to North American Industry Classification System codes as follows: information (51); professional (54); education (61); real estate (53); management (55); finance and insurance (52); health (62); arts (71); administrative (56); retail trade (44, 45); manufacturing (31-33); other services (81); wholesale trade (42); mining (21); accommodation (72); transportation (48-49); agriculture (11); construction (23). The relatively high total factor productivity (TFP) growth in 2023 for the mining sector is likely an outlier. For example, in 2022, TFP growth for the mining sector was -6.9%. Since 1988, it has reached a more extreme growth rate than in 2022 or 2023 only once, at -10.2% in 2000.

When comparing this reported AI usage to TFP and labor productivity, no clear picture emerges. On the one hand, there may be some correlation between AI usage and labor productivity growth—in 2023, labor productivity growth was relatively high in some sectors that had

[62] Bick et al., "The Impact of Generative AI on Work Productivity"; and Goldman Sachs, "AI May Start to Boost U.S. GDP in 2027," November 7, 2023, https://www.goldmansachs.com/insights/articles/ai-may-start-to-boost-us-gdp-in-2027.

[63] The Business Trends and Outlook Survey (BTOS) is not the only survey that asks respondents questions about AI use. There are other private and academic surveys that have done so as well, and results can vary widely. For example, the Real Time Population Survey found that in August 2024, roughly 28% of respondents said that they used generative AI to some degree for work. See Alexander Bick et al., "The Rapid Adoption of Generative AI," Federal Reserve Bank of St. Louis, September 23, 2024, https://www.stlouisfed.org/on-the-economy/2024/sep/rapid-adoption-generative-ai.

relatively high AI usage (such as information and education). Analysis by the Federal Reserve Bank of St. Louis, using data from an academic survey of AI usage, found a positive relationship between AI use prevalence in 2023 and labor productivity growth from 2019 through 2024.[64]

On the other hand, TFP does not appear to follow any pattern across sectors related to AI usage over the same period. That a clear correlation is not necessarily apparent from the above snapshot does not mean that AI could not or has not meaningfully impacted TFP growth. With more time, consistent and abundant data, and, in theory, greater uptake of AI, impacts of AI use on both labor productivity and TFP will likely become clearer. To this point, the initial data do suggest that AI could provide meaningful productivity gains (at least for labor) but that those gains may not be fully realized yet.

Effects of COVID-19 on Productivity

Structural shifts in the economy can alter the path of productivity growth. In recent years, the COVID-19 pandemic was one such shock that many economists argue resulted in structural changes—in particular, how individuals work and businesses function. Initial trends in productivity (particularly labor productivity) during the pandemic followed a fairly typical pattern in relation to the business cycle, with initially increasing and then decreasing productivity as the economy shrank and then expanded. (Labor productivity growth was above average in 2020 and 2021 but fell in 2022.) There is some evidence to suggest that labor productivity increases during recessions as workers boost their output out of necessity or concern for being laid off, some of which would likely be reversed during an expansion.[65] During the height of the pandemic, employment decreased rapidly and unemployment remained high for several months. Some of the factors temporarily holding back job growth had to do with the nature of the public health crisis. During this time, some workers worked harder, longer, or with fewer coworkers, resulting in increased productivity.[66] As the economy and employment recovered, productivity therefore decreased from its pandemic peak—more workers meant that each worker could work less intensively.[67]

Rates of productivity growth remained elevated compared to the previous business cycle in the years since the pandemic. Annual average labor productivity growth was 2.1% from 2020 to 2024 compared to 1.5% from 2007 to 2019. Average annual TFP growth was 1.0% from 2020 to 2024 compared to 0.5% from 2007 to 2019. This break in pattern from the previous business cycle has been the cause of much enthusiasm and study. What has caused it and how likely is it to continue?

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[64] The survey data used for this analysis did not find the same levels of industry AI use as the BTOS survey. In general, BTOS showed lower usage across industries but also comparatively lower usage within particular industries. The starkest difference was for mining, which was reported to have the highest AI usage of any industry by the academic survey but one of the lowest by BTOS. Not all industry breakdowns were comparable. See Oksana Leukhina and Mickenzie Bass, "Industry-Level Growth, AI Use and the U.S. Postpandemic Recovery," Federal Reserve Bank of St. Louis, May 13, 2025, https://www.stlouisfed.org/on-the-economy/2025/may/industry-level-growth-ai-use-us-postpandemic-recovery. Data used came from Alexander Bick et al., "The Rapid Adoption of Generative AI," NBER, February 2025, https://www.nber.org/system/files/working_papers/w32966/w32966.pdf.

[65] Yabor Ivanchev, "Does the Productivity of Individual Workers Increase During Recessions?," BLS, June 2014, https://www.bls.gov/opub/mlr/2014/beyond-bls/does-the-productivity-of-individual-workers-increase-during-recessions.htm.

[66] Research suggests that the increase in productivity at the height of the pandemic was the result of changes in the composition of the workforce. See Jay Stewart, *Why Was Labor Productivity Growth So High During the COVID-19 Pandemic? The Role of Labor Composition*, BLS, January 25, 2022, https://www.bls.gov/osmr/research-papers/2022/pdf/ec220010.pdf.

[67] Other factors can change apart from employment that would affect productivity in such a scenario, such as labor-enhancing capital investments, for example.

As discussed in the previous section, although AI may prove a transformational innovation for productivity moving forward, it likely does not account for much of this 2020-2024 trend. This section delves into three (of potentially many) phenomena arising from the pandemic that could be affecting the productivity growth trend: business formation, educational achievement, and telework.[68]

Business Formation

Business formation (the creation of new businesses) has been shown to contribute to productivity growth—increased rates of business formation ought, in theory, to result in the reallocation of resources toward more productive businesses.[69] The number of business registrations in the United States rose rapidly during the pandemic, and while they have come down somewhat, they are still elevated as compared to 2019, indicating that this trend may not be solely in response to recessionary conditions, for example.[70] This trend occurred not only in the aggregate but also for "high-propensity" businesses (also referred to as "likely employer" businesses), defined as businesses that are likely to become businesses with payroll. High-propensity businesses are most relevant for discussions of productivity gains. Additionally, a significant percentage of new businesses were "high tech" ones (i.e., technology-intensive). High-tech industries have historically strongly contributed to productivity growth.[71]

Whether or not this increase in business formation will ultimately lead to increased productivity growth is uncertain and depends, in part, on the characteristics of the new businesses and how sustained this increase is likely to be.[72] How many businesses formed in recent years survive over the long term and whether those businesses result in increased innovation are important factors in the linkage of business formation to productivity increases.[73] While the persistent elevation of formations as well as the large proportion of high-tech businesses coming out of the pandemic are both generally positive signs for future productivity growth, some economists point to diverging trends in business applications and job creation as evidence that these pandemic effects on entrepreneurship were temporary.[74]

[68] The patterns discussed in this section are not all inclusive. For example, supply chains were affected during the pandemic, and changes to those supply chains could have resulted in more (or less) efficient allocations of labor and capital, thereby affecting productivity in specific sectors or in the aggregate.

[69] Ryan A. Decker et al., "Declining Business Dynamism: Implications for Productivity," Brookings Institution, September 19, 2016, https://www.brookings.edu/articles/declining-business-dynamism-implications-for-productivity/.

[70] Christophe André and Peter Gal, "Reviving Productivity Growth: A Review of Policies," OECD, 2024, p. 36, https://www.oecd.org/content/dam/oecd/en/publications/reports/2024/10/reviving-productivity-growth_936a1da3/61244acd-en.pdf.

[71] Ryan Decker and John Haltiwanger, "High Tech Business Entry in the Pandemic Era," Federal Reserve, April 19, 2024, https://www.federalreserve.gov/econres/notes/feds-notes/high-tech-business-entry-in-the-pandemic-era-20240419.html.

[72] For more details on recent business formation trends, see CRS In Focus IF12792, *Is U.S. Entrepreneurship Declining?*, by Adam G. Levin; and CRS Report R48254, *Entrepreneurship in Regional Economic Development*, by Julie M. Lawhorn and Adam G. Levin.

[73] Ryan Decker and John Haltiwanger, "Surging Business Formation in the Pandemic: Causes and Consequences?," Brookings Institution, Fall 2023, https://www.brookings.edu/wp-content/uploads/2023/09/4_Decker-Haltiwanger_unembargoed.pdf.

[74] Chen Yeh, "Will the Pandemic Surge in Employer Business Formation Last?," Federal Reserve Bank of Richmond, January 2025, https://www.richmondfed.org/publications/research/economic_brief/2025/eb_25-01.

Educational Achievement

Higher levels of education are typically associated with higher labor productivity. Research suggests that there was some level of "learning loss" during the pandemic[75] (via school closures and virtual or hybrid learning environments) both for primary and secondary education students but also higher education students.[76] Studies on the economic effects of this loss indicate that it could result in longer-term economic effects—some of the potential effects will not be fully realized until the affected students are old enough to join the labor force. Generally, lower levels of learning may result in lower levels of cognitive skill, which could reduce future earnings and job opportunities. At a widespread enough scale, these labor market effects could lead to lower labor productivity in aggregate.[77] One study of state-level impacts found that students could face 2%-9% reductions in lifetime income compared to a non-pandemic baseline and that state GDP would be 0.6%-2.9% lower per year through the end of the century compared to baseline projections.[78] Another estimate found that the learning loss associated with the pandemic would lower national GDP by 1.4% by 2051.[79]

Telework

Estimates vary in terms of the amount of full- or part-time telework occurring in the economy. Across metrics there was a swift and significant increase in telework during the pandemic, and while it has since come down, telework has remained elevated compared to pre-pandemic.[80] The sudden shift to telework during the pandemic raised the possibility of a structural shift in the way people worked, potentially resulting in more innovative or efficient business models. At the same time, the potential loss of communication skills and idea sharing could also result in less innovation and efficiency, making the overall effects of telework on productivity uncertain.[81]

Many studies have been done on the effects of increased telework on productivity, and as with the theoretical effects, the results are mixed. A Federal Reserve Bank of San Francisco study found no significant effects of pandemic telework on productivity based on comparing value added per hour across industries in which telework is easy versus challenging to arrange. It also found little statistical relationship between the pace of growth of the two types when accounting for pre-

[75] For more information about the effects of the pandemic on educational institutions and learning, see CRS Report R46666, *The COVID-19 Pandemic and Institutions of Higher Education: Contemporary Issues*, by Benjamin Collins, Joselynn H. Fountain, and Cassandria Dortch; and CRS In Focus IF12264, *Student Learning During the COVID-19 Pandemic*, by Rebecca R. Skinner.

[76] For example, see Giorgio Di Pietro, "The Impact of COVID-19 on Student Achievement: Evidence from a Recent Meta-Analysis," European Commission, May 2023, https://pmc.ncbi.nlm.nih.gov/articles/PMC10028259/; and Wenhua Di and Mytiah Caldwell, "Students Cut College During Pandemic; Their Return Is Uncertain," Federal Reserve Bank of Dallas, First Quarter 2022, https://www.dallasfed.org/research/swe/2022/swe2201/swe2201b.

[77] Santiago Pinto, "The Pandemic's Effects on Children's Education," Federal Reserve Bank of Richmond, August 2023, https://www.richmondfed.org/publications/research/economic_brief/2023/eb_23-29.

[78] Eric Hanushek, "The Economic Cost of the Pandemic: State by State," Hoover Institution, January 4, 2023, https://www.hoover.org/research/economic-cost-pandemic.

[79] Daniela Viana Costa et al., "COVID-19 Learning Loss: Long-Run Macroeconomic Effects Update," Penn Wharton Budget Model, October 27, 2021, https://budgetmodel.wharton.upenn.edu/issues/2021/10/27/covid-19-learning-loss-long-run-macro-effects.

[80] For more information about recent trends in telework, see CRS Report R48528, *Economic Development Implications of Remote Work in the Post-Pandemic Environment*, by Adam G. Levin.

[81] Nicholas Bloom, "Working from Home Is Powering Productivity," IMF, September 2024, https://www.imf.org/en/Publications/fandd/issues/2024/09/working-from-home-is-powering-productivity-bloom.

pandemic trends.[82] However, an analysis from BLS showed a positive association between an increase in remote workers during the pandemic and TFP growth across 61 industries when accounting for pre-pandemic trends. BLS considered TFP, output, and unit input costs in its analysis.[83] Other studies produce various results, from positive to negative, considering a variety of differing scenarios including fully remote work, hybrid work, and company-level differences.[84]

Are Wages Keeping Pace with Productivity?

As mentioned previously, productivity growth or output growth allows for increases in the welfare of Americans. One of the ways this can be accomplished is through higher wages. In theory, an increase in productivity results in an increase in wages, all else equal. For example, if a worker generates $10 of revenue per hour, the employer may be willing to pay that worker up to $10 per hour. If that worker becomes more productive and generates $11 of revenue per hour, the employer's willingness to pay may increase to up to $11 as well. Productivity growth, therefore, allows for sustainable wage increases, while a slowdown in labor productivity could correspond with a slowdown in wage growth.

There is a debate among economists about an apparent "productivity-pay gap." Most economists agree that until the 1970s, productivity and pay trends were closely correlated. However, some economists have begun to measure and research a possible disconnection between labor productivity growth and real wage growth in recent decades, with productivity growth outpacing real wage growth. There is disagreement about this point, much of it coming down to methodology for analyzing these trends. There are several different measures of productivity, pay, and inflation that can be used in determining trends in productivity and pay, and as such, trends across different methodologies may differ.[85] For example, BLS found that across sectors and industries, much of the productivity-pay gap could be explained by using an output deflator as opposed to the consumer price index to calculate real compensation.[86] Nonetheless, many measures do find a gap. Explanations for this gap are wide-ranging, including changes to the way employers compensate their employees, globalization, and increasing wage inequality, among others.[87]

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[82] John G. Fernald et al., "Does Working from Home Boost Productivity Growth?," Federal Reserve Bank of San Francisco, January 16, 2024, https://www.frbsf.org/research-and-insights/publications/economic-letter/2024/01/does-working-from-home-boost-productivity-growth/.

[83] Sabrina Wulff Pabilonia and Jill Janocha Redmond, "The Rise in Remote Work Since the Pandemic and Its Impact on Productivity," BLS, October 2024, https://www.bls.gov/opub/btn/volume-13/remote-work-productivity.htm.

[84] Analyses of business-level effects of telework on productivity more often show negative impacts. For example, one study shows an 8%-19% drop in labor productivity during the pandemic as a result of telework at an Indian technology company. See Michael Gibbs et al., "Work from Home and Productivity: Evidence from Personnel and Analytics Data on Information Technology Professionals," *Journal of Political Economy Microeconomics*, vol. 1, no. 1 (February 2023), https://www.journals.uchicago.edu/doi/full/10.1086/721803.

[85] For a discussion of methodological choices when approaching this issue, see Michael R. Strain, "The Link Between Wages and Productivity Is Strong," in Aspen Institute, *Expanding Economic Opportunity for More Americans*, February 4, 2019, https://www.aspeninstitute.org/wp-content/uploads/2019/01/3.2-Pgs.-168-179-The-Link-Between-Wages-and-Productivity-is-Strong.pdf. The author endorses a specific methodology, and there are other arguments for using a wide array of measures.

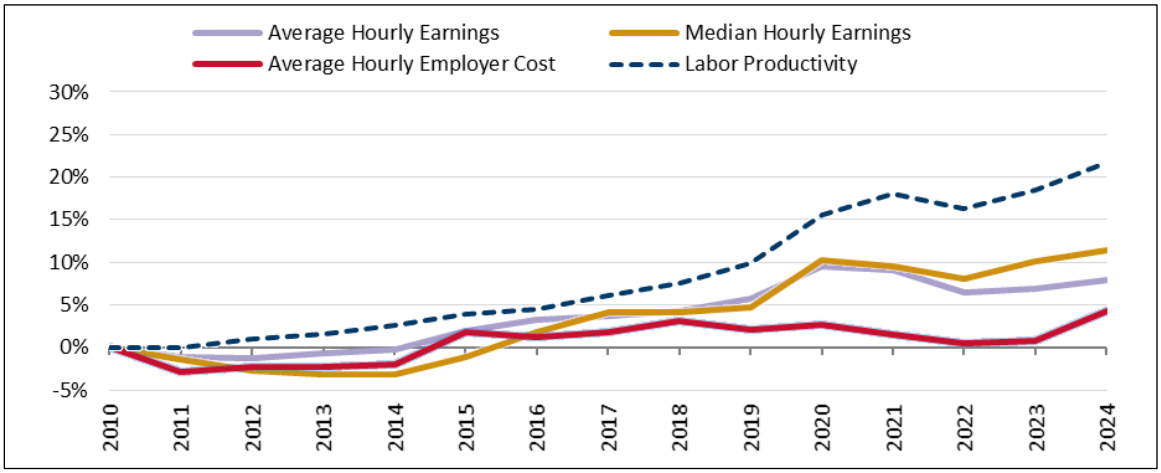
[86] This was not the case across all industries. BLS noted that decreasing labor share of income—the share of income going to workers as opposed to other factors of production, such as capital—was also a major explanatory variable and the dominant one in some industries. See Michael Brill et al., *Understanding the Labor Productivity and Compensation Gap*, BLS, June 2017, https://www.bls.gov/opub/btn/volume-6/pdf/understanding-the-labor-productivity-and-compensation-gap.pdf.

[87] For example, see Cyrill Schwellnus et al., "Decoupling of Wages from Productivity," OECD, January 31, 2017, (continued...)

Whether or not wage gains are keeping pace with productivity gains may be of interest to Congress, not only because it has implications for individual well-being but also because it could highlight certain sticking points in increasing labor productivity growth. For example, there is some evidence to suggest that, for at least some workers, wage increases result in labor productivity growth in addition to productivity increases resulting in wage increases.[88] **Figure 6** below shows cumulative annual labor productivity growth since 2010 as compared with a variety of real wage metrics, including median hourly earnings, average hourly earnings, and average employer costs for employee compensation.[89] Wages, by all three measures, have grown less than labor productivity has since 2010. Differences in definition and methodology among the different wage measures may explain some or all of the gaps among the different wage measures. Additionally, none of these wage measures provides an exact apples-to-apples comparison measure to labor productivity given that they are all *per worker* measures, whereas labor productivity is an economy-wide measure. Nonetheless, that each of these wage measures has grown less than labor productivity has implies that, to some extent, wage growth has not been keeping pace with labor productivity growth. Gains in labor productivity are ultimately less meaningful if they do not bring about increases in welfare for the workers driving those gains.

Figure 6. Cumulative Annual Growth in Labor Productivity Versus Real Wages

2010-2024



Source: CRS calculations based on BLS Current Population Survey, Current Employment Statistics, Employer Costs for Employee Compensation, and Productivity data.

Notes: Underlying data are adjusted to 2024 dollars using the Consumer Price Index for all Urban Consumers. Median hourly earnings include only wage and salary workers paid hourly rates. Employer costs include benefits as well as wages and salaries and are for workers at the 50th percentile (median).

https://www.oecd-ilibrary.org/economics/decoupling-of-wages-from-productivity_d4764493-en; and Richard G. Anderson, "How Well Do Wages Follow Productivity Growth?," Federal Reserve Bank of St. Louis, 2007, https://files.stlouisfed.org/files/htdocs/publications/es/07/ES0707.pdf.

[88] Natalia Emanuel and Emma Harrington, "The Payoffs of Higher Pay: Elasticities of Productivity and Labor Supply with Respect to Wages," Harvard University, January 12, 2020, https://scholar.harvard.edu/files/nataliaemanuel/files/emanuel_jmp.pdf.

[89] For a detailed explanation of these different wage measures, see CRS Report R47381, *A Comparison of Selected Official Wage Measures*, by Lida R. Weinstock.

Policy Issues and Questions Facing Congress

"Productivity policy" may not be targeted or exist in a formalized way. However, productivity is one of the most important determinants of the long-term health of the economy and the individuals and businesses participating in it. And productivity can be affected, be it directly or indirectly, by almost all policy decisions made by Congress. Such policies may be particularly impactful now given trends of slowing productivity growth and what that could mean for the economy in the long run. Congress may consider what its role is in targeting productivity growth and whether increases to productivity are policy goals worth pursuing.

This report lays out several issues for congressional consideration. Each issue raises policy questions, as summarized below.

Issue 1: Average productivity growth, while varied, has shown slower growth since 2000 compared to previous decades, which has been a contributing factor to decelerating GDP growth over this period.

- What policy levers does Congress have to increase productivity growth? Ought policies be for the explicit purpose of increasing productivity growth? What policy trade-offs exist to increasing productivity?
- How have past policies affected productivity growth? Are there specific types of policies that more effectively increase productivity growth?
- Are targeted policies effective at increasing productivity growth? Should specific sectors, industries, or firms be the focus of policies? If so, what are the economic and political implications of picking and supporting winners?
- What is the role of new technologies in producing productivity gains? Why do some innovations produce more gains than others do? Is AI likely to produce long-term productivity growth gains? What role does Congress have in regulating or promoting such innovations?

Issue 2: Productivity growth during the current business cycle has thus far outpaced productivity growth from the previous couple of business cycles.

- What role did COVID-19-era policies play in this uptick and how likely is this trend to be long-lasting? Are the structural shifts in the economy since COVID-19, such as higher rates of telework, likely to bring about short-term or long-term increases in growth rates?
- To what extent can Congress take advantage of current trends to further improve productivity growth? Or do these shifting trends make policy efforts unnecessary in order to maintain average growth rates seen during the current business cycle?
- Has the economy fully absorbed the effects of decreased education rates and pandemic learning loss? Or are the effects of these trends likely to show up more strongly in productivity data in the medium term? To what extent should Congress consider enacting policies preemptively to account for potential future slowdowns in productivity growth?

Issue 3: Productivity growth, in theory, should result in comparable wage growth, a key component of increasing welfare. However, depending on the methodology, by several metrics, wages have not been keeping pace with productivity in recent years.

- To what extent have trends in productivity growth and wage growth been diverging in recent years? Are gaps a byproduct of the way wages and

- productivity are measured, or is there an underlying market failure resulting in a gap? Is this potential gap a topic that Congress would want to study or task another agency/entity with studying?
- Assuming there is a gap, what policy levers does Congress have to address this issue? To what extent are policies to promote productivity growth useful to Congress if they do not result in welfare increases as well? Would some types of policy produce more passthrough to wages?

As noted, policy actions to increase productivity growth may require trade-offs. Policies tend to have broader impacts and implications for the economy and society than their specific areas of focus. And, typically, policies are not implemented for the sole or explicit purpose of increasing productivity growth. The broad policy areas discussed in this report—education, immigration, tax, infrastructure, R&D, antitrust, and trade—all have impacts separate from productivity that Congress may be concerned with. For example, some or all of these policy types can impact budget deficits, the composition of the labor market, foreign policy, and national security. In considering ways to increase productivity growth, policymakers may face decisions regarding how to balance productivity goals with other policy priorities.

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