**Do We Have Potential?: An Analysis of U.S. Potential Economic Growth Compendium**

**Summary**

An economy’s long-run sustainable rate of economic growth—the rate at which it can grow over a long period of time at a constant inflation rate—is determined by underlying supply factors, specifically by its labor force growth rate and its underlying rate of labor productivity growth. Unlike actual GDP growth, an economy’s potential growth rate is unobservable and must be estimated. While the concept of potential economic growth may appear to be largely an academic exercise to some readers, there are important real world consequences associated with potential economic growth. An economy that can grow at a robust rate for a sustained period will be better able to project economic and geopolitical power. Additionally, strong potential economic growth allows real economic growth to grow at a stronger rate without leading to higher inflation. In a five-part series of reports, which we collate in this compendium, we analyze the outlook for potential economic growth in the United States.

The potential growth rate in the U.S. economy has trended lower in recent decades as growth in labor productivity and growth in the labor force have both slowed. During the last decade, the labor force has decelerated due in part to slower population growth. Labor productivity—which is determined by growth in the capital stock, changes in labor "composition" and changes in total factor productivity (TFP)—has also softened. Though capital accumulation accelerated during the past decade, weak TFP growth significantly downshifted labor productivity growth. As a result, the Congressional Budget Office (CBO) estimates that the potential growth rate of the U.S. economy is only 2.2% per annum presently.

Though potential growth has been lackluster during the last decade, we look for it to grow more strongly in the next few years. Labor force growth has strengthened considerably in the past two years, due primarily to robust immigration flows and a post-pandemic rebound in the labor force participation rate (LFPR). We expect immigration to further boost the LFPR, alongside other factors such as the flexibility of remote work. The net capital stock has also exhibited positive growth recently, due in part to a surge in the construction of manufacturing facilities. We expect stronger growth in the net capital stock in the near future, especially due to spending on hardware and software that will be required to more fully develop automation and artificial intelligence (AI) capabilities in the business sector. TFP growth has remained lackluster in the wake of the global financial crisis, but there are some reasons for optimism. We anticipate remote work and AI will have the potential to lift TFP growth, which will ultimately strengthen labor productivity growth by the end of the decade, alongside the boost from capital stock growth.

Ultimately, we suspect the economy's potential growth rate will be stronger than what it averaged over the past expansion (~1.8%). Potential growth rates are challenging to estimate, but we feel reasonably confident that the potential growth rate of the U.S. economy could ramp up to 2.5 percent per annum by the end of the decade. A potential growth rate as high as 3% could be within reach if labor force growth does not sink back to rates of the past decade and AI adoption speedily diffuses throughout the economy.
Part I: Introduction

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Summary

- An economy’s long-run sustainable rate of economic growth—the rate at which it can grow over a long period of time at a constant inflation rate—is determined by underlying supply factors, specifically by its labor force growth rate and its underlying rate of labor productivity growth.

- The potential rate of economic growth in the United States has trended lower over the past few decades as labor force growth has slowed considerably. Productivity growth has waxed and waned over that period, but it is slower today than it was in the 1950s and 1960s. The Congressional Budget Office estimates that potential economic growth in the United States is only 2.2% per annum today.

- Potential economic growth can have important real world consequences. An economy that grows in excess of its potential growth rate for a long enough period of time will likely experience rising inflation. Conversely, an economy that consistently falls short of potential economic growth could experience a downward spiral of falling prices and rising defaults among borrowers.

- Furthermore, differences in potential GDP growth compound over time, affecting a country’s ability to project economic and military power.

- In a series of five reports, we will analyze the outlook for potential economic growth in the United States. We will address U.S. labor force growth in Part II before turning to the two factors that determine growth in labor productivity. Part III will focus on changes in the capital stock while we will discuss total factor productivity in Part IV. We will offer concluding thoughts in Part V.

Potential Economic Growth is An Economy’s Sustainable Rate of Real GDP Growth

The U.S. economy has grown at a solid rate over the past few years (Figure 1). Real GDP in the United States shot up nearly 6% in 2021, its strongest annual average growth rate since 1984. Of course, this robust rate of real GDP growth in 2021 reflects, at least in part, a rebound from the pandemic-distorted year of 2020. That noted, the 2.5% growth rate that the economy notched in 2023, which was largely free of pandemic-related distortions, was in line with the average per annum growth rate of 2.4% that the U.S. economy registered during the long economic expansion of 2010-2019.

As Figure 1 makes clear, real GDP can grow at essentially any rate in any given year due to changes in economic policies and shocks (e.g., pandemics, natural disasters, wars, etc.). But an economy’s long-run sustainable rate of economic growth—the rate at which it can grow over a long period of time at a constant inflation rate—is determined by underlying supply factors. Economic theory posits that this so-called “potential rate of economic growth” is determined by growth in an economy’s labor force and its underlying (i.e., secular) rate of productivity growth. That is, an economy can potentially produce more goods and services if it has more workers to do so. Even if the labor force is not growing, an economy can potentially produce more goods and services if each worker can produce more. It is important to note that an economy’s potential economic growth rate is not directly observable as its GDP growth rate is during any quarter. Although labor force growth is readily observable, productivity growth must be estimated as the difference between growth in output and growth in aggregate hours worked. The implied rate of productivity growth can be volatile on a quarter-by-quarter basis, and past estimates of productivity growth are often revised considerably. Therefore, an economy’s underlying productivity growth rate must be estimated.
The Congressional Budget Office (CBO) has decomposed the U.S.’s potential rate of economic growth into its two underlying factors (Figure 2). According to the CBO, the economy’s potential growth rate averaged roughly 4% per annum through the 1950s and 1960s, and real GDP actually grew at an annual average rate of 4.4% over that 20-year period. Not only was productivity growth generally strong over those two decades, but the entry of Baby Boomers into the workforce starting in the mid-1960s lifted the labor force growth rate. Additionally, an increasing number of women entered the workforce around that time, which also boosted the labor force growth rate.

**U.S. Potential Economic Growth Has Trended Lower in Recent Decades**

The potential growth rate of the U.S. economy trended lower between the late-1960s until the mid-1990s as growth in labor productivity and growth in the labor force both slowed. Although the labor force participation rate among women continued to rise during this period (Figure 3), the demographic lift provided by Baby Boomers entering the workforce started to ebb in the mid-1970s. Consequently, growth in the American labor force, which rose to as high as 3% per annum in the early 1970s, downshifted to only 1% per annum by the mid-1990s. The rate of potential economic growth subsequently rebounded in the late 1990s as growth in the labor force picked up a bit. Furthermore, the widespread adoption of the internet and the networking of computers had a profound influence on the rate of U.S. productivity growth, which we described in more detail in the series we published last year on artificial intelligence. The rate of potential economic growth downshifted anew in the early 21st century due to deceleration in productivity and slowing growth in the labor force. CBO estimates that the potential growth rate of the U.S. economy is only 2.2% per annum at present.
Discussion of an economy’s potential rate of growth may seem like an academic exercise to many readers. However, potential economic growth can have some important real world consequences. An economy that grows in excess of its potential growth rate for a long enough period of time likely will experience rising inflation. This phenomenon occurred in the mid- to late-1960s as federal spending on the Great Society programs and the Vietnam War boosted real GDP growth to above-potential rates. Conversely, an economy that consistently falls short of potential economic growth could experience a downward spiral of falling prices (i.e., deflation) and rising defaults among borrowers. The 26% plunge in U.S. real GDP between 1929 and 1933 was associated with a 25% decline in U.S. consumer prices that occurred during that period.

The Power of Compounding

Furthermore, differences in potential GDP growth compound over time. As noted above, CBO estimates that the potential growth rate of the U.S. economy is presently 2.2% per annum. If the economy continues to grow at this rate between 2024 and 2050, then the American economy in mid-century will be 80% larger than it is today [Figure 4]. If, however, it were to grow 3.0% per annum, which CBO estimates was the average rate of potential economic growth between the cyclical peak of 1981 and the cyclical peak of 2007, then the economy would be more than 120% larger in 2050 than it is today. The 3.0% growth economy would be 23% larger in mid-century than the 2.2% growth economy. In geopolitical terms, the faster-growing economy would be better able to project economic and military power, everything else equal, than the slower-growing economy.

Revisiting Figure 2 shows that CBO forecasts that the rate of potential economic growth in the United States will downshift from 2.2% per annum at present to only 1.8% in 2034. Is the U.S. economy destined for a slow growth environment? Not necessarily. But an uplift in potential economic growth will require some combination of stronger labor force growth and/or productivity acceleration. We will address the outlook for U.S. labor force growth in the second installment in this series before turning to productivity growth.

As discussed in Fernald (2014), growth in labor productivity can be further disaggregated into three components: growth in the capital stock, changes in labor “composition” (i.e., labor quality) and growth in total factor productivity (TFP, i.e., changes in technology and other processes). Growth in the capital stock and changes in TFP have accounted for the vast majority of the total increase in U.S. labor productivity in the post-World War II era. Therefore, we will eschew discussion of changes in labor “composition” in this series. We will analyze the potential for stronger growth in capital accumulation in Part III, and we will discuss the outlook for total factor productivity (TFP) in Part IV. Part V will offer some concluding thoughts.
Part II: Labor Force Growth

Published on May 21, 2024

Summary

- Labor force growth is one of the primary determinants of an economy’s potential rate of economic growth. The American labor force grew at an average annual rate of 1.8% in 2022 and 2023, considerably above its growth rate of the past decade.

- Recent strength in labor force growth reflects, in part, strong population growth that stems from immigration. Foreign-born nationals, who currently represent about 20% of the labor force, have accounted for more than one-half of its growth over the past two years. A rise in the labor force participation rate (LFPR) from its pandemic-induced plunge has also supported growth in the labor force.

- Looking forward, it does not seem likely that the labor force will continue to grow at the same robust rate that it has over the past two years. Although it is difficult to predict the path of immigration in coming years—yet-to-be-determined policy choices and economic conditions in the United States as well as in foreign countries will affect immigration flows—the aging of the population and marked drop in the U.S. fertility rate in recent years means that the “natural” growth rate of the workforce will slow.

- There are some factors that could boost the LFPR further in the near term. More remote work could lift the participation rate, particularly for women with young children, as it has done over the past few years. Strength in cyclically-sensitive industries, which tend to be male dominated, could raise the LFPR rate of prime-age men. That said, the aging of the labor force will likely pull the participation rate lower over the longer-term.

- On balance, we estimate that faster labor force growth over the next several years, via more immigration and labor force participation, could raise the potential economic growth rate of the United States by 0.1–0.3 percentage points per annum over the 1.8% potential GDP growth rate that was registered during the last decade.

- That noted, there is uncertainty about whether the immigration boom will continue and whether more lofty participation rates will be realized. Additionally, potential GDP growth that is slightly above 2% rather than slightly below would still leave it well short of the +3% trend growth rate that prevailed for much of the second half of the 20th century.

Labor Force Growth: The Population Factor

As we noted in the first installment of this five-part series, labor force growth is one of the primary determinants of an economy’s potential rate of economic growth (Figure 1). The downward trend in the rate of potential U.S. economic growth that has been in train for the past few decades reflects, in part, deceleration in the labor force that itself is a function of slower population growth. But in recent years, labor force growth has been strong, averaging 1.8% per annum in 2022 and 2023. Part of the recent acceleration in the workforce simply reflects a rebound from its pandemic-related nosedive, but population growth also has strengthened recently.

The Bureau of Labor Statistics (BLS) estimates that the civilian non-institutional population, which reflects the economy’s potential pool of workers, has risen about 1% per year over the past two years. This recent pace is a tenth or so stronger than the average annual rate in the 2010s and a notable pickup from 2020-2021 when the COVID-19 pandemic drove mortality rates higher. A sharp rise in immigration also has spurred the pickup in population growth since 2021 and raised the possibility that stronger labor force growth could shift U.S. potential economic growth into a higher gear.
and 3.3 million individuals, respectively, a pace that is about three times the annual average of the 2010s. The leap partly reflects a rebound in work-related visas that began in 2022. However, the net boost to the immigrant population from those with work or student visas, as well as lawful permanent residents, has been similar to that of the prior decade (Figure 2).

Part II: Figure 1

**U.S. Potential GDP Growth**

5-Year Moving Average

- Labor Force Productivity Growth: 2034 @ 1.5%
- Labor Force Growth: 2034 @ 0.4%

Source: Congressional Budget Office and Wells Fargo Economics

CBO estimates that the bulk of the recent jump in immigration has sprung from “other foreign nationals” (i.e., persons without legal status). Specifically, CBO estimates an additional 2.9 million individuals will be in the labor force this year compared to its prior estimate published in early 2023, with “most of that increase resulting from higher projected net immigration.” Separate data published by the BLS also show foreign-born workers have been a sizable source of labor force growth in recent years. The BLS data do not distinguish between foreign-born persons legally admitted to the United States and undocumented immigrants, but total foreign-born workers have accounted for 56% of the growth in the U.S. labor force over the past two years (Figure 3).

Despite strength over the past two years, the BLS and CBO both project population growth will slow in coming years from its recent above-trend rate. Specifically, both agencies project the civilian non-institutional population (CNIP) will increase by less than 1.0% per annum between 2024 and 2032 (Figure 4). Excluding individuals of traditional retirement age (65+), the CNIP is estimated to grow less than half a percent per year, which would mark a significant slowdown in the growth of the potential pool of labor compared to prior decades. The outlook for historically slow growth in the working-age population is one contributing factor to expectations that U.S. economic growth will be slower in the years ahead compared to the roughly 3.5% historical average that prevailed between the end of World War II and the 2008 financial crisis.
Immigration is likely to be the most important swing factor in the outlook for U.S. population growth. CBO estimates that over the next decade, natural growth in the population—the net of births minus deaths—will slow to about half the pace registered in the 2010s (Figure 5). Immigration, however, is expected to blunt the impact to overall population growth from an aging population. CBO estimates net immigration will remain elevated over the next few years before reverting to a pace more in line with recent history. Yet, there remains considerable uncertainty around these estimates.

Economic conditions and policy choices in the United States and abroad influence the rate of immigration, making the pace difficult to predict. From a more technical standpoint, estimates of immigration can be challenging due to the need to make assumptions around the number of individuals who enter the U.S. undetected, the share of those encountered at the border who stay in the country as well as the rate at which individuals over-stay temporary visas. Nevertheless, the aging U.S. population along with the sharp drop in fertility since 2007 puts labor force growth on a downward trajectory without an offset from the foreign-born population or a rise in labor force participation.
a downward trajectory without an offset from the foreign-born population or a rise in labor force participation, a topic to which we now turn.

Not Just About the Size of the Pie: Labor Force Participation

Population growth is not the only factor that determines the contribution to potential GDP growth from hours worked. The labor force participation rate (LFPR) is also critical to the outlook for economic growth in the decade ahead. To use an analogy, it is not just about the size of the working-age pie, but also what share of the pie is working. The civilian LFPR for the 16-and-older population peaked in 2000 and has declined in fits and starts since then (Figure 7). This decline can be attributed in part to the aging of the population over the past quarter century. As a greater share of the population aged 16+ moves out of their prime working years, the LFPR declines, all else equal.

Part II: Figure 7

![Labor Force Participation Rate](source: U.S. Department of Labor and Wells Fargo Economics)

Part II: Figure 8

![65+ Population Share Set to Grow](source: U.S. Department of Labor, Congressional Budget Office and Wells Fargo Economics)

Perhaps unsurprisingly, most analysts expect the LFPR to decline further in the decade ahead as the population continues to age. CBO projects the share of the population ages 65+ will rise by nearly 3 percentage points over the next decade (Figure 8, blue bars). With adults ages 65+ significantly less likely to participate in the labor market (Figure 8, red diamonds), population aging is expected to be a key factor in the total LFPR declining from 62.7% today to 61.4%. That said, the LFPR has had a habit of surprising to the upside over the past decade. CBO persistently overestimated the decline in the LFPR in the second half of the 2010s, and a similar phenomenon has played out over the past few years (Figure 9). To what extent could a higher LFPR in the decade ahead contribute to faster potential GDP growth?

To illustrate this outcome, we generated a scenario in which the LFPR is 0.5 pp higher on average over the next decade compared to CBO’s projections. Under this scenario, the labor force grows by 0.7% per year compared to 0.6% per year in CBO’s baseline projections, and labor’s contribution to potential GDP growth is roughly 0.1 pp higher than in CBO’s baseline, all else equal.

Notably, a ~0.5 pp jump in the labor force participation rate relative to CBO’s baseline would not be unprecedented. CBO’s 10-year projections published in early 2014 estimated the labor force participation rate would average 62.1% from 2014-23 (Figure 9). Looking back now with historical data in hand, the labor force participation rate averaged 62.5% over the decade, or about 45 bps higher than CBO’s projections.

Most analysts expect the labor force participation rate to decline in the decade ahead as the population continues to age.

Potential GDP growth would increase by roughly 0.1pp per year if the labor force participation rate is 0.5pp higher on average over the next decade compared to CBO’s projections, all else equal.
Upside Risks to Labor Force Participation in the Years Ahead

We see a few potential tailwinds ahead that could lend support to the labor force participation rate in the coming years and potentially help it once again surprise to the upside. For starters, remote work could prove stickier or diffuse further as businesses compete for a slower-growing pool of potential workers. Despite headlines about companies pushing to “return-to-office,” the share of workers teleworking some or all hours has risen over the past year. While increases have been broad-based across demographic groups, women have experienced more pronounced increases in remote work. The flexibility offered from telework has come alongside sharp rebounds in the LFPR of women in their prime working years (25-54), particularly those with young children. Furthermore, a continuation in the trends of more women obtaining higher education, delaying marriage, starting families later and having fewer total children could also support a further secular rise in the labor force participation rate among women.

The LFPR for prime-age men also has rebounded impressively this cycle, and for the first time since the early 1960s, it has surpassed its prior cycle peak. The recovery has been fueled by the general strength of the jobs market as well as the resilience of employment in more cyclically sensitive sectors. Labor force participation among older workers also could have scope to climb further.
— and male dominated — industries, such as construction, manufacturing and mining. Fiscal support for infrastructure spending, such as the Infrastructure Investment & Jobs Act and the Chips & Science Act, private-sector efforts to de-risk supply chains and keep production closer to the U.S. market and a structural shortage of housing could help labor force participation among prime-age men climb further in the years ahead via support to male-dominated industries.

Labor force participation among older workers also could have scope to climb further. Older workers are less likely to transition back into the labor force after exiting than younger workers, which has contributed to a slower and incomplete recovery this cycle (Figure 12). Yet without such a unique shock as COVID-19 to knock retirement-age workers out of the jobs market, the participation rate among this group could climb further due to a lower exit rate. The decline in the share of workers employed in physically demanding jobs, rising longevity and the decades-long trend of retirement plans moving away from defined benefits and toward defined contributions could lead to a resumption of the upward trend in “retirement-age” workers’ participation rate that began around the mid-1980s.

Lastly, more persistent immigration than what is currently projected could also help generate a higher LFPR than CBO’s baseline. Foreign-born workers have a higher propensity to engage with the labor market. The participation gap between the foreign-born and native-born populations has widened to over four percentage points over the past year (Figure 13). The higher LFPR among foreign-born workers stems from the population skewing younger than the native population, with 59% of the foreign-born population in their “prime” working years of 25-54 versus 46% for the native-born population.

Downside Risks to Labor Force Participation

Yet there are also reasons to be cautious about the path of labor force participation ahead. While the prime-age participation rates of men and women have recovered impressively since the pandemic, the pace has lost steam over the past year and highlights that further increases may be harder to come by. Remote work has supported the rebound in labor force participation, but in order for it to provide more than a one-time boost to the level of the participation rate, and instead lift the LFPR on a reoccurring basis, telework would need to continue to grow in prevalence. This could be difficult, as most companies have already been forced to experiment with remote work, suggesting further diffusion of telework is likely to be more incremental, or possibly reverse, in a labor market where employers hold more sway than during the hiring frenzy of 2021-2022.

Part II: Figure 13

Labor Force Participation Rate

Part II: Figure 14

Total Federal Outlays and Revenues

While the prime-age participation rates of men and women have recovered impressively since the pandemic, further increases may be harder to come by.

There is also the risk that the increase in participation derived from the influx of foreign-born workers subsides more quickly than expected. This could occur due to policy changes on either side of the border, or changes in economic conditions domestically and/or abroad that reduce the “push” and “pull” factors for foreign-born workers to head to the United States.
More generally, with the labor market quick to snap back from the pandemic and offering ample opportunities for workers in recent years, there may be only a shallow pool of labor that can be wooed off the sidelines. The better-than-expected outturn in the labor force participation rate over the past 10 years relative to CBO’s 2014 baseline came as a rebound from the Great Financial Crisis (GFC) among prime-age workers finally started to emerge. In 2014 the participation rate for prime-age workers was still 2.2 percentage points below its pre-GFC peak, providing scope for a recovery if job opportunities became more plentiful, whereas today the labor force participation rate for 25–54 year olds is already 0.3 points higher than its prior cycle peak.

A tightening in fiscal policy over the next decade to address chronic budget deficits could further serve as a headwind to labor force participation. Whereas individual and corporate taxes were reduced in 2018, the yawning gap between revenues and outlays shown in Figure 14 heightens the prospect of tax increases in the coming years to get the U.S. deficit on a more stable trajectory. If realized, higher tax rates on labor income would, on the margin, reduce the number of hours some individuals choose to work and lead some to choose not to participate in the labor market at all.

All told, we suspect that once accounting for the country’s aging demographic profile, the tailwinds to the labor force participation rate overshadow the headwinds. However, even with risks tilted to the upside, the impact of a higher LFPR on potential GDP growth is likely to be small.

Labor’s Contribution Is Important, but Productivity Is the Secret Sauce

On balance, the combination of faster population growth via more immigration and higher labor force participation rates could increase potential GDP growth by 0.1-0.3 percentage points per year over the next decade relative to what prevailed in the 2010s. That said, there are some important caveats. First, there is uncertainty about whether the immigration boom will continue and whether more lofty participation rates will be realized. Second, potential GDP growth that is slightly above 2% rather than slightly below would still leave it well short of the +3% trend growth rate that prevailed for much of the second half of the 20th century (refer back to Figure 1). Third, it is important to note that these factors can boost aggregate economic growth, but they do not necessarily boost per capita GDP growth. It is the latter indicator that is most consistent with rising living standards for the average person.

Of course, this is not to say that faster potential GDP growth has no real world impact. For example, more robust labor supply could help improve the federal fiscal outlook. The aging of the U.S. population is putting significant structural pressure on the federal budget via slow labor force growth and robust outlay growth on mandatory spending programs such as Medicare and Social Security (Figure 15). Labor force growth that is 1.0% per year over the next decade would reduce the federal government’s debt-to-GDP ratio by about five percentage points compared to CBO’s baseline projection of 0.6% labor force growth per year, all else equal (Figure 16). Such a difference is not
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enough to single-handedly solve America’s long-run fiscal challenges, but every bit helps, and faster labor force growth does not involve painful policy trade-offs such as cutting benefits or raising taxes.

That said, labor productivity growth is ultimately the secret sauce that leads to rising living standards over the longer-run. In Parts III and IV, we explore the outlook for labor productivity growth in the decade ahead.

**Endnotes**

1 – The civilian noninstitutional population (CNIP) is narrower in scope than the total U.S. population. The Bureau of Labor Statistics defines the CNIP as persons 16 years of age and older residing in the 50 states and the District of Columbia, who are not inmates of institutions (e.g., penal and mental facilities, homes for the aged), and who are not on active duty in the Armed Forces. (Return)

2 – See Box 2-1 of The Budget and Economic Outlook: 2024 to 2034, Congressional Budget Office. February 2024. (Return)


4 – See the Telework or work at home for pay data published by the BLS starting in October 2022. (Return)

5 – Educational attainment is positively associated with labor force participation. Never-married women have higher rates of labor force participation than married women, while women without children under age 18 have higher labor force participation rates than women with children. (Return)

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**Part III: Capital Accumulation**

Published on May 23, 2024

**Summary**

- Labor productivity is one of the primary determinants of an economy’s potential rate of economic growth. Productivity has waxed and waned over the years, but it is considerably slower today than it was during the halcyon economic years of the 1950s and early 1960s.

- Labor productivity is determined by growth in the capital stock, changes in labor “composition” (i.e., labor quality) and changes in total factor productivity (TFP, i.e., changes in technology and other processes). Growth in the capital stock and changes in TFP have largely dictated productivity growth in recent years. We focus on growth in the capital stock in this report.

- Over the past expansion (2010-2019), total labor productivity growth in the business sector slowed relative to the 1990s and the early years of the 21st century. Productivity growth was slower in the service sector, and especially in the manufacturing sector, partly due to slower rates of capital accumulation.

- The economy’s capital stock reflects the value of capital assets (i.e., structures, equipment and intellectual property products) at a specific point in time, and its change is determined by business fixed investment spending less depreciation. Growth in the economy’s capital stock, and hence its productivity growth, downshifted after the tech bubble burst in the early 2000s.

- Capital stock growth picked up in the factory sector, and more notably in the service sector, coming out of the global financial crisis. Yet growth in labor productivity remained lackluster compared to the 1992-2007 period, implying weak TFP growth during the 2010s.

- Looking forward, we see the build-out in capital required for the widespread adoption of automation and artificial intelligence (AI) as a major upside for labor productivity. The necessary accumulation of hardware and software to use AI effectively may cause capital accumulation growth to strengthen and could lead to stronger productivity growth.

- Reliable estimates of the volume of hardware and software investment required to support the AI transition are not readily available. Using a scenario analysis, we estimate capital accumulation can account for 1.7 percentage points of the annual rate of productivity growth by the end of the decade, which represents a six-tenths improvement from the past decade’s average contribution.
• Ultimately, capital accumulation is just one part of the productivity puzzle. The lackluster trend in labor productivity growth over the past expansion, despite the acceleration in the capital stock, implies weak TFP growth. While the AI build-out across the business sector will require significant capital investment in hardware and software, it will also likely come with a rise in efficiency and improvements to other processes that manifest in total factor productivity gains, a topic to which we will turn in the next installment of this series.

Productivity Matters
We began this five-part series by noting that an economy’s rate of potential GDP growth is determined by growth in its labor force and by its underlying rate of labor productivity growth. The rate of potential economic growth in the United States has followed a downward trend over the past few decades due largely to the secular decline in the rate of labor force growth (Figure 1). Growth in labor productivity has waxed and waned over the years, but it is considerably slower today than it was during the halcyon economic years of the 1950s and the early 1960s. We discussed the outlook for labor force growth and its implications for potential economic growth in Part II of this series. We now turn to the outlook for labor productivity growth.

As we noted in Part I, growth in labor productivity can be further disaggregated into three components: growth in the capital stock, changes in labor “composition” (i.e., labor quality) and changes in total factor productivity (TFP, i.e., changes in technology and other processes). According to a dataset that is maintained by the Federal Reserve Bank of San Francisco, productivity growth in any given year is largely determined by changes in the capital stock and changes in TFP (Figure 2). Changes in labor composition—or shifts in the work force’s age, education or gender—have had essentially no effect, on net, on the fivefold increase in the level of labor productivity since the end of the Second World War. We therefore eschew discussion of labor composition in the remainder of this series. We will address changes in the capital stock in this report, and we will analyze the outlook for TFP growth in Part IV of this series.

Part III: Figure 1

How Productive Have We Been?
The growth rate of overall labor productivity in the U.S. business sector is shown by the red line in Figure 2. After growing at an annual rate of roughly 3% in the early 2000s, labor productivity has increased around 1.5% per annum in recent years. The business sector consists of six broad industries (agriculture, mining, utilities, construction, manufacturing and services), and it excludes government, households and nonprofits. The Bureau of Labor Statistics (BLS) publishes productivity data for the business sector and the manufacturing sector, but a breakout for the broad service sector is not readily available.
Labor productivity growth in the manufacturing sector exceeded productivity growth in the overall business sector during the 1990s and the early years of the 21st century (Figure 3). However, productivity in the manufacturing sector was essentially flat on balance during the last economic expansion of 2010-2019. Therefore, the 1.2% annual average growth rate of labor productivity in the business sector during those years was due entirely to the five industries outside of manufacturing that were noted previously. The service sector would have accounted for essentially all the productivity growth in the business sector, because it represents nearly 80% of value added in the private sector of the U.S. economy, while the other four non-manufacturing sectors together account for only 9%. We will return subsequently to the service sector, but let's first drill down a bit further into productivity growth in the factory sector with a focus on changes in the capital stock, which has been the largest contributing factor to productivity growth in recent years (revisit Figure 2).

**Part III: Figure 3**

![Growth in Labor Productivity](image)

**Growth in Labor Productivity**

*Year-over-Year Percent Change of 5-Year Moving Average*

- Business Sector: 2023 @ 1.7%
- Manufacturing: 2023 @ -0.4%

Source: U.S. Department of Labor and Wells Fargo Economics

**Part III: Figure 4**

![Manufacturing Capital Stock](image)

**Manufacturing Capital Stock**

*% Point Contribution to YoY % Change in Productive Capital Stock*

- Structures: 2022 @ 0.2pp
- Equipment: 2022 @ 0.2pp
- Intellectual Property Products: 2022 @ 1.1pp
- Productive Capital Stock: 2022 @ 1.4%

Source: U.S. Department of Labor and Wells Fargo Economics

**Takin' Stock**

The capital stock measures the value of all capital assets at a specific point in time, and changes in the capital stock are determined by business fixed investment spending less depreciation. What exactly is included in the stock? Economists typically disaggregate capital assets into three main categories: equipment (i.e., physical assets used to produce output), structures (i.e., non-residential buildings) and intellectual property products (IPP, e.g., intangible assets such as software and research & development). These categories make up the productive capital stock of an economy.

As shown in Figure 4, growth in the manufacturing sector's productive capital stock strengthened significantly in the 1990s. As manufacturers incorporated computers into their production processes, the contribution to growth in the overall capital stock from information processing equipment picked up, which in turn spurred investment in software and research & development. Around the same time, a wave of offshoring sent many labor-intensive tasks to other countries that ultimately boosted capital intensity in domestic factories and encouraged further investment in automation. Thus, the mix of accelerating digitalized capital inputs and offshoring went a long way in boosting labor productivity growth in the manufacturing sector in the 1990s and into the 2000s.

Growth in the factory sector's capital stock, and hence its productivity growth, downshifted after the tech bubble burst in the early years of the 21st century. Although capital accumulation subsequently accelerated during the past decade, labor productivity growth in the manufacturing sector continued to soften and was essentially flat on balance over the past economic expansion (Figure 3). The softness in the overall rate of labor productivity growth, despite positive growth in the factory sector's capital stock, implies that the sector's TFP growth rate was weak during the economic expansion of 2010-2019, an issue we will discuss in more detail in Part IV of this series.

The BLS does not calculate a productivity growth rate for the overall service sector, but it does provide data on productivity growth in each of the 14 individual industries that comprise it. Figure 5 shows
that productivity growth was positive in 12 of these 14 industries between 1992 and 2007, a period which included two economic expansions (i.e., 1992-2000 and 2002-2007). Positive productivity growth in the vast majority of service industries was associated with acceleration in all three categories of the productive capital stock in the 1990s (Figure 6).

Similar to the factory sector (revisit Figure 4), the rate of capital accumulation in the service sector slowed after the tech bubble burst and again in the immediate aftermath of the global financial crisis. Despite some re-acceleration in the capital stock that occurred during the 2010-2019 economic expansion, growth in labor productivity during those years was slower in 9 of the 14 service industries than it was between 1992 and 2007 (revisit Figure 5). In sum, productivity growth during the 2010-2019 expansion was more sluggish in the service sector, and especially in the manufacturing sector, than it was in the 1992-2007 period. Part of this deceleration reflects slower rates of capital accumulation in recent years compared to the 1992-2007 period.

**Part III: Figure 5**

**Average Annual Labor Productivity Growth**

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<tr>
<td>Real Estate</td>
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<td>Retail Trade</td>
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<td>Finance, Insurance</td>
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<td>Health &amp; Social Assist.</td>
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<td>Wholesale Trade</td>
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<td>Professional Services</td>
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<td>Transp., Warehousing</td>
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<td>Other, Ex Gov.</td>
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<td>Admin., Waste Services</td>
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<td>Arts/Entertain./Recre.</td>
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<tr>
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<tr>
<td>Manufacturing</td>
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</tbody>
</table>

**Part III: Figure 6**

Service Sector Capital Stock

<table>
<thead>
<tr>
<th>Component</th>
<th>2022 Contribution %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structures</td>
<td>0.4pp</td>
</tr>
<tr>
<td>Equipments</td>
<td>0.7pp</td>
</tr>
<tr>
<td>Intellectual Property Products</td>
<td>1.5pp</td>
</tr>
<tr>
<td>Productive Capital Stock</td>
<td>2.6%</td>
</tr>
</tbody>
</table>

Source: U.S. Department of Labor and Wells Fargo Economics

**Look Ahead: Capital to Provide Lift to Productivity**

Is growth in the capital stock destined to remain lackluster in coming years, or are there reasons to believe that capital accumulation will strengthen, which should lead to stronger productivity growth, everything else equal? There are some reasons to be optimistic. For starters, there is a construction boom underway in the U.S. manufacturing sector, specifically for facilities that will produce “high-tech” equipment and components such as computers and semiconductors (Figure 7)\(^6\) The construction surge may continue as federal infrastructure incentives spur private investment that eventually translates to a stronger contribution from structures to capital stock growth in the manufacturing sector.
However, the value of structures represents just 24% of the manufacturing sector’s capital stock, and the manufacturing sector accounts for only 10% of value added in the U.S. economy. Even if the construction boom in the factory sector continues at a breakneck pace for the next decade, it will not really move the needle much in terms of the overall rate of labor productivity growth in the business sector. To bring about a meaningful acceleration in business sector productivity, capital investment in equipment and IPP would need to strengthen in not only the manufacturing sector but also in the service sector.

The development that could lead to robust growth in the overall capital stock, thereby giving a significant boost to productivity growth, is the widespread adoption of automation and artificial intelligence (AI). The business sector will need to accumulate new hardware and software to use AI effectively. The hardware required to perform generative AI tasks (e.g., decision-making, writing, chatting, etc.) typically includes specialized graphical processing units (GPUs). These GPUs are able to run complex machine-learning algorithms, but they are not present in many existing computers. 7

Early signs of the AI build-out are starting to appear. Business investment spending on software is currently about 60% above pre-pandemic levels, and spending on information processing equipment, specifically computers, has also outpaced other areas of nonresidential investment recently (Figure 8). Dell Technologies, Inc. recently announced that a new line of personal computers will be enabled with chips that will be optimized for AI tasks. 8

Reliable estimates of the volume of hardware and software investment that will be required to support the AI transition are not readily available. How, then, can we think about the impact of these factors on the capital stock in coming years? Data on the business sector’s productive capital stock through 2022 (latest available data) indicate that its growth rate is still recovering to its pre-pandemic run-rate (Figure 9). Elevated borrowing costs and a tightening in lending standards have restrained investment flows over the past few years, preventing a more robust pickup in capital accumulation. Data on the gross flow of business fixed investment spending show that its growth rate in 2023 was more or less the same as in 2022 (4.5% versus 5.2%). Therefore, the change in the net capital stock in 2023 likely was not meaningfully different from the previous year.
In an effort to conceptualize the outlook for capital accumulation, we explore three scenarios that are shown in Figure 9. In our lower bound scenario, we assume that the increases in the net capital stock of structures, equipment and IPP each hold steady at their 2022 growth rates through the end of decade. Under this scenario, the growth rate of the overall capital stock rises to 2.3% by 2029 (Figure 9). We suspect this is a low estimate given the momentum in technology investment in recent years, which should boost business fixed investment spending as macro uncertainty dissipates and the Federal Reserve begins to ease monetary policy.

In our upper bound scenario, we allow growth in computer and software capital to ramp up to their average paces registered during the 1993-2000 productivity acceleration. Under this scenario, growth in the total capital stock will run closer to 3.4% by the end of 2029. That pace of expansion would eclipse the growth rates in the net capital stock that were registered in the early 2000s, which is an overly optimistic outcome, in our view. The most probable scenario likely lies somewhere in the middle of these two, and we peg capital stock growth in the business sector to run around 2.7% by the end of this decade.

So what does this acceleration in the net capital stock imply for labor productivity? Over the past decade, growth in the capital stock contributed 1.1 percentage points on average to annual productivity growth in the business sector (revisit Figure 2). We estimate capital's contribution could range from 1.1 to as high as 2.4 percentage points under the various scenarios we just laid out. In the middle-of-the-road scenario, capital input would edge up to a 1.7 percentage point contribution by 2029 (Figure 10). In a world of productivity growth running between 1-2%, a six-tenths improvement could have a sizable effect. If realized, changes in the capital stock would be contributing a similar amount to productivity growth that it did in the 1993-2000 period.

Ultimately, capital accumulation is just one part of the productivity puzzle. The lackluster trend in labor productivity growth over the past expansion, despite the acceleration in the capital stock, implies weak TFP growth during the 2010s. Thus, stronger TFP growth is also needed for a meaningful pickup in productivity growth ahead. While the AI build-out across the business sector will require significant capital investment in hardware and software, it will also likely come with a rise in efficiency and improvements to other processes that manifest in total factor productivity gains, a topic to which we will turn in the next installment in this series.

Endnotes

1 – The San Francisco Fed presents a quarterly series on total factor productivity for the U.S. business sector, adjusted for variations in factor utilization. (Return)
2 - Land, inventories and residential real estate rental properties are also included in the capital stock, but we exclude them from our analysis because they have minimal effects on the business sector’s overall labor productivity growth. (Return)

3 – Older capital assets wear out and lose efficiency over time. The BLS makes an adjustment for this efficiency loss in its measure of the productive capital stock. (Return)


5 – We define the service sector as NAICS codes 42 through 81. This aggregation excludes the mining, utilities and construction industries, which are included in the BLS’ nonfarm non-manufacturing sector estimates. (Return)


9 – The net stock of structures rose 0.6% in 2022, equipment was up 1.8% and the net stock of IPP grew 6.6%. (Return)

Part IV: Total Factor Productivity

Summary

• Growth in labor productivity is determined by growth in the capital stock, changes in labor “composition” (i.e., labor quality) and changes in total factor productivity (TFP, i.e., changes in technology and other processes). We focused on growth in the capital stock in the previous installment of this series, and we now turn to changes in TFP in this report.

• TFP, also known as multifactor productivity, measures the portion of output growth not attributable to capital and labor inputs, such as efficiency and process improvements. New technologies associated with the internet and the networking of computers led to robust TFP growth in the late 1990s and the early years of the 21st century. But TFP growth slumped in the immediate aftermath of the global financial crisis and has remained weak in recent years, helping to explain sluggish growth in overall labor productivity.

• There likely are a number of reasons why TFP growth has slowed, including a slower pace of technological diffusion after initial efficiency gains were realized. Yet TFP growth may be on the cusp of recovery amid a more widespread adoption of remote work and the budding AI-transition.

• For remote work to have a positive effect on productivity growth, it has to allow workers to produce more output per hour worked, not simply free up more working hours through decreased commuting time. Recent studies suggest employees who worked from home performed better and produced more per hour due to an improved ability to focus. With a larger share of Americans working more from home today than pre-pandemic, remote work could be supportive of TFP growth going forward.

• Early evidence also shows that AI can lead to efficiencies that increase the speed of task completion and the quality of output. AI tools generally may be better suited to complement some industries more than others, but if widely adopted, these tools can lift TFP growth.

• While these advancements appear supportive of firmer TFP growth, there historically tend to be a long lag between technological advancement and efficiency gains. It’s uncertain how and when increased remote work and AI will lead to efficiency improvements that manifest in TFP gains, but we expect these innovations to have similar effects as the tech build-out of a few decades ago.
In accounting for these lags, we suspect TFP growth will not reach its high watermark from the last productivity acceleration (1.9%) until the mid-2030s. A gradual ramp up to that point, however, implies that TFP growth could approach its long-run average (~1.2% per annum) by the end of this decade. Faster TFP growth in conjunction with the stronger rate of capital accumulation that we discussed in Part III positions labor productivity for faster growth in the coming decade.

There Are Multifactors to Consider

We noted in the first installment of this five-part series that an economy’s rate of potential economic growth—the rate at which it can grow over a long period of time at a constant inflation rate—is determined by growth in the labor force and growth in labor force productivity. Productivity growth is itself primarily determined by two factors: growth in the capital stock and growth in total factor productivity (TFP), also known as multifactor productivity. The Bureau of Labor Statistics (BLS) defines TFP as “the portion of output growth that is not accounted for by the growth of capital and labor inputs and is due to contributions of other inputs, such as technological advances in production, the introduction of a more streamlined industrial organization, relative shifts of inputs from low to high productivity industries, increased efforts of the workforce, and improvements in managerial efficiency.”

That said, researchers have offered some reasons that may explain the downshift in TFP growth over the past two decades. In surveying many papers that have been written in recent years, economists at the BLS note there is some evidence suggesting that the recent deceleration in TFP is not due to a slower pace of technological change. Rather, some potential explanations include a slower pace of technological diffusion in the economy due to rising market power and concentration that has stifled competition. The International Monetary Fund (IMF) also finds little evidence of a slowing pace of technological progress. Rather, the IMF attributes the TFP deceleration to “a loss of efficiency or market dynamism over the last two decades.”

TFP growth was strong in the late 1990s and the early years of the 21st century, but it has slumped more recently.
For instance, Moore’s law translated to robust efficiency gains in the production of computer chips and information processing equipment in the 1990s and early 2000s. This, along with the implementation of just-in-time inventory management, ultimately boosted the entire manufacturing sector’s labor productivity growth. After the GFC, technological advancements in transistors continued, but their contributions to labor productivity diminished as the diffusion of knowledge and best practices across the sector slowed. Furthermore, Bailey and Kane (2024) note that large retailers such as Walmart, Kroger and Costco drove efficiency gains in the retail and wholesale trade sectors in the early years of this century through procurement process improvements. However, these effects have subsequently faded, and TFP growth in these sectors has slowed (Figure 2).

All told, TFP growth in recent years has fallen well short of the robust rates it registered during the 1990s and the early years of the current century. What is the outlook for TFP growth in coming years? Is the slow TFP growth rate of the post-GFC era destined to continue? Or is the American economy on the cusp of a TFP acceleration à la the 1990s?

TFP Growth Enhancers

Work From Home

There are some reasons for optimism. We discussed in Part II how work-from-home (WFH, a.k.a., remote work) could have a positive effect on labor force participation and thereby on potential economic growth via stronger growth in the labor force. But could WFH have a positive effect on productivity growth as well? Some observers contend that WFH raises the amount of output that workers can produce due to the elimination of commuting time. In this view, WFH raises productivity. But labor productivity is generally defined as output produced per hour worked. An individual who works remotely can potentially work, say, two hours more per day rather than commuting. In that case, the individual can produce more. But their output per hour worked does not necessarily rise. In order for a productivity gain to occur, the worker would need to produce more output per hour worked.

There is some evidence to suggest that WFH can raise output per hour worked. Bloom et al. (2015) report findings from an experiment that was conducted by a travel agency in China. Some of the employees who worked in the agency’s call center continued to work in the office five days a week while others were allowed to work from home four days per week with one day spent in the office. The authors report that “the performance of the home workers went up dramatically, increasing by 13% over the nine months of the experiment.” Although nine percentage points of this improvement resulted from working more minutes, four percentage points came from an increase in the number of calls that the workers could handle per minute worked. The WFH individuals attributed this increase “to the relative quiet of home.”

WFH, which is conducive to periods of “intense focus,” can potentially raise TFP.
In another survey that included more than 30K American workers in 2020 and 2021, Barrero, Bloom and Davis (2021) estimate that WFH will raise output per hour worked by roughly 1%. In a 2023 follow-up paper, the same authors note that individuals who perform analytical tasks are well suited for WFH. The authors hypothesize that periods of “intense focus” that WFH affords individuals with analytical jobs may be behind the productivity enhancement. Although the number of days spent working from home has receded somewhat from its 2020 peak, a larger share of full-time American workers continue to work more from home than they did pre-pandemic. In short, wider adoption of WFH could strengthen productivity growth, specifically growth in TFP, albeit by a fairly small amount.

**Artificial Intelligence**

We discussed in Part III how the widespread adoption of automation and artificial intelligence (AI) will require a build-out in hardware and software that will lead to acceleration in the capital stock and thereby stronger growth in labor productivity. Recent research has found that AI may also come with a rise in efficiency and improvements to other processes that manifest in TFP gains. For example, Peng et al. (2023) found that software developers who had access to an AI programming aid could, on average, complete a programming task 56% faster than developers without access to the tool.

Noy and Zhang (2023) conducted an experiment involving writing tasks. On a random basis, one half of the marketers, grant writers, consultants, managers and other professionals were given access to ChatGPT while the other half did not have access. The researchers found that the speed and quality of the writing assignment improved significantly in the ChatGPT group. Specifically, this group spent 40% less time on the assignment than the group without access to the AI tool, and they also found that quality improved the most among the least effective writers.

These studies focused on firms in an array of labor-intensive service industries, such as software development, professional services and administrative & support services. As shown in Figure 4, TFP growth in these industries has outstripped the overall business sector’s TFP growth since 2018. The studies suggest AI and amenability to remote work are potential drivers of these industries’ TFP growth.

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**Recent research has found that AI may also come with a rise in efficiency and improvements to other processes that manifest in TFP gains.**

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**Part IV: Figure 3**

**Part IV: Figure 4**
strength recently. In sum, a wider adoption of WFH and AI could boost the business sector’s TFP growth in coming years.

While the evidence is supportive of firmer TFP growth, it is uncertain just how quickly these advancements will materialize. There tend to be long lags between technological advancement and efficiency gains that manifest in TFP. For example, growth in TFP downshifted in the 1970s and 1980s despite the groundbreaking inventions of mobile phones, personal computers and internet protocol in the 1970s. It was not until the widespread adoption of these technologies in the business sector in the 1990s that total factor productivity accelerated anew. Indeed, researchers from the Federal Reserve Bank of St. Louis reported that early evidence suggests the diffusion of AI is following a similar timeline to that of personal computers and cloud computing.\footnote{15}

Consequently, the process-improving component of AI may take a while to transfuse throughout the economy. While accumulation of AI-compatible hardware and software will boost overall labor productivity, proprietary data is often used in the development and deployment of AI tools. Heightened focus on data privacy over the decade has weakened the free flow of knowledge across the business sector and likely contributed to diminished TFP growth, despite the robust expansion in the net stock of intellectual property products.\footnote{16} Should this trend continue with AI, the boost to labor productivity from capital may be initially offset, at least in part, by softening TFP growth, all else equal.

**Look Ahead: TFP to Strengthen**

There is a great deal of uncertainty regarding the timeframe in which process improvements related to WFH and the technological advancement inherent in AI will show up in TFP growth in the aggregate business sector. But to conceptualize our analysis, we assume that these effects on TFP growth will play out similarly to the tech boom of the 1990s. TFP growth can bounce around on a year-by-year basis, so to get a sense of the underlying trend we smooth annual growth rates with a 5-year moving average. This underlying trend of TFP growth reached its high watermark of $\approx 1.9\%$ per annum in 2004-2005.

When thinking about the future, we allow the 5-year moving average of TFP growth to slowly ramp up to 1.9\% per annum over the next twelve years to account for the lags that were noted previously. Under this scenario, the implied index of TFP will be 20\% above its current level by 2035 (Figure 5), which is a fairly comparable gain to that experienced in the 15 years between 1992 and 2007. As shown in Figure 6, this scenario translates to the five-year moving average of TFP growth gradually ramping back up to its long-run average (1948-2023) of 1.2\% by the end of this decade (2029). This pickup suggests that the contribution of TFP growth to the overall growth rate of labor productivity and potential economic output would be fairly in-line with its historical average over the next six years.

**Part IV: Figure 5**

**Part IV: Figure 6**
The annual growth rate of TFP averaged just around 0.8% between 2010 and 2019, helping to explain the weaker trend in labor productivity growth during the last economic expansion. Yet wider adoption of remote work and the rise of AI usage have the potential to lift TFP growth in coming years. Acceleration in TFP in conjunction with faster growth in the capital stock, which we discussed in Part III, positions labor productivity for a stronger pace of growth in the coming decade. In the next and final installment of this series, we will bring together our expectations for the growth rates in TFP, the capital stock and the labor force (Part II) to make some estimates about potential economic growth in the United States in coming years.

Endnotes

1 – See https://www.bls.gov/productivity/ for U.S. productivity data. (Return)


4 - Moore's law is broadly defined as the doubling in the number of transistors in a microchip every two years. Transistors are devices that amplify or switch electrical power. (Return)

5 - "Investing in Productivity Growth," McKinsey Global Institute, March 2024. (Return)


7 – Bailey, Martin Neil and Aidan Kane, "How Will AI Affect Productivity?" Brookings Institution, May 2, 2024. (Return)


13 - Quality was assessed by experienced professionals who worked in the same occupations. Evaluators assigned separate grades for writing quality, content quality and originality as well as an overall grade. Each piece of output was assessed by three evaluators, and the overall score was the average of each score. (Return)


15 - Kalyani, Aakash and Marie Hogan, "AI and Productivity Growth: Evidence from Historical Developments in Other Technologies," Federal Reserve Bank of St. Louis, April 2024. (Return)

Part V: Conclusions

Published on May 31, 2024

Summary

• In this final installment of our five-report series, we bring our expectations for the labor force, net capital stock and total factor productivity (TFP) together in an estimate for U.S. potential economic growth by the end of this decade.

• Robust immigration, strong labor force participation among foreign-born workers and remote work could strengthen labor force growth. Stronger growth in the labor force could boost potential GDP growth by 0.1-0.3 percentage points per annum in the next decade relative to the growth rates of the last decade.

• The hardware and software investment required to fully develop automation and artificial intelligence (AI) capabilities in the business sector will boost capital stock growth. We estimate the net capital stock to grow between 2.5%-3.0% per year by the end of the decade. Under this assumption, net capital stock's contribution to labor productivity growth should ramp up from roughly 1 percentage point at present to 1.5 percentage points or more by 2029.

• Remote work and AI could also lift TFP growth. Working from home gives individuals “relative quiet” and periods of “intense focus” that can make them more productive. Studies of labor-intensive service industries have found that the use of AI significantly reduced the amount of time needed to complete a task and/or raised the “quality” of the output.

• Technological advances generally affect productivity with a long lag because it takes time for the new technology to become widely adopted. To account for these lags, we allow the 5-year moving average of TFP growth to slowly ramp up to 1.9% per annum—its high-water mark from the past productivity boom—over the next twelve years. This scenario translates to TFP growth reaching 1.2%, its long-run average, by 2029.

• Thus, labor productivity could be growing 2.50%-2.75% per annum by the end of the decade in the business sector, which is considerably stronger than the rates registered during the past decade but comparable to 1992-2007. Adding in our forecast for labor force growth shows that the business sector’s potential output could be growing as strongly as 3.5% per annum by 2029.

• Yet, analysts typically consider the total economy, which also includes the government and nonprofit organizations, not just the business sector, when thinking about growth in potential output. We estimate the potential growth rate of the total U.S. economy could rise to about 3% by the end of the decade rather than the 3.5% we expect for the business sector.

• By 2029, the total U.S. economy would be 1.7% larger than today under our estimate for potential growth, versus 1.3% larger under the current consensus estimate of 2.2% potential growth.

• When considering downside risks, the potential economic growth rate could run closer to 2.5% per annum by the end of the decade, although 3% could be achievable. While 2.5% is lower than what was experienced in the 1990s and the early years of the 21st century, it is stronger than the potential growth rates of the post-financial crisis period (~1.8%).

Potential Economic Growth: An Important Concept

We began this five-part series by showing in Part I that the potential economic growth rate of the United States has trended lower since the mid-20th century (Figure 1). Growth in the labor force, which is one of the primary determinants of an economy’s potential growth rate, downshifted from its apex of roughly 3% per annum in the early 1970s to an annual average rate of only 0.5% during the last decade. Growth in labor productivity, which is the other primary determinant of potential economic growth, has waxed and waned over the years, but it too is slower today than it was in the 1950s and 1960s, which were halcyon years for the U.S. economy.

Unlike actual GDP growth, which is reported on a quarterly basis in many countries, an economy’s potential growth rate is unobservable and must be estimated. To many readers, the concept of potential economic growth may appear to be largely an academic exercise. But there are some important real world consequences associated with potential economic growth. An economy that...
can grow at a robust rate for a sustained period, without generating ever-higher rates of inflation, will be better able to project economic and geopolitical power. For example, China was essentially an agrarian economy in 1990. But real GDP in China grew at an average annual rate in excess of 9% between 1990 and 2019 with an average inflation rate of only 4% during that period. China today is the world’s second largest economy with the ability to project military power, at least within the Asian region. Similarly, if there are factors at work that can raise the potential economic growth rate of the United States in coming years, then the U.S. economy can grow at a stronger rate than it has in recent years without leading to higher inflation.

The Determinants of Potential Economic Growth

Growth in the Labor Force

We started our investigation of the potential U.S. economic growth rate in coming years by analyzing labor force growth in Part II. As noted above, labor force growth in the United States was lackluster during the last decade. However, the American labor force grew 1.9% in 2022 and 1.7% in 2023, the strongest growth rates since 2000, due largely to two factors (Figure 2). First, immigration flows were robust. Second, the labor force participation rate (LFPR) rebounded from its pandemic-related nosedive, although it currently remains half-a-percentage-point below its February 2020 level of 63.3%.

We concluded that stronger labor force growth could boost potential GDP growth by 0.1–0.3 percentage points per annum in the next decade relative to the growth rates of the last decade. Researchers at the Congressional Budget Office (CBO) expect immigration will remain elevated in the next few years, and the LFPR of foreign-born workers has been considerably higher than the participation rate among native-born workers for the past two decades. Additionally, the flexibility associated with remote work could lift the female LFPR, especially among women with young children. The LFPR of older individuals, who tend to have lower participation rates than their younger counterparts, also has scope to increase further due in part to rising longevity.

Growth in Labor Productivity

Growth in labor productivity, the other primary determinant of potential economic growth, is itself determined by three factors: growth in the net capital stock, growth in total factor productivity (TFP) and changes in labor “composition” (i.e., shifts in the work force’s age, education or gender). Labor composition has essentially had no effect, on net, on the fivefold increase in the level of labor productivity since the end of the Second World War. We therefore eschewed discussion of this component in earlier installments, and we make the simplifying assumption in this report that labor composition will have a neutral effect on labor productivity growth in coming years.

We showed in Part III that growth in the net capital stock downshifted after the tech build-out of the 1990s (Figure 3). While there has been a surge in the construction of manufacturing facilities recently,
the factory sector is a small slice of the economy. In our view, the spending on hardware and software that will be required to more fully develop automation and artificial intelligence (AI) capabilities in the business sector is what will enable capital stock growth to rival the tech build-out of the 1990s. Under reasonable assumptions about business spending on hardware and software in coming years, we estimate that the net capital stock could be growing between 2.5% and 3.0% per year by the end of the current decade (Figure 3). Under this assumption, the contribution that growth in the net capital stock makes to the annual growth rate of labor productivity should ramp up from roughly 1 percentage point at present to 1.5 percentage points or more by the end of the decade (Figure 4).

We next turned to an analysis of TFP growth in Part IV. The Bureau of Labor Statistics (BLS) defines TFP as “the portion of output growth that is not accounted for by the growth of capital and labor inputs and is due to contributions of other inputs, such as technological advances in production, the introduction of a more streamlined industrial organization, relative shifts of inputs from low to high productivity industries, increased efforts of the workforce, and improvements in managerial efficiency.” As shown in Figure 5, TFP growth slumped in the wake of the global financial crisis, and it has subsequently remained lackluster.

Looking forward, however, there are some reasons for optimism regarding TFP growth. Recent research suggests that productivity (i.e., output per hour worked) can be enhanced via remote work and AI. Working from home gives individuals “relative quiet” and periods of “intense focus” that can make them more productive. Experiments that were conducted among workers in labor-intensive industries such as software development, professional services and administrative & support services found that the use of AI significantly reduced the amount of time needed to complete a task and/or raised the “quality” of the output. The time savings and the quality improvement were especially marked among less experienced workers. In short, AI raised productivity significantly.

As we discussed in the series we published in 2023 on artificial intelligence, major technological advances generally affect productivity with a long lag because it takes time for the new technology to become widely adopted. For example, mobile phones, personal computers and the internet protocol were developed in the 1970s but these inventions really did not begin to have a meaningful effect on productivity growth until the mid-to-late-1990s. To account for these lags in our forward-looking analysis, we allow the 5-year moving average of TFP growth to slowly ramp up to 1.9% per annum—its high-water mark during the tech build-out—over the next twelve years (Figure 5). This scenario translates to the 5-year moving average of TFP growth gradually ramping up to 1.2%, its long-run average, by the end of this decade (2029). Under this assumption, the level of TFP would be about 20% higher in the mid-2030s than it is today. This rise is roughly equivalent to the increase in TFP that occurred between 1992 and 2007 (Figure 6).
Adding It All Up

What does our analysis imply for the potential economic growth rate of the United States in coming years? As shown in Figure 7, our rough estimate suggests that labor productivity in the business sector could be growing 2.50% to 2.75% per annum by the end of the decade, which is considerably stronger than the rates that were registered during the past decade but comparable to the rates of 1992-2007. Adding in our forecast for labor force growth shows that potential GDP in the business sector could be growing as strongly as 3.5% per annum by the end of the current decade (Figure 8).

We would note the following caveats to skeptical readers. First, our estimates for labor productivity are based on the narrowly defined business sector. Analysts typically consider the total economy, which includes the government and non-profit organizations as well as the private business sector, when thinking about the potential output of an economy. CBO’s estimates of the annual potential growth rate of the total U.S. economy are, on average, 0.5 percentage points below estimates of the potential growth rate of the business sector (Figure 9). If that residual is used as a guide, then the potential growth rate of the total U.S. economy would rise to about 3% by the end of the decade rather than the 3.5% we estimate for the business sector.

Second, our rough estimate of productivity growth between now and the end of the decade that is shown in Figure 8 is made under the simplifying assumption that changes in labor composition will have no effect on labor productivity in coming years. If instead, the contribution from labor composition remains modestly negative, as it has been in recent years (Figure 7), then growth in labor productivity would be slightly less robust in coming years than our estimates suggest.
Third, there is considerable uncertainty regarding forecasts of labor force growth and growth in labor productivity, and hence potential economic growth, in coming years. The robust inflows of immigrants that have characterized recent years may not continue, and the rebound in the labor force participation rate may peter out. Growth in TFP, which is unobservable and must be estimated, is a real wild card. Although a return of TFP growth to its long-run trend seems reasonable, we acknowledge that it could take longer than the end of the decade to reach that growth rate due to the lags that historically have been associated with adoption of new technologies. If the actual growth rates of the labor force and labor productivity end up weaker than our estimates, then the potential economic growth rate of the U.S. economy in coming years likely will fall well short of 3% per annum.

That said, the incipient build-out of AI and automation capabilities gives us a reasonable degree of confidence that growth in the net capital stock will strengthen in coming years. CBO estimates that the potential growth rate of the U.S. economy is currently 2.2% per annum at present. In our view, an annual rate of potential economic growth of 2.5% for the total economy by the end of the decade seems reasonable with a rate as high as 3% potentially achievable, especially if AI boosts total factor productivity to the degree that some recent studies suggest.

Implications of Stronger Potential Economic Growth
There are a number of meaningful implications of potential economic growth, starting with an economy’s size. As noted above, CBO estimates that the potential growth rate of the U.S. economy is 2.2% at present. The level of U.S. real GDP stood at $22.4 trillion at the end of 2023, and if real GDP grows at 2.2% per annum through 2029, then the size of the U.S. economy will grow to $25.3 trillion at the end of the decade. If, however, the potential growth rate of the U.S. economy ramps up as we show in Figure 9, then real GDP will rise to $26.2 trillion. In short, the U.S. economy at the end of the 2020s would be 17% larger than today under the stronger growth scenario, versus 13% larger under the current consensus estimate of potential growth (Figure 10).

Furthermore, an economy’s potential growth rate has implications for interest rates. We noted in the series on artificial intelligence that an economy with a higher rate of potential growth would have higher equilibrium real interest rates, everything else equal. If the potential rate of economic growth in the United States strengthens in coming years, then interest rates likely will be higher throughout future business cycles than they were during the last economic expansion. Short-term interest rates, as measured by 1-month LIBOR, averaged about 70 bps between 2010 and 2019, while the yield on the benchmark 10-year Treasury note averaged roughly 2.40% during that period.
Finally, we have noted the positive effect that artificial intelligence can have on productivity growth throughout this series. There is common perception that AI could lead to mass unemployment in coming years, but we think this concern is overblown. As we discussed in our series on AI, technological revolutions can lift employment rather than destroy it. Technology can complement existing jobs by allowing workers to focus on higher value-added tasks, new industries can be created, and the higher levels of aggregate real income that are associated with productivity acceleration can raise demand for all goods and services, thereby bolstering total employment.

Bessen (2019) also argues that new technologies do not necessarily lead to job losses. Bessen explains that new technology reduces prices through labor productivity enhancements, which leads to higher demand for an industry’s good or service and stronger job growth, at least for a period of time. For example, prices of “personal computers and peripheral equipment,” as measured in the Consumer Price Index, have dropped by more than 75% since 2005. But when demand for that good or service eventually becomes satiated, employment in related industries can decline. Consequently, individuals may need to learn new skills to facilitate their transition to other industries and occupations.

We closed our AI series by acknowledging that “new technologies can be disruptive, which can cause detrimental microeconomic effects to individuals that in turn can have social and political consequences.” Therefore, we concluded that “supportive public policy may be needed in coming years if generative AI has disruptive microeconomic effects that lead to social and political pathologies.” But we also stated that “we generally are AI optimists, at least in terms of its macroeconomic effects.” We remain AI optimists today.

Ultimately, we suspect the economy’s potential growth rate is higher than what it averaged over the past expansion (~1.8%). Potential growth rates are challenging to estimate, but we feel reasonably confident that the potential growth rate of the U.S. economy could ramp up to 2.5 per annum by the end of the decade. A potential growth rate as high as 3% could be within reach if labor force growth does not sink back to rates of the past decade and AI adoption speedily diffuses throughout the economy.

Endnote
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