Productivity and Potential Output Growth in the United States

Stephen Oliner
Senior Economist, UCLA Anderson Forecast
Resident Scholar, American Enterprise Institute
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"Productivity isn’t everything, but in the long run it is almost everything. A country’s ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker."

Paul Krugman, The Age of Diminished Expectations

Discussions about the state of the economy tend to focus much more on the monthly wiggles in the data, the Fed’s latest program to stimulate spending, and the drama on Capitol Hill than on the potential for the economy to generate higher income over the long haul. Yet, the growth in potential output is really what matters for the economic health of the nation. Moreover, as emphasized in Krugman’s famous quote, growth in productivity is the engine that drives the rise in living standards. Between 1889 and 2012 — the longest span of time with reasonably consistent data — real output per hour worked in the United States rose about 2¼ percent per year on average. At this annual rate, output per hour doubles every 31 years, which implies roughly a 15-fold increase since 1889.

PRODUCTIVITY GROWTH: A LOOK BACKWARD

Viewed against this long historical record, the recent performance of productivity has been lackluster. Figure 1 plots the data for output per hour worked in the nonfarm business sector over the past forty years, broken into three periods: 1974-95, 1995-2004, and 2004-12. During the first period, output per hour grew at an average annual rate of about 1½ percent, well below the long-term average pace of 2¼ percent. Productivity growth strengthened from 1995 to 2004, rising about 3 percent per year. But since 2004, the trend increase in output per hour has returned to the slow pace recorded from 1974 to 1995. Notably, this slowdown pre-dated the onset of the financial crisis. Thus, while the dislocations produced by the crisis likely have damped the gains in productivity, they are not the root cause of the slowdown.

Figure 1. Growth in Real Output per Hour in the Nonfarm Business Sector

Source: Bureau of Labor Statistics
PRODUCTIVITY AND POTENTIAL OUTPUT GROWTH IN THE UNITED STATES

To analyze the growth in output per hour, economists often distinguish between the contributions from three sources: changes in the composition of the workforce, capital deepening, and multifactor productivity (MFP). With regard to workforce composition, an hour worked by a highly productive person will generate more output than an hour worked by someone with less skill and experience. Thus, shifts in the mix of workers affect aggregate output per hour. Capital deepening, the second factor, contributes to growth in output per hour by increasing the amount of equipment and other types of capital used by workers, while MFP refers to the ability to produce more output with a given amount of capital and labor. To illustrate the distinction between capital deepening and MFP, if I become more productive by replacing my old computer with a new more powerful one, that increase in output per hour is the result of capital deepening. But even with my old computer, the Internet made it possible to find information many times faster than before the web existed, which represents an increase in MFP.

Table 1 presents this type of decomposition back to 1974, with additional detail about the growth contribution from information technology (IT). The contribution from IT capital deepening measures the increase in output per hour from the use of computers and peripheral equipment, software, and communication equipment throughout the economy. By contrast, the contribution from MFP in IT-producing sector captures the efficiencies achieved by firms that produce computers and peripherals, software, communication equipment, and semiconductors. We include semiconductors in this group because advances in semiconductor technology are the ultimate source of the performance improvements and price declines for IT capital goods.

The first line of the table shows the rapid gains in output per hour over 1995-2004, sandwiched between the two periods of sluggish advances. Much of this variation reflects shifts in the growth contribution from information technology. IT capital deepening was unusually rapid from the mid-1990s to 2004, as was multifactor productivity growth in the IT-producing part of the economy. This was a period of extraordinary advances in semiconductor technology, which led to sharp declines in quality-adjusted prices for computers and communication equipment. Investment in IT capital surged as a result. At the same time, the development of the Internet made this IT capital more productive than when it was used on a largely stand-alone basis. The rapid decline in the cost of computing power combined with enhanced connectivity spurred far-reaching changes in the way business was done. Two examples were the advent of online retailing and the development of sophisticated inventory control systems. The efficiency gains resulting from these and other innovations contributed to the hefty rise over 1995-2004 in MFP outside the IT-producing sector of the economy.

Table 1 also indicates that IT-related factors explain much of the deceleration in output per hour since 2004. First, the price declines for IT capital goods have moderated, reducing the incentive to invest in this equipment and

| Table 1. Contributions to Growth of Output per Hour in the Nonfarm Business Sector |
|-------------------------------------|-----------------|-----------------|-----------------|
| Growth of output per hour (percent) | 1.56            | 3.06            | 1.56            |
| Contributions* (percentage points): |                 |                 |                 |
| Information technology             | .77             | 1.50            | .65             |
| IT capital deepening               | .41             | .78             | .36             |
| MFP in IT-producing sector         | .36             | .72             | .29             |
| Non-IT capital deepening           | .33             | .44             | .38             |
| MFP outside IT-producing sector    | .13             | .90             | .05             |
| Labor composition                  | .26             | .22             | .34             |

Source: Byrne, Oliner, and Sichel (2013).
a. Excludes the effects of cyclical influences on MFP growth.
thus slowing the rate of capital deepening. Second, the IT-producing sector — which accounts for a disproportionate share of MFP growth in nonfarm business — has shrunk as domestic firms have shifted production abroad. Indeed, the share of nonfarm business output represented by computers and peripherals, communication equipment, and semiconductors has fallen more than 70 percent from its peak in 2000 (see figure 2). Third, the most productive uses of the Internet may have been adopted early on, giving way to smaller innovations in recent years. This pattern would be consistent with the historical regularity that innovation comes in waves.

Over and above these IT-specific explanations for the post-2004 slowdown, the financial crisis surely took a bite out of productivity growth by reducing the financing available for early-stage business ventures and by causing firms to become more cautious about all forms of investment activity.

PRODUCTIVITY GROWTH: THE OUTLOOK

Can we expect the anemic performance since 2004 to persist for many more years, or might the future look brighter? Before presenting the forecasts from several sources, we should stress that productivity growth is notoriously hard to predict. Almost all analysts have failed to anticipate the major shifts in growth over the past several decades, and we should not expect much better going forward. Even so, the forecasts provide a useful snapshot of informed opinion on the matter.

Table 2 presents the projections for growth in output per hour from four sources: the Congressional Budget Office (CBO); the median forecast from the Survey of Professional Forecasters (SPF), which collects projections from a large group of economists in the private sector and academia; Robert Gordon of Northwestern University, who has analyzed productivity issues for many years; and the estimates that I have developed with Daniel Sichel and other coauthors. The CBO, SPF, and Gordon projections all

<table>
<thead>
<tr>
<th>Source</th>
<th>As of 2007</th>
<th>As of 2013</th>
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<tr>
<td>Congressional Budget Office</td>
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<td>2.1</td>
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<tr>
<td>Survey of Professional Forecasters (^a)</td>
<td>2.2</td>
<td>1.8</td>
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<tr>
<td>Robert Gordon</td>
<td>2.0</td>
<td>1.75</td>
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<tr>
<td>Oliner/Sichel framework</td>
<td>2.3</td>
<td>1.8</td>
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pertain to productivity growth in the nonfarm business sector over the coming ten years. The Oliner/Sichel figures also apply to the nonfarm business sector but have no specific time horizon, as they represent the steady state of a growth model under a variety of assumptions.

As shown in the table, just before the onset of the recession in late 2007, the projections of growth in output per hour clustered between 2 and 2.3 percent, close to the historical average rate of increase. All the forecasts have been revised down since then. The average of the 2013 forecasts, at about 1.9 percent, sits slightly below the long-run historical average, undoubtedly reflecting the cumulative effect of the weak productivity growth since 2004. Another factor that weighs on the Oliner/Sichel estimate is the dramatic shrinkage of domestic production of IT goods, which as noted above, has been an important source of MFP growth in the United States. We assume that little of this production will come back home in the near future.

Overall, these projections envision a period of decent gains in productivity — below the long-run average rate but better than the anemic pace in recent years. It is possible to imagine a more favorable outcome, one driven by a new IT revolution that boosts productivity by combining the diffusion of cheap handheld devices with access to "big data". Nothing dictates that IT will induce only one period of rapid growth. In fact, the era of electrification in the United States was associated with two such periods, one from 1915 to 1924 and a second from 1933 to 1940. But at this point, a second wave for IT is not evident in the data.

FROM PRODUCTIVITY TO POTENTIAL OUTPUT

Potential output is the maximum level of real GDP that could be attained with a stable rate of inflation. Currently, the actual level of real GDP in the United States is below potential as the unemployment rate remains above the so-called natural rate that economists associate with a stable pace of increase in labor costs and prices. The growth of potential output can be thought of as a speed limit for an economy that has reached full employment (as defined by the natural rate). Of course, in the current situation, real GDP can — and hopefully will — grow faster than the potential rate for a while to bring down unemployment without igniting inflation pressures.

The CBO estimates growth of potential GDP in three steps. First, it estimates trend growth of output per hour in nonfarm business, which we discussed above. Next, it adds an estimate of trend growth in hours worked to measure potential output growth in nonfarm business. Finally, it converts the measure of potential output growth in nonfarm business into an estimate of potential GDP growth by accounting for developments in other sectors of the economy.

Figure 3 shows the CBO’s estimate of potential GDP growth since 1950 and its projection for 2012-22. As can be seen, potential growth has slowed over time, falling from roughly 4 percent in the 1950s and 1960s, to 3 percent in the 1980s and 1990s, and to less than 2½ percent over 2000-12. The main factor that restrained potential output growth over 2000-12 relative to earlier periods was a sharp slowdown in the growth of the labor force, which reflected the front wave of retirements by baby boomers and the end of the earlier increase in labor force participation by women. Looking ahead to the coming decade, the CBO anticipates that potential hours growth will remain subdued, averaging 0.5 percent annually. This forecast, combined with the CBO’s projection that output per hour will trend up at a 2.1 percent annual rate (see above), implies that potential output in nonfarm business will expand 2.6 percent per year. The adjustment to cover all of GDP brings this figure down to 2.2 percent, mainly due to limited growth in the government sector.

The CBO, of course, is not the last word on this subject. The Federal Reserve publishes forecasts of potential GDP growth submitted by the members of the Federal Open Market Committee. In the December 2012 forecast, the central tendency range (computed by throwing out the three lowest forecasts and the three highest) was 2.3 to 2.5 percent, slightly above the CBO projection. It is also possible to generate a forecast for potential output growth that is weaker than the CBO’s. As shown in table 2 above, the CBO was on the high end of the projections of growth in output per hour. Substituting the other forecasts in the table for CBO’s projection, all else equal, would bring down...
CBO’s projected growth in potential GDP to the neighborhood of 2 percent. All of this suggests that a reasonable range for projected growth in potential GDP is between 2 and 2½ percent per year.

CONCLUSIONS

Productivity growth in the United States has been anemic since 2004, due in large part to a smaller contribution from the use and production of IT capital. The financial crisis and its aftermath likely have held back the gains in productivity as well. Analysts generally expect productivity growth to pick up somewhat in coming years but not by enough to match the long-run average advance of 2¼ percent per year. An upside risk is that widespread business adoption of handheld devices connected to massive data resources could deliver a new wave of rapid productivity growth. However, there is no sign yet of these effects in the data.

With the prospect of slightly subpar growth in productivity and only modest increases in trend labor input, potential GDP is expected to advance only 2 to 2½ percent per year, well below the average postwar pace. Any analysis that involves longer-term economic projections should recognize that, in all likelihood, the United States will be a slow-growth economy for some time to come.

Nonetheless, it bears emphasis that the growth outlook for the United States is not set in stone. The future will be brighter if we proceed with sensible policy actions on several fronts. These include greater emphasis on high-quality education, immigration reforms that increase the pool of talent in the U.S., investment in infrastructure, and additional government support for basic scientific research. Nothing fancy here — just taking care of the basics.

REFERENCES


ENDNOTES

1. For a detailed discussion of the data and methodology used in this decomposition, see Oliner, Sichel, and Stiroh (2007).
2. For further discussion of developments in the semiconductor industry, see Aizcorbe, Oliner, and Sichel (2008).
4. Although the question is phrased in terms of "longer run" GDP rather than "potential GDP," the instructions guide the respondents to provide a forecast of potential GDP growth.