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Reassessing Longer-Run U.S. Growth: How Low?

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Abstract: What is the sustainable pace of GDP growth in the United States? A plausible point forecast is that GDP per capita will rise well under 1 percent per year in the longer run, with overall GDP growth of a little over 1-1/2 percent. The main drivers of slow growth are educational attainment and demographics. First, rising educational attainment will add less to productivity growth than it did historically. Second, because of the aging (and retirements) of baby boomers, employment will rise more slowly than population (which, in turn, is projected to rise slowly relative to history). This modest growth forecast assumes that productivity growth is relatively "normal," if modest—in line with its pace for most of the period since 1973. An upside risk is that we see another burst of information-technology-induced productivity growth similar to what we saw from 1995 to 2004.

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I. Introduction

What is the "new normal" for U.S. GDP growth? A traditional rule of thumb is that GDP per capita will grow around 2 percent per year. That was its average per-capita pace over long periods (1870 to 2007; see, for example, Jones, 2015) as well as more recent periods (e.g., the so-called "Great Moderation" period of 1984 to 2007). With population projected to grow about ¾ percent per year over the next decade, that historical rule of thumb would suggest overall growth of around 2¾ percent.

This paper argues that the new normal pace is likely to be well below that old normal. Based on trends in demographics and productivity, a reasonable modal forecast for GDP is in the range of 1½ to 1¾ percent; my point estimate for longer-run growth (calibrated to a time horizon of around 7 to 10 years out) is 1.6 percent per year. GDP per capita would then grow about 0.9 percent per year.[1]

The slow pace implies slow growth in average wages and living standards. For businesses, it implies relatively modest growth in sales. For policymakers, it suggests a low "speed limit" for the economy and relatively modest growth in tax revenue. It also suggests a lower equilibrium or neutral rate of interest.[2]

The main reasons the new normal for GDP per capita is slower than the old normal are educational attainment and demographics. First, we are unlikely to replicate the strong growth in educational attainment seen in the 20th century (Goldin and Katz, 2009; Bosler et al., 2016;

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[1] Focusing on a time horizon 7 to 10 years allows any cyclical dynamics associated with the Great Recession to unwind. For example, as of this writing (mid-2016), capital might be below steady state because of cyclically weak investment; and cyclically-induced decisions regarding labor-force participation might take a number of years to play out. At the same time, as we move further into the future, demographics slowly evolve and also becomes less certain (e.g., because of immigration and uncertainty about mortality rates). The main arguments in this paper will not surprise readers of Dale Jorgenson (e.g., Jorgenson et al., 2016), Bob Gordon (e.g., Gordon, 2014, 2016) or earlier papers of mine (e.g., Fernald, 2015). The analysis here reflects updated data and analysis.

[2] See Laubach and Williams (2003). The link between growth and the neutral real rate holds in many models. For example, it does not require that the consumption Euler equation for a representative consumer hold. For example, in the canonical Solow model, slower productivity growth implies a lower steady-state marginal product of capital.

Jorgenson et al., 2016). Hence, labor quality will add notably less to GDP per hour than it did historically. Second, as the population ages and baby boomers retire, hours worked are expected to grow more slowly than the overall population. That slower pace reduces growth in GDP per capita relative to growth in GDP per hour. In contrast, during the second half of the 20th century, the reverse was true—baby boomers were entering prime working age and women were increasingly entering the labor force, so GDP per capita *exceeded* growth in GDP per hour.

Of course, this forecast also assumes that productivity growth will be only modest. An intuitive baseline is that productivity growth, net of labor quality growth, will be relatively "normal" and incremental: Relatively similar, perhaps, to the 1973-95 period, or to what we have seen on average since 2004. For example, 1.6 percent growth in GDP is consistent with growth in GDP per quality-adjusted hour of just under 0.9 percent per year, its average pace from 1973-95. This pace nevertheless requires a substantial pickup in productivity growth from its pace since 2010.

Section II considers demographics. It makes two points. First, the labor force will grow much more slowly than historically, around ½ percent per year. Second, because of the aging of the population, the labor force will grow more slowly than the overall population, which is expected to rise about ¾ percent per year in the mid-2020s. This "wedge" implies that GDP per capita will rise more slowly than GDP per worker, or GDP per hour.

Section III considers productivity at a relatively intuitive level, focusing on GDP per hour worked. It argues that a "regimes" view fits the data well, with normal periods and exceptional ones. These regimes tend to be persistent. There was an exceptional IT-induced pace that started after 1995 but that ended around 2004, prior to the Great Recession. The best guess is that we're in a normal/incremental/slow regime now. A back-of-the-envelope projection that assumes productivity growth (net of labor quality growth) will be similar to its 1973-95 pace implies GDP growth of around 1.6 percent.

Section IV considers a more nuanced growth-accounting perspective on productivity growth. It updates the analysis in Fernald (2015), which uses a multi-sector growth model for the projections. Although the details differ—and it bases projections on TFP data since 2004—it also implies a preferred point estimate of 1.6 percent per year. This section also discusses the period since 2010, when labor productivity has been exceptionally weak. Over this shortperiod, the "fundamentals" of labor-productivity growth (namely, growth in total factor productivity, TFP) have exceeded the actual realization, for reasons that reflect the unwinding of dynamics of labor quality and capital deepening associated with the Great Recession.

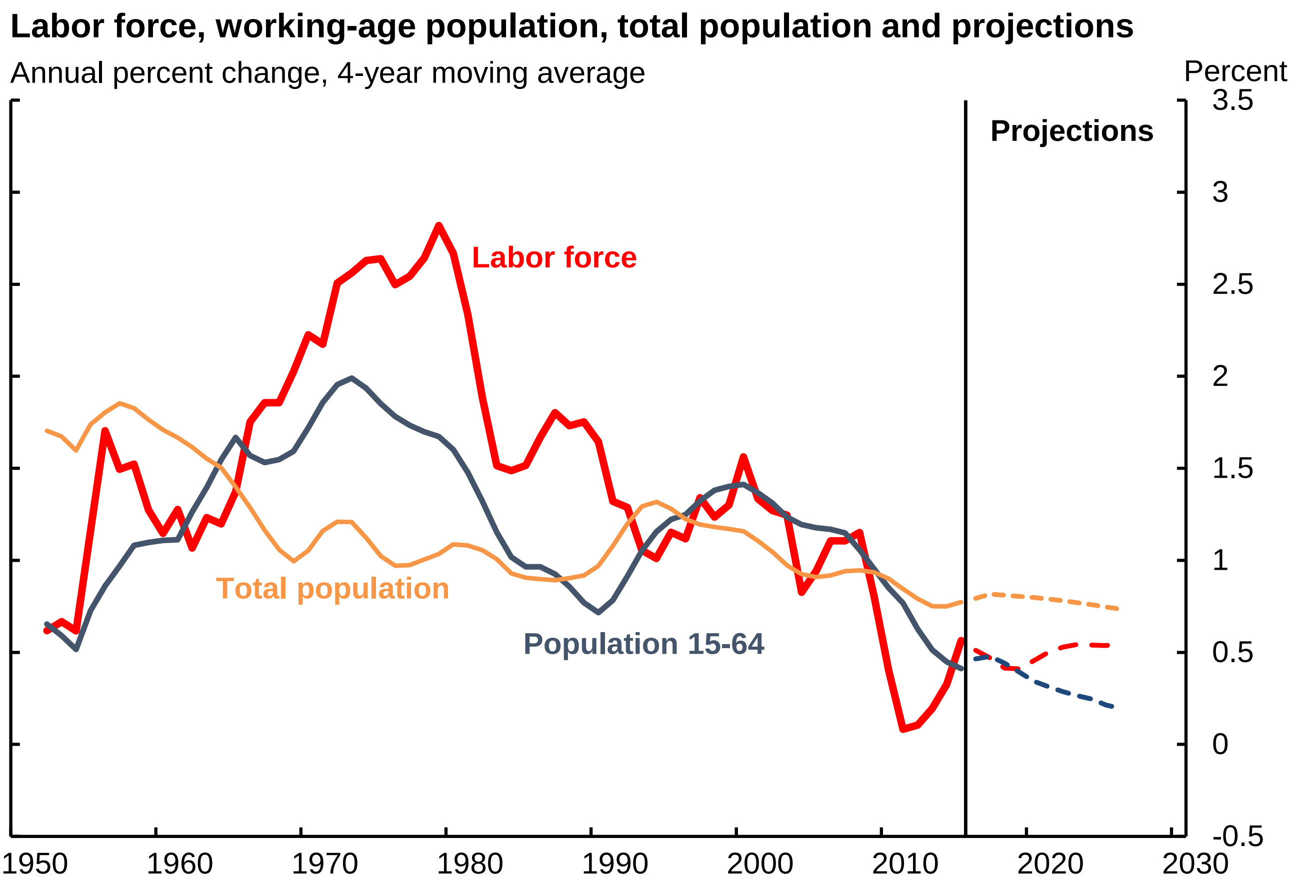
Section V considers several other explanations why recent productivity experience has been relatively modest. Section VI considers the sizeable risks around any forecast. I then conclude.

II. Subdued growth in the labor force

Going forward, the labor force is expected to grow at a subdued pace relative to history. In addition, because of the aging of the population, the labor force is likely to grow more slowly than the overall population. Because of this "wedge," GDP per capita will rise more slowly than GDP per worker, or GDP per hour.

Figure 1 shows that growth in the labor force has varied substantially over time, and has often diverged from growth in overall population. In the 1950s and 1960s, population (in yellow) grew more rapidly than the working-age population (shown here as those aged 15 to 64, in blue) or the labor force (red). In contrast, in the 1970s and 1980s, the labor force grew much more rapidly than population. One reason was that the baby-boom generation was entering the labor market, so the working-age population grew more rapidly than overall population. In addition, rising female labor-force participation raised labor-force growth even relative to the working age population.

Figure 1: Slowing growth in working-age population and labor force



Note: Labor force projections from Congressional Budget Office (CBO). Sources: BEA, BLS, CBO, and Census.

Going forward, slow growth of the working-age population implies that labor force growth is likely to remain slow. Indeed, according to Census projections, the working-age population will grow more slowly than the overall population, reflecting the aging of baby boomers. Of course, some of those older individuals will continue to work. With assumptions about trends in labor-force participation by different groups of workers, the CBO projects labor-force growth of about ½ percent per year (red dashed line) as of the middle of the next decade—substantially slower than in the second half of the 20th century.[3]

[333] Bosler et al. (2016) discuss the sensitivity of hours projections to participation assumptions.

III. Slow-growth regime for productivity

Many macroeconomic models assume that trend U.S. productivity growth is constant over time. A motivation is the surprisingly consistent growth rate of GDP per capita since 1870. But, as the previous section suggestions, GDP per *capita* has differed from GDP per *hour*. There is limited empirical justification for the view that trend growth in GDP per hour has been constant. For example, straightforward break tests on productivity growth suggest that trend growth varies over time (Fernald, 2007, 2015). Regime-switching models suggest that trend growth varies over time (Kahn and Rich, 2007). And some growth models suggest that U.S. growth per capita has been well above its steady-state pace, implying growth may change (Jones, 2002, Fernald and Jones 2014).

One view of the history of productivity growth is that there are normal periods and exceptional ones. This is essentially the view in Gordon (2016) and Fernald (2015) as well as in the broader literature on general purpose technologies. Unusual influences—such as the steam engine, electric dynamo, internal combustion engine, and microprocessor—promote a host of complementary innovations which boost productivity growth broadly for a time.[4]

For example, productivity growth before 1973 was exceptional, reflecting gains associated with electricity, the telephone, the internal combustion engine, the Interstate Highway System (Fernald 1999), and so forth. Those exceptional gains ran their course by the early 1970s, and productivity growth receded to a normal, modest pace.

Starting around 1995, productivity growth was again exceptional for eight or nine years. Considerable research highlighted how businesses throughout the economy used information technology (IT) to transform what and how they produced.[5] After 2004, the "low-hanging fruit" of

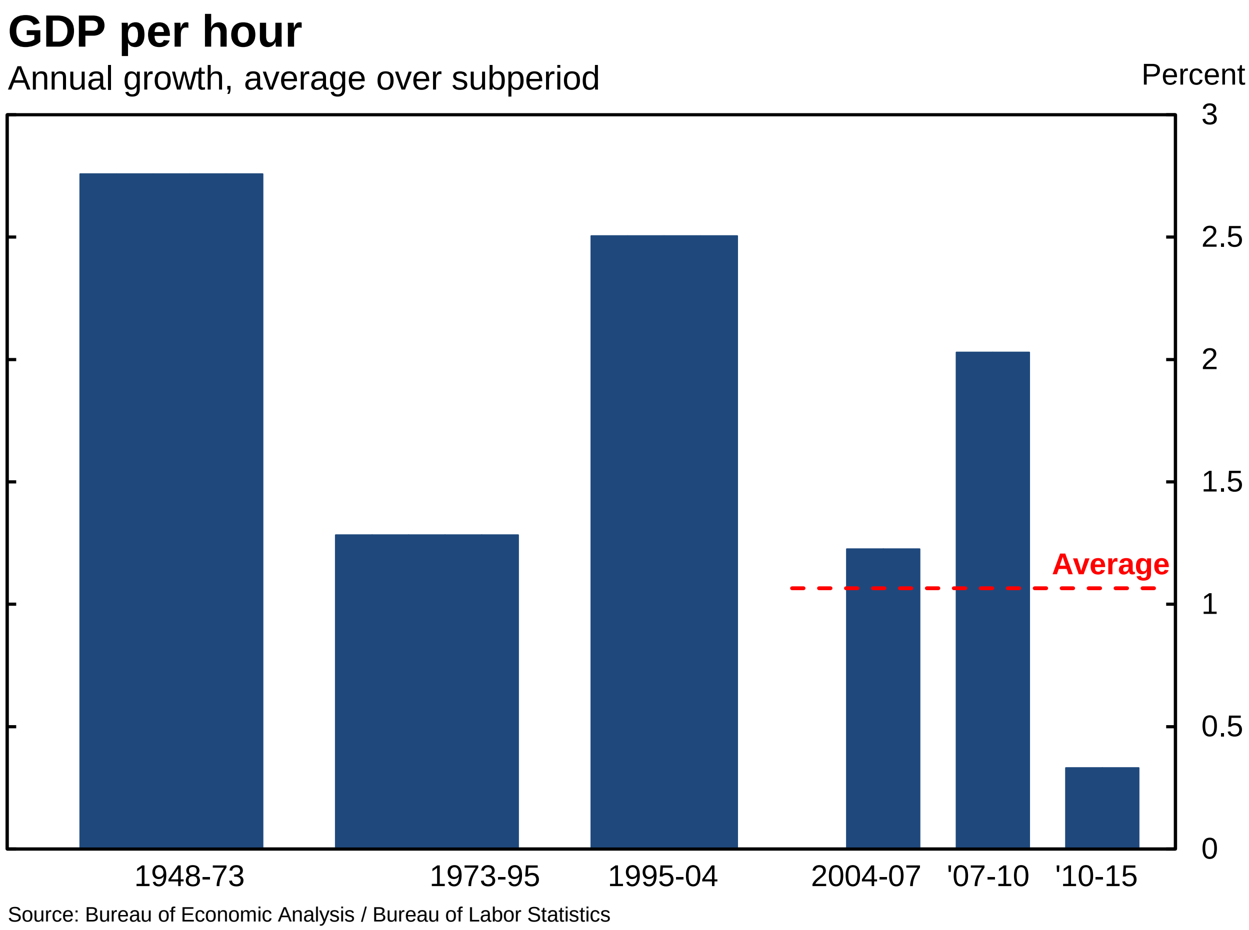
[4] Bresnahan and Trajtenberg (1995) discuss general purpose technologies (GPTs) and Basu et al. (2004) link them to growth accounting. Fernald and Jones (2014) discuss how to model GPTs in a model of semi-endogenous growth.

[5] See, for example, Brynjolfsson and Hitt (2000), Basu, Fernald, Oulton, and Srinivasan (2004), and Van Reenen et al. (2010).

IT had been plucked. Productivity growth returned to a more normal, modest, and incremental pace—not that different from the earlier period of 1973-95.[6]

The economic logic in the preceding paragraphs implies that underlying productivity growth might vary over time. Figure 2 shows subsample averages in growth in GDP per hour. The (exceptional) "fast growth" periods (1948-1973 and 1995-2004) have similar means, as do the "slow growth" periods (1973-95 and 2004-15). The next section discusses the very slow-growth 2011-2015 period separately.

Figure 2: Regimes in GDP per Hour



[6] A somewhat different hypothesis about slow productivity growth, which leads to the same conclusion for growth (but different policy prescriptions), is reduced dynamism (e.g., Decker et al., 2016). Causation is not necessarily clearcut. For example, if the "problem" is the lack of low-hanging fruit for the broad economy, then the lack of dynamism might simply be a symptom of that lack of opportunity.

Statistically, Kahn and Rich (2007) find that a two-state Markov process—with “fast” (about 3 percent) and “slow” (about 1¼ percent) regimes for non-farm business productivity growth—fits the data well. A recent update of their model (Kahn and Rich, 2016) puts very high probability on the economy being in the low-growth regime at present. Transitions between regimes are infrequent.

Table 1 decomposes annual growth rates of GDP by sub-period (column 1) into GDP per hour (column 2) and total-economy hours (column 3). It also shows two “naïve” projections for GDP growth going forward. Both projections assume that total-economy hours grow at 0.55 percent per year (consistent with CBO assumptions for the 2023-26 period).

The first projection assumes that productivity growth (GDP per hour, column 2) grows at its average pace from 1973-95 of 1.28 percent per year. In this scenario, GDP growth would be a bit above 1¾ percent per year. This is a notable stepdown from the actual GDP growth rate of just under 3 percent from 1973-95. By construction, the entire stepdown in growth in this scenario is from slower growth in hours worked.

Table 1: Decomposing GDP growth by sub-period

	GDP	GDP per hour	hours	Labor quality	Qual.-adj. hours	GDP per quality-adj. hour
	(1)	(2)	(3)	(4)	(5)	(6)
1948-73	3.95	2.76	1.19	0.27	1.46	2.49
1973-95	2.86	1.28	1.58	0.42	2.00	0.86
1995-04	3.36	2.51	0.86	0.39	1.25	2.12
2004-15	1.59	1.07	0.52	0.46	0.98	0.60
2004-07	2.56	0.87	1.34	0.33	1.67	0.89
2007-10	-0.20	1.80	-2.23	0.84	-1.39	1.19
2010-15	2.07	0.47	1.68	0.31	1.99	0.08
"Naïve" project. I	*1.83*	***1.28***	0.55	*0.20*	0.75	*1.08*
"Naïve" project. II	*1.61*	*1.06*	0.55	*0.20*	0.75	***0.86***

Notes: Total economy hours (column 3) are from unpublished BLS data. Labor quality (column 4) is from Fernald (2014) and corresponds to the business sector. Both projections assume labor quality grows at 0.2 percent per year (Bosler et al., 2016). Naïve projection I assumes GDP per hour (column 2) grows at its average pace from 1973-95. Naïve projection II assumes GDP per quality-adjusted hour (column 6) grows at its average pace from 1973-95.

For longer-run GDP growth to do much better than 1¾ percent requires that productivity growth be faster than it was in the 1973-95 period. But productivity growth could easily be lower than in the 1973-95 period. First, productivity growth has grown more slowly from 2004-2015 than in the 1973-95 period. And productivity growth has grown much more slowly since 2010 (Table 1 and Figure 2).

Second, even apart from the recent experience, an important reason to expect slower productivity growth in the future is that educational attainment will add much less to productivity growth via labor quality. Labor quality, which measures the contribution of education and experience, rose 0.42 percent per year from 1973-95.[7] Hence, it "explained" a substantial share of productivity growth. In contrast, Bosler et al. (2016) estimate that from 2022-2025, labor quality

[7] Labor-quality measures have been standard in growth accounting since Jorgenson and Griliches (1967). See Bosler et al (2016) for a review.

will rise only about 0.10 to 0.20 percent per year. (Jorgenson, et al, 2016, is qualitatively similar though for a different time period: They estimate that labor quality will rise less than 0.10 percent per year from 2014-2024.) On its own, then, reduced labor quality growth suggests marking down productivity and GDP projections by at least 2/10th of a percentage point and possibly more. (In economic models, the mapping from labor quality growth to productivity growth is one-for-one. [8])

The second naïve projection in Table 1 assumes that GDP per *quality-adjusted* hour (column 6) grows at its 1973-95 pace of 0.6 percent per year. If labor quality grows at 0.2 percent per year, then GDP growth in this scenario would be only a bit above 1-1/2 percent per year (1.61 percent).

This discussion highlights that GDP growth of only 1-1/2 to 1-3/4 percent per year would be consistent with productivity performance that we have seen historically. The main reason growth is expected to be low relative to history is demographics and education.

IV. Detailed growth accounting

This section looks in detail at growth-accounting fundamentals. It then uses a multi-sector neoclassical growth model to make projections about the future. The model takes technological progress as exogenous. Fernald and Jones (2014) suggest that this approach may be a reasonable approximation over a decade or two, given the uncertainties in the forecasts (and timing) of even more fundamentally based endogenous growth models. A range of scenarios is, of course, possible. Nevertheless, my preferred point estimate for GDP growth of 1.6 percent is consistent with continued slow growth in productivity. Although the logic differs in places, this point estimate matches the second naïve projection from the previous section.

[8] In standard growth accounting, the contribution needs to be multiplied by labor's share. But in neoclassical growth models, that effect would be magnified because of induced capital deepening—by exactly enough to offset the labor-share adjustment. In other words, in these models, exogenous TFP explains capital per quality-adjusted hour. This means that if quality-adjusted hours grow faster, growth in the long-run rises one-for-one.

a. The rise and fall of exceptional productivity growth

As we saw earlier, labor productivity growth has been weak since the mid-2000s and—following a brief rebound during and immediately after the Great Recession—extraordinarily weak since 2010. Figure 3 shows a growth-accounting decomposition of business-sector productivity growth. The business sector is about ¾ of overall GDP.[9]

In contrast to labor productivity, TFP growth has been more consistent over sub-periods since 2004. Even since 2010, the pace has been only modestly weaker than its 1973-95 average. Typical macro models—starting from at least Solow (1956)—take TFP as the fundamental driver of labor-productivity growth. Thus, we would naturally expect some rebound in labor productivity performance relative to the past five years.

The "shortfall" in productivity growth relative to fundamentals reflects, at least in part, the unwinding of two dynamics associated with the Great Recession. First, at the end of the Great Recession, businesses had a lot of capital relative to labor, which has attenuated the need to add capacity to meet demand in recent years. In contrast to the outsized growth in capital deepening from 2007-2010, we have seen capital "shallowing" since 2010. Second, businesses fired low-skilled workers during the recession, which raised labor quality in the 2007-2010 period. As these potential workers have been rehired, the growth rate of labor quality has added less.

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[9] The non-business portion of the economy is government, households (mainly owner-occupied housing), and non-profits. Productivity in a large portion of the non-business sector reflects assumptions rather than data. So productivity growth in the non-business sector is very smooth.

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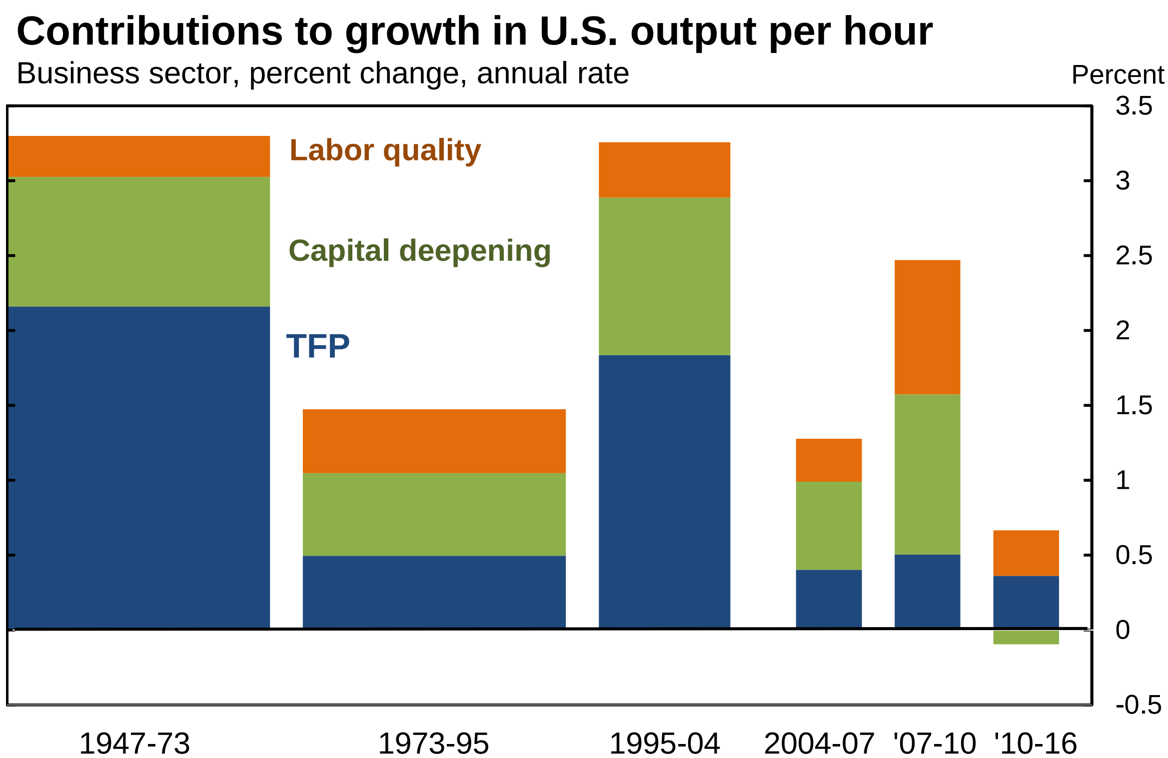
Figure 3: Recent productivity growth…weak and weaker



Source: Fernald (2014a). Quarterly; samples end in Q4 of years shown except 1973 (end Q1) and 2016 (end Q2). Capital deepening is contribution of capital relative to quality-adjusted hours. Total factor productivity measured as a residual.

b. Method of projecting with a multi-sector growth model

Following Fernald (2015), this section projects GDP growth based on a multi-sector neoclassical growth model. The model is used to project business-sector productivity growth (measured in terms of quality-adjusted hours). In this model, one sector produces investment goods and the other sector does not. The reason for using this decomposition is that, in the neoclassical model, steady-state capital deepening depends solely on investment-sector TFP.[10] Growth in labor productivity (net of labor quality) is:

$$\hat{Y} - \hat{H} - \widehat{LQ} = \alpha \widehat{TFP_I}/(1-\alpha) + \widehat{TFP} \tag{1}$$

Y, H, and LQ are, respectively, output, hours, and labor quality. TFP is overall TFP, and TFP_I is investment-sector TFP. α is the share of reproducible (net of land) capital, which I set to its 2007 value of 0.324.[11] Hats indicate growth rates.

Data are from Fernald (2014). Investment TFP growth is a user-cost-weighted average of TFP growth for equipment and consumer durables; intellectual property products; and structures. These measures are derived from overall TFP using relative prices (Greenwood, Hercowitz, and Krusell, 1997).

Given a forecast for business-sector productivity growth, the following additional assumptions are used to map to a forecast for GDP growth:

- Quality-adjusted hours grow 0.75 percent per year, based on Bosler et al. (2016, Section 5.4). This projection is consistent with rising labor-force participation rates for older, more-educated individuals and falling participation rates for younger, less-educated individuals. Although these trends are uncertain, they appear consistent with the CBO projection that hours growth over the period 2023-26 will average 0.55 percent per year (as shown by the labor-force projection shown in Figure 1). Bosler et al (2016) find that those trends are consistent with labor-quality growth of 0.15 to 0.25 percent per year. My projection is consistent with using the CBO hours and the midpoint for labor quality, or 0.2 percent per year. (A projection of 0.75 percent for quality-adjusted hours is, in fact, towards the upper end of what Bosler et al consider reasonable.)
- Non-business output grows 0.96 percent per year, from the CBO (average growth 2023 to 2026).

[10] See Fernald (2015) for further details on the model and underlying assumptions. The model abstracts from a large number of potentially important issues related to automation, artificial technology, robots, and the like. Nordhaus (2015) discusses substitution elasticities (on the supply or the demand side) that differ from one. Hémous and Olsen (2016) and Acemoglu and Repolo (2016) discuss a broader range of issues related to automation.

[11] In 2015, capital's share (exclusive of land) had risen to 0.343. In the non-financial corporate sector, capital's share in 2016:Q1 was only modestly above its 2007 level.

c. Projected growth rates from the model

The economic logic of Section IV suggests that we have been in a "normal" (aka, slow) productivity-growth regime. My benchmark modal forecast assumes that this pace continues, as calibrated using data since 2004. That projection implies a forecast of about 1.6 percent for GDP per capita.

Specifically, given any window of data (say, my benchmark from 2004:Q4 to the present), I project labor productivity growth by inserting average growth in investment-sector and overall TFP into equation (1) above. In Table 2 below, column (1) shows estimates based on data from 2004:Q4 to the present. Business-sector labor productivity (row 3), in terms of quality-adjusted hours, grows 1.02 percent in this projection.

With quality-adjusted-hours growth of 0.75 percent, business output growth is 1.02+0.75=1.77 percent. Assuming the business-sector share remains at its current value of 76 percent, and that non-business output grows at 0.96 percent per year, longer-run GDP growth based on data from 2004:Q4 on would be 1.57 percent per year.

The predicted pace using data since 2004 slightly exceeds the actual productivity pace since 2004, reflecting a shortfall of capital deepening relative to the model. Business-sector labor productivity net of labor quality grew only 0.9 percent per year from 2004 through 2015. (For the total economy, shown in Table 1, the pace was only 0.60 percent.) Still, an ex post miss of only 1/10th percentage point between the steady-state model and the data does not seem large.

Table 2: Projecting labor productivity and GDP

	Variable	(1) Since 2004:Q4	(2) 1973Q1-1995Q4	(3) Since 1973:Q1	(4) AveW	(5) ExpS (δ = 0.02)	(6) ExpS (δ = 0.04)
(1)	**Overall TFP**	0.41	0.49	0.75	0.82	0.76	0.55
(2)	**Investment TFP**	1.26	0.87	1.36	1.60	1.55	1.31
	Bus. sector labor prod.						
(3)	**Projection**	1.02	0.91	1.40	1.58	1.47	1.17
(4)	**GDP projection**	1.57	1.49	1.86	2.00	1.91	1.69

Notes: Business-sector labor-productivity projections in row (3) are net of labor quality. Columns (1) through (3) show data and projections for particular windows of data. For each window, the average pace of growth of overall TFP and investment TFP are used to project business-sector labor productivity. Column (4), the AveW estimator, uses all windows that start from 1973Q1 through 2007Q4 (and that end in 2016Q2) and then averages the implied labor-productivity projections. Columns (5) and (6) show exponential smoothing (ExpS) estimates (as of 2016Q2) from the formula $ExpS_{x,t} = (1-\delta)ExpS_{x,t-1} + \delta x_t$. The GDP projections in row (4) assume quality-adjusted hours grow 0.75 percent per year and that non-business output grows 0.96 percent per year (derived from CBO assumptions for 2023-26).

Using the data since 2004 is only one window for the "normal" regime. Column (2) shows that, using averages from 1973-95, business-sector productivity would grow at only a 0.9 percent pace, and GDP growth would be under 1½ percent. Even though overall TFP growth (line 1) since 2004 has been a touch slower than its pace from 1973-95, investment TFP growth has been faster in the recent period. Thus, implied growth in capital deepening, business-sector labor productivity, and GDP are also faster.

An important question is whether to use any specific window at all. The forecasting literature, e.g., Pesaran et al. (2013), suggests that, in the presence of structural change, it may not be optimal (in terms of minimizing mean squared prediction error) to focus on a single window. For example, there is uncertainty about exactly when the break occurred and there is a relatively short sample since the break.

One method recommended by Pesaran et al. (2013) is the so-called AveW estimator. The AveW estimator in Table 2 averages forecasts from all windows that start between 1973:Q2 and 2007:Q4 and end at the most recent date (2016:Q1). For each window, I calculate the average pace of growth in investment and overall TFP over the window. I then use equation (1) to calculate the corresponding labor-productivity projection for each of those windows. AveW then averages these projections over all the windows.

Column (4) shows that the AveW estimator, applied to the multisector growth model, implies a mean estimate of 0.8 for overall TFP growth, 1.6 percent for business-sector productivity growth, and 2.0 percent for GDP growth. So this estimator is notably faster than using data only since 2004. The reason is that the fast-growth period from 1995-2004 gets substantial weight.

Another approach that is often used in the presence of structural change is exponential smoothing (ExpS). The table shows two exponential smoothing projections that use different (quarterly) "gain" parameters. Exponential smoothing with a 0.02 quarterly "gain" (and 0.98 down-weighting parameter) is a touch slower than the AveW estimator. With a quarterly gain of 0.04, the exponential smoothing estimator is closer to using the average since 2004, and implies a growth rate for GDP of 1.7 percent.

Which of the various forecasts is preferred depends in large part on whether one is doing a modal or mean forecast. In the context of the regime-switching model, the AveW estimator is one reasonable way to get a mean forecast, in that it puts weight on the fast-growth period from 1995 to 2004. (Similarly, the mean forecast from Kahn and Rich, 2016, is above their low-growth estimate.) More generally, a non-regime-switching view of how trend growth changes might push for one of the other estimators. For example, if the growth rate itself were modeled as a random walk, rather than a regime shift, then the AveW, the ExpS, or a Kalman filter estimator (not shown) might be preferred. The challenge there is the tradeoff between bias (with a random walk in growth, the best estimator of future growth is the current "drift" term) and precision (the current drift term is poorly estimated because of year-to-year volatility in productivity growth).

That said, many practical forecasters think about a modal forecast: What is the most likely outcome? In the regime-switching logic with persistent regimes, the mode and the mean are different. For a modal forecast, using averages since 2004:Q4 (column 1) or the ExpS estimator with high gain (column 6) seem preferable. Both imply GDP growth in the 1.6 percent to 1.7 percent range.

V. Other (less likely) explanations for the slowdown in productivity growth

This paper takes the view that the slowdown in TFP growth after 2004 reflects the end of a wave of the IT revolution. For forecasting, the important question is whether the slowdown in growth was structural and likely to continue into the future.

One alternative view is that the slow pace of recent TFP growth reflects the Great Recession and its aftermath. That event has left an imprint on capital deepening and labor quality which, in turn, have affected recent dynamics of labor productivity. But these business cycle and transitional dynamics do not affect forecasts of longer-run *growth* (regardless of whether they permanently scar the level of activity). What does matter for forecasting is what the recession has meant for measured TFP growth since the recession. One channel could be through depressed factor utilization. In this regard, Fernald (2015) argues that cyclical effects on TFP from the Great Recession had largely run their course by early 2011.[12]

Even apart from utilization effects, Reifschneider et al. (2015) and Anzoategui et al. (2016) argue that the slow pace of recent TFP growth could in part reflect effects of the Great Recession on incentives to innovate. In addition, Sedlacek and Sterk (2013) find that not only did the number of

[12] Concerns about cyclical utilization may be more relevant in Europe, where the output gap has closed much more slowly than in the United States.

U.S. startups drop sharply during the Great Recession, but that recession-born firms tend to be less productive than others even when the recovery recovers. If this story is quantitatively important, then a "high-pressure economy" might help reverse those effects and lead to faster growth in innovation and technology.

Although intuitive, the Great Recession cannot be the entire story, since TFP growth as well as labor productivity were only modest in the years leading up the Great Recession (see Figure 3).[13] Even more to the point, Huang, Luo, and Starts (2016) find that, for the United States, the level of TFP always bounces back quickly from recessions, including from the Great Recession. (The temporary recession decline and rebound is consistent with cyclical utilization of capital and labor.) In contrast, labor-market variables and GDP have, following recent recessions, followed an "L-shaped" pattern where there is no bounce back in the level. These results suggest that the place to look for persistent effects of recessions is the labor market rather than productivity.

More broadly, for advanced economies, Oulton and Sebastia-Barriel (2014) find no evidence of a persistent level or growth effect of financial crises on TFP. They do find persistent reductions in the level of GDP, which come from lower trend paths for employment as well as capital-labor ratios. Fatas (2002) finds that, for the richest countries (but not overall), higher volatility—which would naturally result from more severe business cycles—is if anything, associated with *faster* growth in GDP per capita. Finally, the Great Depression was an extraordinarily innovative period (Field, 2003, Alexopoulos and Cohen, 2009, Gordon, 2016).

A second story is a rising share of low-productivity-growth sectors. Byrne et al. (2016) document the shift towards low-TFP-growth services in recent decades. But the shift is not large enough to have a quantitatively important effect on TFP growth. Specifically, they find that holding industry shares fixed at their 1987 values would make negligible difference to the actual time

[13] Anzoategui et al. (2016) argue that there was a pre-recession shock to exogenous growth combined with the large shock from the recession.

profile of aggregate TFP growth. Of course, even if true, this story does imply that low productivity growth is structural, consistent with the projections in the previous sections. Nevertheless, to the extent the low TFP growth reflects challenges in measurement of real services output, it suggests that living standards could be rising faster than measured.

A third story is growing mismeasurement associated with prices for IT hardware and services as well as the increasing importance of digital goods. Byrne et al. (2016) and Syverson (2016) find little evidence that IT-related mismeasurement has gotten worse or that it can explain the post-2004 slowdown in productivity growth.

The bottom line is that the modest pace of TFP growth since 2004 appears genuine and structural.

VI. Risks

Uncertainty about longer-run forecasts is inherently high. Neither economists nor statisticians have a good track record of forecasting changes in trend productivity growth. Statistically, Müller and Watson (2016) estimate that a 90 percent prediction set for average labor productivity growth over a 10-year period runs from 0 to 3-1/4 percent—a very wide interval.

Under the “regimes” view in Section III, much of the uncertainty is about which regime we are in. Even within a regime, however, productivity is inherently volatile. And of course, there is no reason the future needs to look like the past.

Economically, the ongoing debates between techno-pessimists and techno-optimists highlight the uncertainties about the future pace of innovation. On the one hand, there could be another wave of the IT revolution—as Brynjolfsson and McAfee (2014), Baily, Manyika, and Gupta (2013), and Syverson (2013) suggest—or some other, unexpected productivity breakthrough. In addition, as Fernald and Jones (2014) suggest, the future growth model might look substantially different from the past—perhaps reflecting the innovative potential of robots and machine learning, or the rise of China, India, and other countries as centers of frontier research. In that case, the results in this paper could reflect an extended pause, a return to normal before the next wave of transformative growth.

Uncertainty about quality-adjusted labor-force growth over the next decade is probably much smaller than uncertainty about productivity. Bosler et al. (2016) consider a range of plausible scenarios for participation based on age and education. They find that the plausible range of outcomes is relatively narrow. Still, given the subdued growth in the working-age population (those aged 15 to 64 in Figure 1), a key uncertainty in this regard is whether labor-force participation of those older than 64 will continue to rise.

VII. Conclusions

This paper pulls together arguments from recent discussions about the new normal for U.S. growth. Once the economy recovers fully from cyclical dynamics associated with the Great Recession, GDP growth is likely to be well below historical norms, plausibly in the range of 1½ to 1¾ percent per year. Looking, say, 7 to 10 years out, my preferred point estimate is 1.6 percent growth in GDP per year, with per capita growth of under 0.9 percent. The reason for the slow pace is not primarily productivity, in that we've previously seen long periods (such as 1973-95) with modest productivity growth. Rather, it's the combination of modest productivity growth with demographics.

Raising growth above this modest pace depends primarily on whether the private sector can find new and improved ways of doing business. Still, at the margin, policies may help. For example, policies to improve education and life-long learning can help raise labor quality and, thereby, labor productivity. Infrastructure can complement private activities. And publicly funded R&D can help offset the fact that these activities are underprovided.[14]

In addition, in a probabilistic sense, policy can help by ensuring that, if there turn out to be exceptional, broadbased opportunities associated with information technology or other sources, that society can benefit from them. In particular, economic fluidity and dynamism can plausibly help ideas to diffuse broadly to businesses throughout the economy. One indirect piece of evidence that dynamism and flexibility matter for productivity comes from a comparison of the gains from IT in the United States versus Europe. Europe invested in computers, but didn't get the same productivity benefits after 1995. Much of the research points to labor and product-market inflexibilities that limit the ability to reorganize to benefit from IT.[15]

Of course, a potential cost of fluidity and dynamism is a heightened degree of individual uncertainty. Indeed, whether the pace of innovation turns out to be modest or fast, not all workers appear likely to benefit equally—there will be winners and losers. One area for policy to focus on is education and skill development to allow more people to take advantage of the opportunities that innovation brings.[16] Maintaining an appropriate social safety net can help individuals to weather the volatility and upheaval that may accompany ongoing change. This support at the individual level would help ensure that those workers who are negatively affected are better able to adapt.

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[14] On infrastructure, see Fernald (1999). On R&D, see Jones and Williams (1998).

[15] See van Rees et al. (2010). Bartelsman (2013) argues that, with suitable reforms, Europe has considerable scope to boost productivity through improved reallocation of resources associated with IT. The White House (2015) discusses how occupational licensing might constrain growth.

[16] Acemoglu and Autor (2012)

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