PGIM FIXED INCOME

Perspectives

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Prospects for the U.S. Economy Over the Long Run

While very long trends in economic developments can be difficult to predict, we think there are many reasons to be optimistic about future U.S. growth prospects — in particular, about the role that innovation could potentially play in offsetting demographic challenges posed by a rising contingent of retirees over the next few decades. If the U.S. continues to experience labor productivity growth on par with its average over the last ten years or so, we think real GDP could grow at around a 1¾% to 2½% annual pace over the long run. Already-high debt levels, a further tightening of financial regulations, and the budgetary drag that could result from the long-term entitlement problem in the U.S. are all factors that could push the economy's potential growth rate to the lower end of this range. On the other hand, if the possibility of an upturn in immigration or the labor force participation rate is factored in, real GDP growth could average towards the upper end of that range.

In this paper, we examine:

- *Sources of productivity growth over time, assessing their potential to help offset demographic headwinds;*
- *The importance of disparate productivity performances across industries and firms in driving the long-term aggregate performance of the U.S. economy;*
- *The challenges of measuring output and productivity in the context of advancements in a service-sector, knowledge-based economy;*
- *Why we are optimistic about the ability of the U.S. economy to adapt and innovate over the long run.*

The long-run potential growth rate of the U.S. economy has been the focus of much debate over the last several years as the economy has struggled to rebalance and emerge from the 2007-2008 financial crisis and the accompanying recession. Growth of real GDP had already been trending lower over the post World War II period from around 4% early on in this period to a 2.5% - 3.0% pace just before the crisis and has slowed to just 2.1%, annualized, over the last six years of this recovery. This raises important questions regarding whether this general down trend will continue and just what lies in store for the U.S. economy over the longer term.

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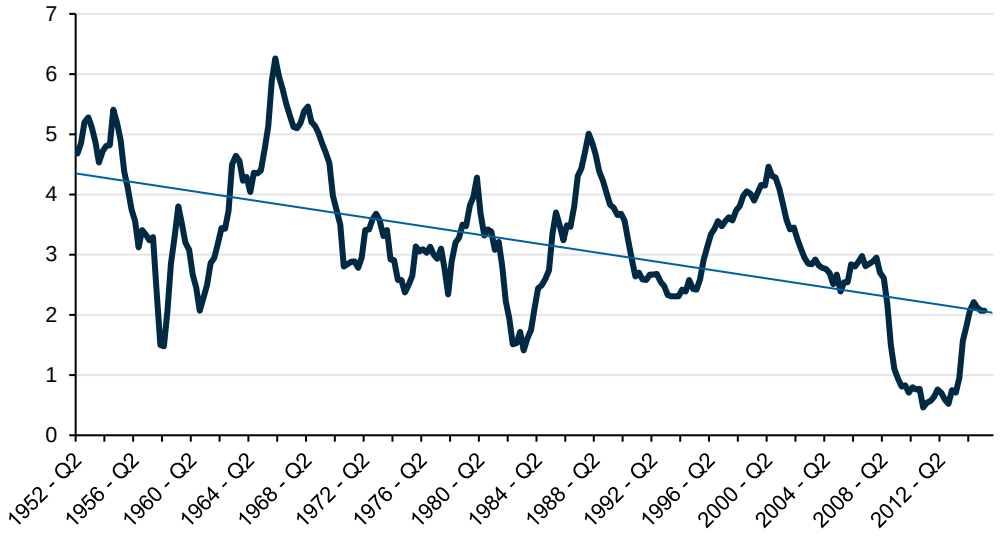
CHART 1:
REAL GDP HAS TRENDED LOWER OVER 60+ YEARS
(% year-over-year, annualized 5-year moving average)



Source: Haver. As of June 2015.

Productivity Increasingly Pivotal in Determining Future Economic Growth

A key expected drag on economic growth over the next few decades is the projected slowdown in the growth of the working age population as Baby Boomers retire and the workforce becomes mainly comprised of the smaller generational cohorts that followed. Economic growth is thus likely to depend increasingly on labor productivity gains over time, generated both from increased capital investments and from technological, organizational, managerial, and other innovations that effectively allow for a greater yield of output from the available workforce and capital investments.

But innovations and their impact – by their very nature – can be difficult to project. Pessimists, led by economist Robert Gordon at Northwestern University, argue there is now a dearth of major technological breakthroughs. The impact of current innovations in the IT sector, he argues, are likely to be more marginal in their effects on economic activity when compared to the enormous and wide-ranging impacts from the introduction of electricity, the internal combustion engine, indoor plumbing and other inventions in the late 1800s, and the steam engine and railroads before that.[1] Optimists, however, argue the current explosion of new technologies – robotics, artificial intelligence, biotech, faster and more integrated communications technologies — are perhaps just beginning to transform existing or in some cases, create businesses, industries, and marketplaces. Realizing the full potential of these new technologies can just take time, they argue, requiring companies and industries to adapt and restructure to take full advantage of the efficiencies, synergies, and any new products these innovations may create.

Added to this uncertainty going forward is the question of whether or not we will be able even to measure the extent to which economic progress – broadly defined – occurs. In an economy dominated by service sectors, and with key industries increasingly dependent on knowledge and creativity as an input, our GDP system of accounting may not be fully capturing evolutions that are taking place.

[1] *See Robert Gordon, "The Demise of U.S. Economic Growth: Restatement, Rebuttal, and Reflections," NBER Working Paper19895, February 2014, and Robert Gordon, "Is U.S. Economic Growth Over: Faltering Innovation and the Six Headwinds." NBER Working Paper 18315, August 2012.*

Measuring Potential Economic Growth

It can be difficult to measure an economy's *current* potential growth rate, let alone its potential for *future* growth.[2] Looking back at past trends in actual output is not exactly the same thing as estimating how much an economy *could* grow if it were fully and innovatively to utilize all available resources. Nonetheless, a historical look at the sources of actual GDP growth can perhaps help shape our thinking about what is possible going forward.

Decomposing Economic Growth: Labor Force and Labor Productivity Trends

One way to estimate an economy's potential growth rate is to use a bottom-up approach, focusing on 1) the amount of available labor, and 2) gains in the productivity of that labor over time. **Chart 2** below shows a breakdown of the growth in those two component sources of economic activity over time estimated by the Bureau of Labor Statistics.

As shown in Chart 2, labor input (the blue area — measured as aggregate hours worked) grew consistently and fairly robustly from the mid-1970s through the 1990s. The swell of Baby Boomers coming of age drove an acceleration in the working age population from a 0.9% average annual growth rate from 1950-1970 to 1.4% per year from 1970-2000. In addition, more women were entering the workforce during the 1970-2000 period, leading to an even faster 1.9% average annual increase in the labor force during this time.[3] **By 2000, however, the female labor force participation rate peaked, Baby Boomers had by this point been assimilated, and the workforce thus slowed as a source of economic growth from 2000 onwards.** In fact, during the 2007-2014 recession and recovery, the net contribution of the labor force as a source of economic growth was negligible; only recently has employment recovered the sharp losses that occurred after the financial crisis.

CHART 2: SOURCES OF GROWTH IN REAL PRIVATE BUSINESS SECTOR ACTIVITY (VALUE ADDED)
(percentage point contributions)

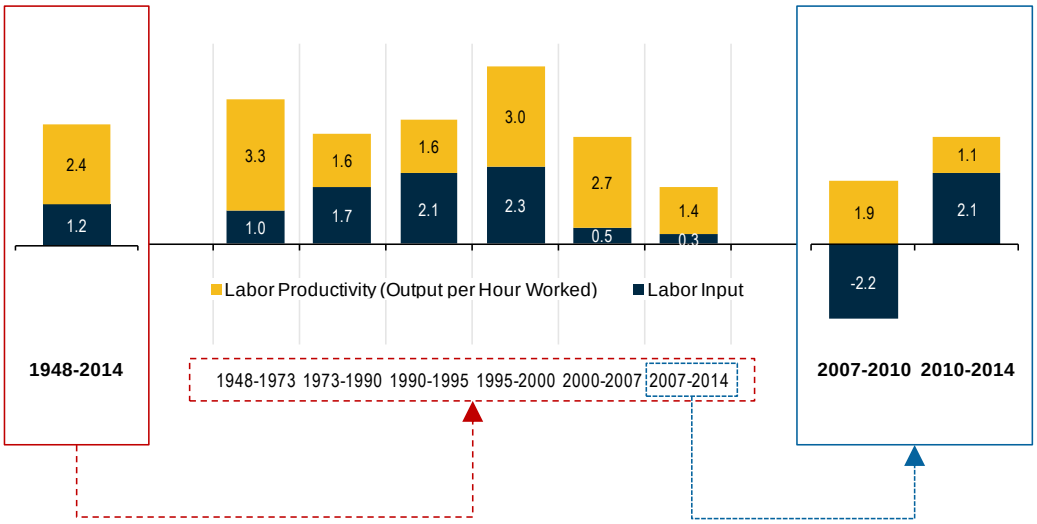


Chart source: Bureau of Labor Statistics (BLS). As of June 2015.

Labor productivity, on the other hand, has followed a somewhat different pattern. **During the post-World War II period from 1948-1973, labor productivity grew rapidly, at an over-3% annualized rate. But from 1973-1990, it slowed to roughly half that pace.** Computers and other information technologies were making in-roads into industries by that time, which one would think should have boosted labor productivity. But as Nobel Prize winning economist Robert Solow famously observed in 1987, one could "see the computer age everywhere except in the productivity statistics."[4] **It wasn't until about 1995 that productivity growth finally picked up, when, for almost the next decade, it clocked in its best performance since the early 1960s.** This was the period of the IT

[2] *In fact, real time estimates of an economy's potential growth rate have at times been subsequently revised significantly. In the 1970s, for example, policymakers at the time generally overestimated potential economic growth, arguably leaning towards too much inflationary policy stimulus as a result. In the 2000s, potential growth was perhaps again overestimated, resulting in policy calibrations that were, in hindsight, overly stimulative for housing and other asset markets.*
[3] *Congressional Budget Office, "The 2015 Long-Term Budget Outlook," June 2015, and PIMFI calculations.*
[4] *Robert M. Solow, "We'd Better Watch Out," The New York Times Book Review, July 12, 1987.*

revolution, when PCs, the internet, and other information and communications technologies were proliferating rapidly.

However, beginning around the early 2000s, this productivity "miracle" dissipated, and a return to a slower pace of productivity growth has since ensued. Researchers and analysts have bemoaned the fact that there doesn't seem to have been much follow-on in productivity gains from the IT revolution since then. **This raises the important question as to what has driven these waves of acceleration and slowdown in labor productivity gains over time and thus what might be in store down the road.** After all, if the U.S. is destined for slower gains in the size of the workforce over the next few decades, economic growth will depend increasingly on labor productivity gains to carry us through.

Decomposing Labor Productivity Growth

Labor productivity growth can in turn be decomposed into three component sources: **1) shifts in the composition of workers that effectively change the quality of labor inputs** over time (e.g. shifts to a more educated or a more experienced workforce); **2) changes in capital intensity** (e.g. increased capital investment that raises the amount of capital per hour worked over time); and **3) total factor productivity (TFP) growth**, which measures the impact of technological innovations; economies of scale; and gains from reorganizing, restructuring, and employing new management techniques. **TFP is most broadly thought of as a measure of the amount of innovation taking place, innovation that ultimately enables an economy's output to increase by *more* than the total increase in inputs, e.g. labor and capital.**[5]

CHART 3:
SOURCE OF PRIVATE SECTOR LABOR PRODUCTIVITY GROWTH
(percentage point contributions)

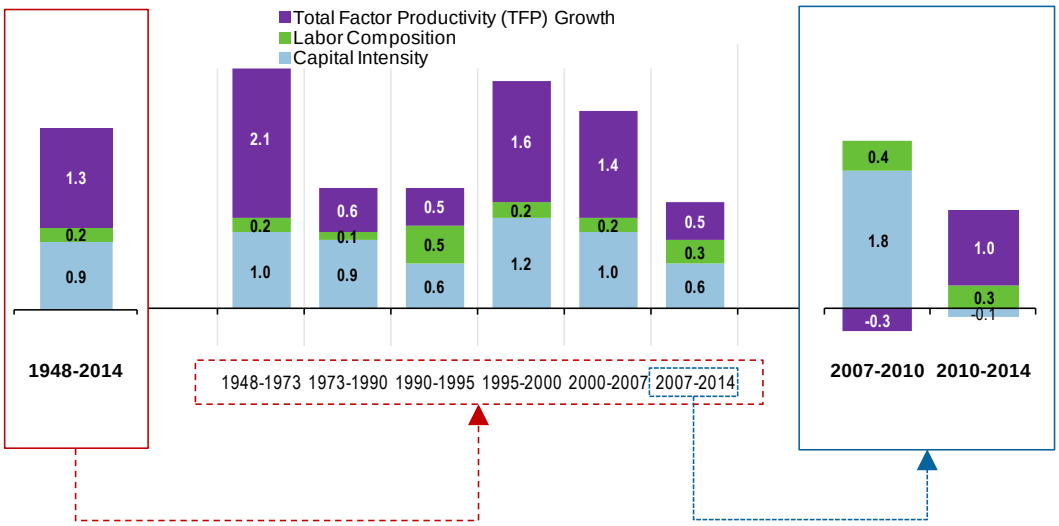


Chart source: Bureau of Labor Statistics. As of June 2015.

Chart 3 above shows estimates calculated by the Bureau of Labor Statistics of the contribution of each of these three components to overall labor productivity growth over time. Several trends stand out:

- **First is the small contribution of compositional shifts in the workforce (green bars).** This component decelerated slightly during the 1973-1990 period, as inexperienced Baby Boomers first entered the workforce, but re-accelerated thereafter as the workforce in aggregate became more seasoned and educational attainment continued to rise. Overall, though, changing characteristics of the workforce have been a relatively small factor as a source of labor productivity gains over time.[6]

[5] *See Dale W. Jorgenson, "Innovation and Productivity Growth," T.W.Schultz Lecture, American Journal of Agricultural Economics 93, no.2 (2011).*
[6] *This graph sheds some insight perhaps onto the observation that real wage growth has generally been sluggish for several decades, failing to keep pace with overall productivity gains. The sources of those productivity gains, as measured here, have been primarily from increasing capital intensity and from TFP (i.e. technological/organizational changes) – not apparently from properties inherent in the quality of the workforce. Coinciding with this trend, the income generated from*

- **Second is the large and somewhat stable contribution of increases in capital intensity (blue bars) as a source of labor productivity gains.** To be sure, growth in the amount of capital per hour worked temporarily accelerated during the 1995-2000 period, which contributed to the surge in overall labor productivity growth during that time, but since then has contributed *on average* at close to its post-World War II historical pace.

- **Third, and perhaps most notable, is how important, but volatile, TFP – that is, innovation, broadly defined – has been as a source of growth over time (purple bars).** In fact, it appears to have been the largest swing factor in determining labor productivity growth over long periods of time. In the post-World War II period from 1948-1973, for example, TFP grew rapidly, but then slowed sharply from the mid-1970s until the mid-1990s when it picked up significantly again. Over the 2007-2014 period, however, it has again slowed.[7]

SHORT-TERM PERFORMANCE VERSUS LONG-RUN TRENDS

The callouts in charts 2 and 3 focusing on the most recent recession (2008-2009) and subsequent recovery (2010-2014) illustrate how large the short-run variations are in the growth rates of both labor input and the various sources of productivity gains over the course of a business cycle. Focusing on performances over just the last few years can thus be misleading – a longer-run, prospective view of trends is critical.

For example, firms cut back sharply on headcount and average workweeks during the 2008-2009 recession; productivity gains yielded by the remaining workforce were notably strong around that time (**Chart 2**). Over the past five years of recovery, however, companies have resumed hiring at a rapid pace and labor productivity growth has again weakened. But even with the strong hiring pace over the last several years, it's taken the first four years of this recovery just to recoup the recession cutbacks, let alone absorb the growth in the working age population over this time. Thus, the growth in labor input and the performance of labor productivity over the entire business cycle is a more meaningful indicator of trends than a look at just one phase of the cycle. **With the caveat that the current business cycle is not yet over, labor productivity so far has grown an average 1.4% per year since 2007.**

While companies were shedding workers at a rapid pace during the recession, capital deepening – that is, the amount of capital stock per hour of employed labor (**Chart 3**) – appeared to surge, as the existing capital stock was applied across fewer and fewer workers. But as firms replenished headcount during the recovery phase of this cycle, their spending on capex has been comparatively limited, resulting in a slight *outright decline* in capital deepening. Labor has been relatively cheap in this recovery, with wage growth muted and labor's share of the overall output pie at a 50-year low – a likely driving force behind companies' choice to focus on hiring rather than capex in recent years. Thus, in some sense, low wages themselves seem to have helped suppress labor productivity gains in this recovery phase. **At some point in this expansion, however, we anticipate that the pace of hiring will slow and a cyclical re-acceleration in capex spending and capital deepening will likely ensue, as firms seek to improve the productivity of the workers they have hired in recent years.**

Meanwhile TFP gains — which are the gains from innovation and economies of scale — have also exhibited strong cyclical variation, weakening during the recession, but notably strengthening during the recovery (**Chart 3**). **Much of the strength in the current economic recovery owes to the more rapid growth of innovative, productive firms and industries, and the decline or elimination of less productive ones.** But the concept of an economy's long-run potential growth rate is meant to look beyond cyclical fluctuations; hence, the focus on productivity developments should cover longer swaths of time.

Aggregate Productivity Performance Can Mask Important Developments at the Industry and Firm Levels

Given the importance of swings in aggregate TFP growth over time, researchers have increasingly focused on analyzing its trends at more granular industry and firm levels. **TFP trends have varied significantly across**

production activities has increasingly accrued to capital/equity owners. Employee pay in some industries has shifted to stock compensation, enabling some workers to benefit directly from business profits (perhaps particularly appropriate when a company's workers are its capital). Public policies currently appear focused on increasing the wage share, but perhaps an alternative tack might be also to focus on the distribution of equity ownership with an eye towards ways of broadening it.

[7] Fernald and Wang, "The Recent Rise and Fall of Rapid Productivity Growth," FRBSF Economic Letter, February 2015 estimate that the slowdown actually seems to have started around 2003, before the financial crisis and recession.

industries and even across firms within the same industry — certainly over each business cycle, but also over longer periods of time.[8]

Jorgenson, Ho, and Samuels (2014) characterize the disparate productivity performances across firms and industries as likely part the Schumpeterian process of "creative destruction" — the very process that can ultimately give rise to economic progress over the longer run.[9] That said, they note it is the technological advancements and other forms of innovation occurring in a handful of key industries that have been the most important drivers of aggregate productivity in the overall economy over the long term. Jorgenson (2011), for example, notes that the agriculture sector in particular, but also the IT sectors, have been dominant sources of the productivity gains measured for the economy as a whole over the last half century.[10]

But disparate performances across industries and firms mean that looking solely at aggregate productivity performance for the economy as a whole can be misleading. Recent research has focused on the significant role that IT has played in differentiated productivity performances and in generating large swings in TFP growth over the past several decades. For example, Jorgenson, Ho, and Samuels (2014) find IT was not a particularly significant factor behind the surge in TFP in the post-WWII period from 1947-1974. Thereafter, however, they estimate there was an important and growing gap between the productivity performances of those industries that were either producers or intensive users of IT and those that were not**. Aggregate productivity measured for the economy as a whole appeared muted in the 1974-1995 period, but that disappointing aggregate belied the transformation occurring below the surface at the industry and firm level. Productivity of those that were heavily involved with IT began accelerating and those that were not began a secular productivity slowdown.**[11]

By 1995-2000, they found that TFP gains in the IT intensive sectors — particularly IT producers — became sufficiently large as to outweigh the drag from non-IT intensive industries; aggregate TFP for the economy as a whole thus picked up during this period. Similarly, Fernald and Wang (2015) estimate that in the 1995-2000 period of surging TFP gains, over 50% of it was accounted for by the IT sector itself — that is, the very sector *producing* these technologies.[12] By 2000-2004, however, TFP gains in IT intensive industries began to slow, but also rotated and broadened from IT producers to those industries that were intensive *users* of IT, e.g. telecommunications, wholesale and retail trade, and a number of other service sectors.[13] Industries that were neither producers nor intensive users of IT did not contribute as significantly to aggregate TFP growth over this period; in fact, Jorgenson, Ho, and Samuels (2014) estimate these industries have on net been negative contributors since the mid-1970s. **Given the importance of IT in differentiating productivity performance, bandwidth has now become one of the most important components of U.S. infrastructure.**

But Are We Measuring Investments and Output Correctly?

There are always questions as to whether or not our current system of GDP accounting is accurately measuring the degree to which output and our collective standards of living are increasing over time. The system is meant primarily to capture the value of all goods and services produced for end-use; the value of the

Past performance is not a guarantee or a reliable indicator of future results.

[8]The persistence of large differences raises the question as to why there isn't a more rapid adjustment or response, either such that less productive firms simply replicate the production methods of the more productive ones, or alternatively, resources flow more rapidly out of less productive firms and industries into more productive ones until the performance gap narrows. Differences in managerial practices/talent, the structure of the firm and its ownership, competitiveness of the industry and of its input markets, financing availability, how well or poorly designed government regulations are – are all some of the factors on which researchers have focused attention. See Chad Syverson, "What Determines Productivity?" Journal of Economic Literature, June 2011, pp. 326-65.

[9] Jorgenson, Ho, and Samuels, "Long-term Estimates of U.S. Productivity and Growth," Presentation at Third World KLEMS Conference, May 2014.

[10] Dale W. Jorgenson, "Innovation and Productivity Growth," American Journal of Agricultural Economics 93(2), 2011.

[11] Jorgenson, Ho, and Samuels, "Long-term Estimates of U.S. Productivity and Growth," Presentation at Third World KLEMS Conference, May 2014.

[12] Moreover, they found that the surge in capital intensity during this period was concentrated in the IT-producing sector, as plunging prices of computer and other IT equipment and software implied greater and greater real (price-adjusted) output in that sector. Fernald and Wang, "The Recent Rise and Fall of Rapid Productivity Growth," FRBSF Economic Letter, February 2015. See also Jorgenson, Ho, and Samuels, "Long-term Estimates of U.S. Productivity Growth", Presentation at Third World KLEMS Conference, May 2014.

[13] Fernald and Wang (2015) emphasize that the productivity slowdown in the 2000s pre-dated the onset of the financial crisis and recession in 2008-2009.

inputs used in producing these goods and services are generally not included, as that would create double-counting. An exception, however, is the inclusion of expenditures on investments — long-lived assets that will, in subsequent periods, be available as inputs to production. The construction of buildings, manufacturing plants, and other structures, along with the production of equipment and machinery, has always been included in the business fixed investment portion of GDP. In 1999, however, the Bureau of Economic Analysis (BEA) updated its definition of investment to include business and government spending on software, and in it 2013 broadened the definition further to include spending on research and development and a number of other "intangible" investments. While these have all been steps towards more fully capturing economic activity, **the GDP accounting framework is at its heart devised to measure very tangible output: goods and services that can be metered and measured. Accounting for quality improvements and the value of increased customization, for example, can be difficult.** [14]

But what if we are not fully capturing the amount of investment spending and output that is actually taking place? For example, companies purchase software and then often unleash their staff to adapt it — sometimes significantly — to make it more productive for the company's purposes. This is a type of investment that is likely not fully captured. Similarly, on-site investments created by 3D printers may present the same measurement problem over time.

More broadly, what if for many companies, the workers *are* their capital investments? Human capital has long been recognized as an important input for firms, but it is particularly important in an economy such as the U.S., which is overwhelmingly a service sector (or "knowledge-based" economy) — with the IT, biotech and pharmaceuticals, and financial services, for example, all particularly high value-added industries. It is not at all clear that we are capturing the human capital that resides in these firms.[15] Under this framework, a number of researchers have noted that companies, such as Apple and Google, would have a very hard time estimating the true value of their capital stock. **When the investment and output are ideas and insights, it is not clear that the GDP accounting framework adequately captures our progress.**

The importance of human capital in a knowledge-based economy is also leading some economists to revisit theories of the firm. Previous theories of why certain activities take place within a firm and others are instead transacted in the marketplace have in the past focused on both transactions costs and on how fully firms can specify contingencies covering the full spectrum of risks when entering into contracts with others. **But with economic activities now more heavily dependent on human capital — knowledge, insights, and creativity — new theories of the most efficient organization of activities across and within firms are perhaps needed.** How best to organize firms to generate the most productivity and/or the most creative synergies in assembling and maintaining a company full of knowledge-based workers becomes the issue.[16]

Often, initial technological innovations tend to standardize and automate existing production processes, usually to reap the benefits from economies of scale. But **many technologies over the past several decades have been focused on enabling more customization, more tailoring to customer needs — something that is not easily captured by GDP measures of progress. One of the most amazing examples of customization is the current research on more customized, personalized medicine.** What if, in this process, researchers are able to crack the code on aging and healthy life spans are significantly extended further than the increase already experienced to date? **A significant expansion in healthy life spans opens the possibility of human progress just from the ability of individuals to continue to build on their previously acquired knowledge skills over a much longer**

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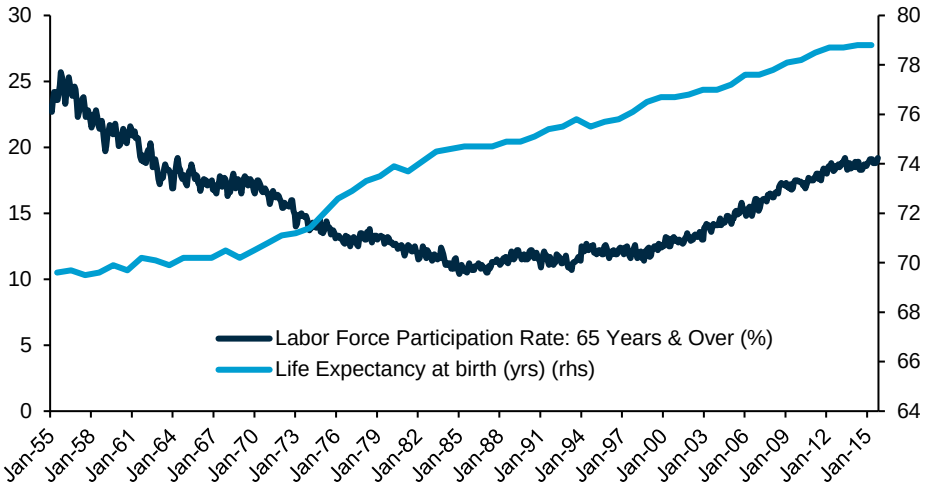
[14] In early 2015, the BEA also unveiled parallel accounts to experiment with alternative measures of output in the healthcare industry, ones based more on healthcare outcomes rather than the current focus on measuring inputs, e.g. the number of doctors visits and medicines sold.

[15] The Oxford Handbook of Human Capital, edited by Alan Burton-Jones and J.C. Spender, Oxford University Press, 2011, provides an excellent collection of in-depth essays analyzing various aspects and implications of human capital.

[16] Important differences between human and other forms of capital exist, including the fact that most of what we think of as human capital is embodied in the workers, not outright owned by the firm. Researchers have explored the implications of this fact for hiring practices, labor contracts, and the optimal organization of activities within and across firms. It also has implications for management structures; Zappos, for example, recently made headlines in announcing a "no managers" experiment, whereby workers would be organized in self-governing teams, rather than in a traditional manager/workers organizational structure.

time period. In such a world, we would become less reliant on each new generation having to start from scratch in learning the already existing body of knowledge. **Potential economic growth would be boosted by both the resulting increased pool of available workers and by an increase in the average level of knowledge and experience of that workforce.** In fact, the labor force participation rate of those 65 years and older has been on the rise over the last 20 years, reversing its earlier downward trend and effectively taking advantage of the rise in life expectancy over this time.

CHART 4: LENGTHENING LIFE EXPECTANCY AND WORK SPANS



Sources: National Center for Health Statistics, Bureau of Labor Statistics/Haver. As of January 2015.

What to Expect Going Forward

Looking ahead, the U.S. Labor Department projects the workforce will grow at an average rate of about 0.5% per year over the next ten years or so, similar to its average pace over the last decade, but slower than the period when the baby boomers were a growing share of the workforce.[17] Labor force participation rates and the pace of immigration remain wildcards, however, and have the potential to alter this growth rate somewhat. Government actions, including regulatory and immigration policies, can help shape these trends, as can possible medical advances that extend healthy life spans and potential working years.

Labor productivity growth also has the potential to offset this expected slowdown in available labor. Going forward, a pickup in capital investments and capital intensity could potentially help offset any slowdown in the growth of the workforce. Importantly, though, a more innovative and efficient use of this labor and capital – that is, gains in TFP – could also play a key role in boosting the economy's growth potential. TFP appears to have grown significantly more slowly over the last decade than it did in the prior decade, but has shown signs of a pickup since the end of the recession.

Final Thoughts

Given that so many factors will determine potential economic growth in the U.S. over the long run, it is difficult to predict exactly what lies ahead. However, there is every reason to be optimistic about the ability of the economy to adapt and innovate. The U.S. has the benefit of robust institutions and legal systems, and a well-developed financial system to support an innovative population. It often takes time for the implications and impact of new technologies to be fully utilized – it takes a reorganizing and redefining of activities that can take time to get right. In the meantime, aggregate measures of productivity can mask tectonic shifts occurring below

[17] *Bureau of Labor Statistics, "Labor Force Projections to 2022," Monthly Labor Review, December 2013.*

the surface in individual industries and firms – shifts that can wind up having profound long-run positive consequences for the economy as a whole.

Many argue we may be in the early stages of figuring out how these new technologies can be utilized to transform not only *how* goods and services are produced, but *what* goods and services are produced. We could perhaps be near the beginning of, say, a 50+ year cycle of an infusion of new technologies and production techniques. **Most readily acknowledge that it is hard to predict when a wave of transformative innovations will proliferate, but also note that innovation may tend to pick up after periods of crises or severe economic downturns.** What rejuvenated the economy after the Great Depression perhaps wasn't so much government policies or the advent of World War II, many argue, but rather it was the building tidal wave of innovation and technological advances that developed during the crisis period of the Depression and then the world war. **These ideas are just some things to consider as the U.S. continues to climb back from its most severe financial crisis and deepest recession since the 1930s.**

Notes

Notes

Notice

Sources of data (unless otherwise noted): Pramerica Fixed Income as of November 2015.

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