Policymakers and economists are debating whether the US—and perhaps the world economy—has fallen into terminal stagnation, and what policy can do to boost growth. There is a growing consensus that prolonged loose monetary policy and more government spending are the only solutions. We disagree.

The US economy stepped down a few gears after the global financial crisis. GDP growth averaged just 2.1% since 2010, compared to 3.3% from 1950 to 2006. What is causing the recent weak US performance, and what can pave the way for stronger growth in the coming years? Our paper takes a close look at the three drivers of growth: employment, investment and productivity.

Five million people more are employed today than at the pre-recession employment peak; but as a share of the population, fewer people are working. The participation rate—the share of people of working age who have or seek a job—is 3 percentage points lower than prior to the recession. Our analysis shows that while the participation rate could rebound a bit in the next couple of years, it will then decline again because of population aging. Weaker demographics will cap the growth of the US labor force at about 0.5% per year, compared to 1-1 ½ % before the financial crisis.

The investment recovery remains incomplete, with fixed investment at 16% of GDP, well below the 18% long-term pre-crisis average. While residential investment (housing) has rebounded strongly, non-residential investment has taken a much more cautious stance since 2012. Most concerning is that investment has weakened over the last few quarters, and not just in the energy sector. In our view, this reflects both higher uncertainty over the global outlook and a weaker US business environment.

Productivity growth has been declining over the last five years, even as technological innovation generated rising excitement. Some economists argue that the latest innovations are as unproductive as they are popular—productivity stagnates because innovation is dead. Others believe productivity is underestimated by official statistics that fail to capture the value created by the digital economy. A third view is that lower productivity reflects lower investment.

We believe innovation is as strong as ever—but it needs to scale to boost productivity economy-wide. A recent OECD study shows that productivity growth in the globally most productive companies is as fast as ever: it is not innovation that has broken down, but the diffusion of innovation. The likely culprits include excessive regulation and an increasing skills mis-match.

Digital-industrial innovations can boost productivity by turning industrial machines into intelligent interconnected devices and augmenting the capabilities of workers at all skills levels. But to unleash the power of these innovations, we need to rekindle investment so that new technologies can scale faster. We need to ensure the economy has the flexibility to efficiently reallocate resources, adopt new business practices and create new skills and businesses.

Given the slower labor force dynamics, boosting productivity growth back to 3% is absolutely necessary if we want economic growth to return to a 3–3 ½% pace; otherwise, we will plod along at a mere 1.5% at best. Stronger growth is still within our reach. Whether the US economy booms or stagnates is our choice—and the answer lies in stronger investment, innovation and productivity.
1. The growth imperative

The US economy has lost steam. Since 2010, GDP growth averaged just 2.1%, compared to 3.3% from 1950 to 2006. Most other advanced economies also decelerated (Germany is one of the very few exceptions). Emerging markets (EM) instead have enjoyed stronger growth: 5.4% during 2010-15 compared to 4.2% during 1980-2006; this boosted global growth to 3.8% from 3.5%. EM growth has been weaker in 2015-16, but this seems to be a normal cyclical slowdown, partly due to weaker commodity prices.

The distinction between EM and advanced economies is important: The current public debate often assumes that global growth is structurally weaker. It is not. There is no global “secular stagnation”. EM are experiencing a normal cyclical slowdown after a robust post-recession recovery. It is advanced economies that have suffered a structural weakening in growth performance. The loss of momentum is especially notable and worrisome in the US: traditionally among the most dynamic industrialized economies, the US seems no longer able to drive global growth.

What are the prospects for long-term US growth? Will it return to the post-WWII levels of 3-5%, or languish at about 2%? What can policy do? The answer to this questions matters a great deal for living standards and for business opportunities. An economy growing at 3.5% per year will double in size in 20 years; at 2% it will take 35 years (and in that time, at 3.5% per year it would have more than tripled).

This paper assesses the reasons for the recent weak US performance and the conditions that could pave the way for stronger growth in the coming years.

What drives economic growth?

A country combines labor and capital to produce output. Given the size of the workforce and of the capital stock, the amount of output depends on the technology, management practices, the education and skills of the workforce, and the overall business environment—regulations, taxes, flexibility of labor and products markets. To understand long-term economic growth prospects, therefore, we need to consider three key drivers:

1. We would like to thank our colleagues Mary Kate Nevin, JP Soltesz, Kim Chase, David Lee and Kalpana Singh for their comments, insights and support.
2. Even though China’s growth has moderated.
4. John Cochrane, Senior Fellow at the Hoover Institution, illustrates the impact of growth on the US economy. Due to the relatively high growth rates seen in the post-war years, the average American is more than three times better off now than his or her counterpart was in 1950. Real per capita GDP has risen from $16,000 in 1952 to $50,000 today; measured in constant [2009] dollars. See Cochrane (2015), “Economic growth”.
• Employment
• Investment
• Productivity

Employment depends on four factors (think of them like Russian dolls nested one inside the other):

1. The size of the population;
2. The share of the population that is of working age;
3. The share of people of working age who want to work—the participation rate
4. The number of people willing to work who are in fact holding a job—the employment rate.

We explore population and labor force dynamics—and its implications for US growth—in Section 2.

Investment is the second crucial input. A labor force that has access to a larger and newer capital stock will produce more. Investment brings on line newer and more efficient equipment, including new technologies. Capital investment includes infrastructure, essential to enable economic growth. The quality of investment matters as much as the quantity—if not more: bridges to nowhere or factories that cannot produce at competitive prices have little or no impact on future growth. We discuss US investment trends in Section 3.

Productivity measures the efficiency of one or both inputs in producing output. Labor productivity measures the amount of goods and services produced per worker or per hour worked. Total Factor Productivity (TFP) measures the amount of goods and services produced by a given combination of labor and capital. TFP depends on factors such as technology, managerial skill, and organizational efficiency. Labor productivity also depends on the quantity and quality of capital. Productivity has by far the greatest impact on long-term economic growth, and is the main determinant of growth in wages and per capita incomes. There is a heated debate on the outlook for US productivity—we will review the arguments and put forward our view in Section 4.

While productivity growth drives per capita income and living standards, attention usually focuses on the headline GDP growth rate, and this depends to an important extent on the size and growth of the employed population. In the next section therefore we start our analysis with a deep dive in the US labor market.

2. Labor market

Completely recovered?

While the US GDP recovery has been disappointing, the labor market recovery has been stronger than is often appreciated. The unemployment rate has dropped below 5%, and as of August 2016 there are 5 million more people employed than at the pre-crisis peak (November 2007). Total employment stands at 151.6 million. At the worst of the crisis, in December 2009, employment bottomed at 138 million, so the US economy has created 13.6 million jobs. As the chart shows, growth in the labor force has also picked up, though it remains below the pre-recession trend.

Employment is higher than before the crisis, but so is unemployment: Compared to the best pre-crisis levels, there are still 1.1 million people more unemployed and another 2.1 million more (compared to pre-

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In "The Age of Diminishing Expectations" (1994), Paul Krugman writes “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.” Cochrane (2015) concurs: “Over long periods of time, economic growth comes from one source: productivity.”

Headline GDP growth also determines the overall size of the economy and its weight in the global economy—an important consideration in the case of the US, which has been the largest world economy for a long time.
crisis) who are either working part time for economic reasons (1.8 million) or marginally attached to the labor force (0.3 million) – these are people who are discouraged and have given up looking for a job because they do not think they will find one, or want a job but have not been looking for 4 months for reasons like family obligations, illness, etc.\(^8\) This helps explain why there is still a feeling that the labor market recovery is not complete, and why wage pressures have remained relatively muted so far.

Looking at the respective unemployment rates points a similar picture: the headline unemployment rate, **U3, is down to 4.9% as of August, after dropping as low as 4.7% in May.** During 2006-07 it averaged 4.6% and went as low as 4.4% -- and that was during a bubble.

The broader **U6 measure includes the other two categories mentioned above, those who work part time for economic reasons and those who are marginally attached to the labor force (and adds the marginally attached to the denominator because they are not part of the labor force). The U6 rate is significantly higher, at 9.7%. Note however that the 2006-07 U6 average was 8.3%, and the lowest point in that period was 8.0%. So while this broader unemployment measure is still elevated, it is not too far from its long-term average of 9% (over 1994-2007).

Are we back to full employment? When the recovery started, a number of economists thought that the equilibrium unemployment rate might be significantly higher following the crisis; the Federal Reserve itself initially shared this pessimism, but has lowered its estimate of the **NAIRU** as the recovery unfolded, to 4.7-5.0% as of June 2016.\(^9\)\(^10\)

**The participation puzzle**

The more interesting piece of the labor market puzzle is the participation rate—the percentage of people of working age who are either working or looking for work. Here the story is more complex.

**Let’s start with a long-term perspective on the participation rate:**

- Participation rose steeply from the mid-1960s to the late 1980s, mostly reflecting the entry of women in the labor force.\(^11\)
- It peaked at about 67% between 1997 and 2000;
- Then declined through the end of 2004; stabilized at about 66%, and then set again on a declining path as the great recession struck.

As of August 2016 the participation rate was at 62.8%. Slightly better than the lowest point reached in September 2015 at 62.4%, but still over 3pp lower than the 2006-07 average, before the Global Financial Crisis.

\(^8\) All figures are based on Bureau of Labor Statistics data for August 2016, the latest available at the time of publication.

\(^9\) The **NAIRU** is the non-accelerating inflation rate of unemployment that is the unemployment rate consistent with a constant rate of inflation.

\(^10\) Compared for example to 5.2-6.0% in June 2013, 5.2-5.5% in June 2014 and 5.0-5.2% in June 2015.

\(^11\) See for example Toossi, "A century of change: the US labor force, 1950-2050"
The US participation rate is not low by international standards. The chart below shows participation rates for all OECD countries as of 2013 (latest year for which comparable data are available). The US participation rate at the time was 63.3%, not too much above its current level; it was 3pp above the OECD average, and higher than other major industrialized economies like Germany, France and Japan.

A decline of 3pp from the pre-crisis level, however, is very significant: if the participation rate were still at 66%, today we would have an additional 8.3 M people in the labor force; and at the current 4.9% unemployment rate this would be an additional 7.9 M people employed.

There are two schools of thought on the decline in the participation rate:

- One holds that the decline in the labor force participation rate is largely cyclical: people dropped out of the labor force during the recession, discouraged by the difficulty of finding a job. As the recovery takes hold, this impact should fade, and participation should rise back to its previous levels.

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12 See [https://data.oecd.org/emp/labour-force-participation-rate.htm](https://data.oecd.org/emp/labour-force-participation-rate.htm)
13 Based on data as of July 2016.
• An alternative view is that the decline in the participation rate is largely **structural**; it reflects demographic and behavioral changes that have nothing to do with the recession. Even as the recovery takes hold, the participation rate will not rise significantly, and may well fall further in the coming years.

**It’s structural**

The Bureau of Labor Statistics (BLS) believes the decline is largely structural. It notes that the participation rate had been falling well before the Great Financial Crisis, and that it dropped by only 0.6 percentage points during the Great Recession, but by a much greater 2.7pp during the subsequent recovery. The BLS therefore projects the decline to continue in the coming years.

The labor force participation rate depends on: (i) **demographics**, determining the size of the various age cohorts; and (ii) **behavioral factors**, determining the participation rate for each individual age cohort. Older age brackets have lower participation rates: the participation rate for the 25-54 age bracket is currently about 81%, it drops to 64% for the 55-64 bracket, and to 26% for the 65-74 bracket. So as the population ages, a greater share of it falls in age brackets with lower participation rates.

The BLS assumes (i) some increase in participation for older people (age 55 and older), reflecting greater healthy longevity; (ii) a continued decline in the participation rate for young people, reflecting increased schooling (ages 16–24); (iii) declining participation for men of prime working age, reflecting historical trends; (iv) a declining female participation rate (it peaked in 1999).

Overall, the BLS projects the participation rate will drop further to 60.9% by 2024 and to 59.0% by 2050.

Given the important role of demographics, we refer to the Appendix for a detailed assessment of US population trends.

Other recent studies support the thrust of the BLS’s analysis. A recent paper by the Atlanta Fed estimates that population aging explains more than half of the decline in labor participation between 2007 and 2015. The analysis shows the important role played by some behavioral factors during the recession and the initial phase of the recovery (2007-11): more young people decided to stay in school for longer, more people took disability benefits, and more people who wanted a job were too discouraged to look for one; on the other hand, more people aged over 60 worked for longer, probably feeling they should save more for retirement. These behavioral changes are consistent with a weak economy, and played a lesser role as the recovery became entrenched (2011-15). Conversely, as economic conditions improved the number of prime-working age women choosing not to work increased—presumably as they felt able to take on household or family responsibilities. During the last four years, population aging accounted for a full two-thirds of the decline in participation. A study by the Philadelphia Fed also finds that the largest share of the decline in participation can be linked to demographics; the study also notes that the recession might have caused a number of workers to accelerate their retirement—a cyclical factor with a structural effect.

**It’s cyclical**

Others believe cyclical factors have played a more important role. Canon, Debbaudt and Kudlyak of the St. Louis Federal Reserve Bank observe that the BLS’s projections tend to respond quickly to the latest changes in participation rates; they compare the BLS projections from 2002, 2006 and 2012, and note that changes in the projections tend to be influenced by the most recent data rather than driven by long-term trends. The paper shows that both the medium (10 year ahead) and long-term projections for the participation rate have been lowered steadily since 2002, as the actual participation rate kept dropping. In successive rounds of forecasts, the BLS has reduced the forecasted participation rates across age groups. Canon, Debbaudt and Kudlyak therefore argue the

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[15] The BLS notes that the in the overall participation rate of men has been falling since 1940.
BLS might be interpreting as structural something that is instead cyclical, namely the impact of the Great Financial Crisis (though they acknowledge that demographics accounts for most of the participation rate decline projected by the BLS).19

Erceg and Levin of the IMF raise a similar criticism. They note that between 2008 and 2012 the participation rate fell significantly more than the BLS was forecasting in 2007, only one year before the onset of the Great Recession. This suggests that the decline was largely cyclical, as any structural factors should have been already embodied in the 2007 forecasts. Erceg and Levin analyze state-level employment data, and conclude that “cyclical factors can fully account for the post-2007 decline of 2 percentage points in the labor force participation rate of prime-age adults” (age 25-54). Their paper also references additional studies which come to similar conclusions, namely that the decline in the participation rate since the Great Recession can be mostly attributed to cyclical factors. 20

Erceg and Levin argue that while ‘normal’ recessions have virtually no impact on participation, a very deep and protracted recession can cause a substantial decline in the participation rate. This decline is temporary, but develops and corrects only with long lags: the participation rate therefore can remain unusually low for some time even after the economy has recovered. 21

Some of the factors at work might be structural but not linked to demographics, and therefore more easily influenced by policy actions. For example, Jason Furman, Chairman of the President Obama’s Council of Economic Advisers, notes that the participation rate for prime-working-age men has declined for over 60 years, from 97% in 1953 to 88% in 2016; and the participation rate for prime-working-age women has declined from 77% in 1999 to 74% in 2016. Furman notes that the decline has been concentrated in people with at most high school education; he enumerates a number of policy steps that might help reverse this trend. 22

Our view – rising participation can offer only temporary respite

We believe the participation rate could recover over the next few years, with more people attracted into the labor force by a strong job market and—eventually—rising wages. Over the longer term, however, the impact of adverse demographics will dominate.

The participation rate recovered by 0.6pp between September 2015 and March 2016, but gave back two-thirds of the gain in the following two months—highlighting the short-term volatility of behavioral factors. The recovery in participation since September 2015 would seem consistent with Erceg and Levin’s idea that the fall in the participation rate was temporary, but would reverse only with a delay. However, the recovery has been tentative, and we saw a similar rebound between December 2013 and March 2014, when the participation rate rose 0.4pp, only to fall again to lower levels. The jury is still out.

We have performed a simple simulation to gauge the impact of demographics, and assess the scope for a possible cyclical recovery in participation. Using detailed BLS and census data, we construct a best-case scenario assuming that:

i. The participation rate for the older age cohorts (age 55 and older) rises as assumed by the BLS in its latest forecasts; while

ii. The participation rates for the younger and prime cohorts (16-54) revert to their 2000 levels; in that year participation rates for nearly all age brackets were at their highest levels (except for the 16-19 bracket), and the overall participation rate peaked at 76.1%.

The simulation shows that:

• If the participation rates for the individual age cohorts were to immediately move to these levels, the overall participation rate would jump to 65.9% by next year, over 3pp higher than the end-2015 value.

• Demographic shifts, however, would then lower the overall participation rate to 64.2% by 2025, 63.1% by 2030 and 62.4% by 2050. This is higher than the BLS’s 59.0% forecast, but well below the pre-recession plateau of about 66%.


21 From this analysis, Erceg and Levin draw an important conclusion for monetary policy: they argue that monetary policy can/should push the unemployment rate below its natural equilibrium rate, as this will accelerate a normalization of the labor force participation rate without a significant rise in inflation, as long as the participation rate remains cyclically low, it has some dampening impact on wage and inflation pressures.

Another way of isolating the impact of demographics is to simulate a scenario where the overall population size continues to evolve in line with the Census’ forecasts, but the age composition of the population remains frozen at its current (2014) shares. Let us again assume that the participation rates for older cohorts rise as projected by the BLS, whereas those for younger cohorts revert to their 2000 levels. In this scenario, the overall participation rate would remain steady at 67.2% throughout the horizon. In other words, population aging will shave at least 1.3pp from the participation rate over the next few years, and close to 5pp by 2050. Note that this second scenario serves only to highlight the effect of population aging, and not to describe a possible future outlook, as the extent of population aging over the next three decades is largely already determined by demographics.

Once participation rates for individual cohorts have adjusted to their long-term values, the rate of growth of the labor force in our first alternative scenario would be the same as in the BLS baseline, driven by the same population growth and the same demographic shifts. There would be a level difference, with the labor force under our alternative scenario larger by about 10 million people compared to the BLS baseline. (Our second alternative scenario, where we assume that the age composition of the population remains unchanged, would have slightly faster labor force growth, and the difference in the size of the labor force would grow to over 25 million by 2050.)

**Bottom-line: labor force growth**

Demographic factors have driven a sustained deceleration in labor force growth over the past decades: from a peak of close to 3% a year in the 1970s to just 0.5% over the last ten years. During the last five years, the slower pace of labor force growth has been compensated by a sustained decline in unemployment; this has allowed employment to grow at a healthier pace, supporting GDP growth. As we saw above, however, the unemployment rate is now close to its lowest levels in recent history; employment growth will therefore depend more directly on labor force growth.

Our simulations shows that in the next few years, the labor force could get an important boost from a cyclical recovery in the participation rate. If the participation rate were to move back to 66%, this would add about 8 million people to the labor force—a 5% increase over the end-2015 level. This could give a significant boost to GDP growth (it could also lead to some increase in the unemployment rate, if job creation does not keep pace with rising participation).

In our alternative scenario, with best-case assumptions on participation rates for the different age brackets, labor force growth would accelerate to about 1% per year through 2025, imparting a significant boost to overall GDP growth. (Assuming a constant unemployment rate, this would translate in a similar acceleration in employment growth). It would also raise per capita incomes, as the same population as in the baseline would generate the increase in output. Afterwards, however, population aging would cause the participation rate to decline again, and even in a best-case scenario it would be back at current levels within 15-20 years. The rate of growth of the labor force (and of employment) would revert to a steady state rate of about half a percent.
3. Investment

The IMF recently noted that “private fixed investment in advanced economies contracted sharply during the global financial crisis, and there has been little recovery since”. The IMF cited policy uncertainty, reduced public investment, and weak aggregate demand as the main culprits. Many economists remain bearish on US investment over the short- and medium-term. Gross domestic private investment contracted in Q2 2016, the latest available observation, but investment data are quite volatile on a quarterly basis, so we should be careful not to jump to conclusions based on just the most recent observation.

An incomplete recovery

Volatility in private investment has moderated somewhat starting in the mid-1980s. Investment accelerated through the 1990s, slowed with the 2001 dot-com crash, recovered, then plummeted with the 2009 Great Recession. The 5-year moving average shows that the recovery since 2010 has been quite robust, bringing the investment growth rate back to the late-1990s peak of about 8%. However, the 5-year average shows a deceleration since early 2015.

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23 “World Economic Outlook: Uneven Growth—Short- and Long-Term Factors”, International Monetary Fund | April 2015
24 “Productivity Growth in the Advanced Economies: The Past, the Present, and Lessons for the Future” by Jason Furman, Chairman, Council of Economic Advisers Peterson Institute for International Economics July 9, 2015; IMF World Economic Outlook (cited above), and OECD Economic Outlook, Vol. 2015/1, Chapter 3 “Lifting Investment for Higher Sustainable Growth” provide three recent examples.
The impact of the Great Recession can also be seen in the trend of the real (at constant prices) stock of private capital, which grew steadily from 1960 until 2010, but declined in the recession and has flattened in recent years.²⁵

Looking at private investment as a share of GDP confirms that the recovery is still incomplete: Private investment as a percentage of GDP showed steady trend growth from 1960 to 1980. It peaked during the 1980s, and after a drop in the early 1990s it rose back to a high plateau of 18 ½ % during the 2000s, up to the Global Financial Crisis. The investment to GDP ratio has bounced back from all-time low of 12% in 2009, and is now running at 16%—clearly below the 18% long-term pre-crisis average (1980-2006).

²⁵ Data from the Bureau of Economic Analysis and the Federal Reserve Bank of St Louis
Note that the investment to GDP ratio has ticked down for the last five consecutive quarters, from a local peak of 17% in Q1 2015 to 16% in Q2 2016. It might be a temporary setback, perhaps linked to the Presidential election uncertainty, but given that the investment recovery is still incomplete, it is a source of concern.

To better understand the dynamics, it helps to decompose investment in its key components. Since housing played a key role in the latest recession, the next chart breaks out residential and non-residential investment. Residential investment accounted for over one-third of total fixed investment at the peak of the housing bubble before the great financial crisis; it is now at 22%.

Note that:
- Both non-residential and residential investment bounced back strongly from the 2010 trough, with non-residential investment recovering first
- Both halted in mid-2012, as the Eurozone debt crisis undermined global confidence;
- Residential investment promptly accelerated again; non-residential investment, however, restarted at a noticeably more cautious pace: business confidence seemed to have suffered a more persistent setback.
- Non-Residential investment slowed again at the end of 2014, and declined in the first quarter of 2016. Residential investment instead kept growing at a fast pace, though it contracted in the second quarter of 2016.
The slowdown in overall investment, therefore, reflects an even more marked slowdown in investment other than residential construction.

Over the last year and a half, the energy sector has suffered a severe contraction. The next set of charts shows how Non-Energy, Non-Residential investment has flattened out since Q3 2015, but has not contracted. The charts also show that investment in equipment and intellectual property, arguably the most relevant for future economic growth, fell starting in Q3 2015, likely reflecting the ongoing contraction in the energy sector, but stabilized in Q2 2016. Energy investment collapsed, from 5 ½% of total fixed investment in 2011-14 to just 1.7% in Q2 2016.
Our view – we need a better business environment to reboot investment

Where does this leave us?

- Residential investment has recovered strongly. Non-residential investment has not.
- The sharp energy sector contraction of the last year and a half has had a significant impact on overall non-residential investment; however non-energy non-residential investment has flattened out since Q3 2015.
- Overall fixed investment has rebounded from a 12% of GDP trough in 2010 to 16% of GDP, but remains well below the 18% long-term pre-crisis average.
- What is most concerning is that key measures of investment have weakened over the last few quarters, even adjusting for the energy sector contraction. This reflects the elevated policy uncertainty of the US Presidential elections and heightened monetary policy uncertainty as the Fed initiated a very cautious reversal of its monetary stance; but also the higher level of perceived global uncertainty since 2012, including the UK’s recent decision to leave the EU and its potential repercussions on the EU and the Eurozone, the delicate growth transition in China, and geopolitical tensions in the Middle East. It also reflects a deterioration in the US business environment, including higher taxes and an increased regulatory burden.

Global uncertainty will remain elevated: neither the impact of “Brexit”, nor the unfolding of China's transition nor the volatility in the Middle East will be resolved within the next few months.

Putting investment back on an accelerating path, therefore, will require improvements in the US business environment: a simpler tax system, more focused regulation, and an upgrading of the country’s physical infrastructure should rank among the top priorities. Resisting protectionist temptations will be another: given the rising importance of global markets for manufactured products, trade openness will help spur more domestic and foreign investment in the US.

Investment has so far been the weak link in the US economic recovery. Unless we can lay the basis for an acceleration, there is a risk of a vicious circle where weak investment undermines domestic growth and domestic demand, further discouraging investment. This would be especially damaging as investment plays an important role in determining the pace of productivity growth, and therefore in shaping the country’s long-term growth outlook, as we discuss in the next section.
4. Productivity

Productivity is the most important driver of long-term growth. Productivity growth determines the sustainable pace at which wages and incomes can rise: it is the ultimate determinant of living standards. And it plays a key role in defining a country’s competitiveness in the global economy.

Defining productivity

There are two main different definitions of productivity.

**Labor productivity** measures the amount of output produced by one unit of labor. The productivity of labor will depend positively on (1) the size of the capital stock; (2) the level of technology embodied in the capital stock; (3) the efficiency of business organization and processes; and (4) the talent or abilities of the workforce. The unit of labor input can be defined a one worker, or as one hour worked; the latter adjusts for the fact that a country’s workers might be very productive but produce less because they work fewer hours.

**Total Factor Productivity (TFP)** measures the amount of output produced by labor and capital combined. TFP gauges how efficiently the two inputs are used, and depends on technology and business organizations and processes.

For the purposes of our analysis we will use labor productivity defined as output per hour worked. In terms of the productivity trends, similar arguments and observations apply to TFP.

So much innovation, so little productivity

US productivity growth averaged about 3% per year in the decade leading up to the Global Financial Crisis. Over the last five years it averaged a mere 0.5%. What happened?

Between 1948 and 1973, US productivity growth averaged close to 3% per year. Between 1974 and 1994, it decelerated to 1.5%. In the following decade, 1995-2005, it jumped back to about 3%. The chart below show the long term trend in US productivity: the blue line is the 10-year moving average; the orange line shows the significant degree of volatility from year to year—the volatility is even higher on a quarterly basis.
There is a broad consensus in the economic literature that strong productivity growth up to the early 1970s reflected the long wave of impact of the industrial revolution. It is interesting to note that this impact seemed to wane just as the US economy—and much of the world economy—was knocked off course by the two consecutive oil price shocks (1973 and 1979).

Similarly, the productivity resurgence in the mid-1990s was driven by the first Information and Communication Technology (ICT) revolution. While computers had been around for many years, it took time for companies to adopt the new technologies and adapt operations to fully exploit their potential. We discussed this in our 2012 Industrial Internet paper, which includes key references to the relevant literature.26

The end of that ten-year productivity boom coincided with the Global Financial Crisis and the Great Recession—just like the previous run of high productivity ended with a recessionary global shock.

The chart below, based on the latest OECD data, shows that productivity growth is now lower in almost all OECD countries, compared to the decade before the Global Financial Crisis:

![Productivity growth chart](chart_url)

Why is US productivity growth still so slow, particularly at a time when technological innovation generates so much excitement? Opinions differ, and there are three main schools of thought:

1. **Today's innovation is all hype.**

   The most pessimistic view, championed by Northwestern University economist Robert Gordon, is that the latest innovations are as unproductive as they are popular: while the industrial revolution brought life-changing technologies, from electricity to cars, trains and airplanes, today's innovations can at best deliver marginal improvements. Uber makes it easy to get a ride, but you are still getting from A to B by car, same as in the 1950s. Gordon takes a terminally pessimistic view of US growth prospects, arguing that the era of strong growth is over, because all the truly life-changing innovations have already been incorporated into the modern economy.

2. **It's a measurement problem.**

   An alternative view is that productivity growth is much faster than the official statistics recognize. Hal Varian, Google's Chief Economist and a highly respected academic, argues that the official statistics fail to capture much of the value created by the digital economy. This is in part because digital innovations now allow free access to a range of services. With a computer and an internet connection,

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26 *Industrial Internet: Pushing the boundaries of minds and machines*, GE, 2012
3. It’s lack of investment

A third view is that productivity growth has declined because investment has slowed. As we showed in the previous section, the investment recovery after the Great Recession has been slow and incomplete. As a consequence, the existing capital stock is older and less productive: older equipment is less efficient and more prone to failure; and less investment slows the pace at which new technologies are deployed across industry.

A recent paper by Jason Furman shows that the deceleration in labor productivity over the last few years can be almost entirely traced to lower capital deepening, defined as the amount of investment per hour worked. Furman also shows that a similar phenomenon has occurred in other industrial countries, including Canada, Germany and Japan. And while for most of the post-war period TFP and labor productivity have moved together, after the Global Financial Crisis labor productivity has slowed much more sharply than TFP.

This line of argument is sometimes incorporated in the Secular Stagnation hypothesis. In a nutshell, the Secular Stagnation idea holds that slow economic growth is due to a lack of aggregate demand so extreme that overcoming it would require deeply negative interest rates; monetary policy is therefore unable to address the problem because it cannot push nominal interest rates below zero, and low inflation keeps real interest rates too high.

Our view -- Innovation needs to scale

Where do we stand? All three views have an element of truth, but none provides the full story. The slowdown in investment has played an important role. However, John Fernald of the Federal Reserve Bank of San Francisco, argues that the productivity slowdown started in 2004, and therefore cannot be attributed to the great recession. This would suggest that by the mid-2000 the productivity boost of the ICT had lost steam; the great recession then delivered a further blow, accelerating and entrenching a productivity slowdown that was already in the cards.

Similarly, measurement problems are becoming more significant because of the profound transformation brought about by digital innovation; but we do not feel comfortable shrugging off the productivity slowdown as a measurement issue. Chad Syverson of the University of Chicago notes in a recent paper that the productivity slowdown has occurred across a large number of advanced economies, in a way that is not correlated to the size of information and communication technologies in each country. Syverson also notes that estimates of the “consumer surplus”—the value that consumers derive from new services and products which is not reflected in the amounts spent—is “at least an order of magnitude smaller” than the amount of lost output corresponding to the productivity slowdown since 2004, which is in the order of $3 trillion. Like us, Syverson recognizes there is a mis-measurement problem, but concludes that it cannot account for the bulk of the productivity slowdown.

We strongly believe that innovation has not lost the ability to boost productivity—to the contrary, we believe new digital-industrial innovations have even greater potential than those of the industrial revolution:

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28 “Productivity growth in the advanced economies: the past, the present, and lessons for the future” [2015]

29 See for example Summers [2016] “The age of secular stagnation”

30 Five major central banks have moved policy interest rates in negative territory, and some government bond yields have become negative (notably Japan) but the difficulty lies in pushing market interest rates much below zero.

31 In Productivity and potential output before, during and after the Great Recession [2012]

32 There is an additional twist to the measurement issue, which is the slower pace of growth in wages and median incomes. It might be the case that slower wage growth reflects in part the fact that much of the additional value produced by digital innovation is free or nearly free. The flip side of the coin, though, would be that official statistics also underestimate the increase in real incomes, failing to capture both the value of new free services and the quality improvements of existing services and products (official price statistics carry out periodic hedonic adjustments to account for the improvements in quality, but these probably fall further behind the curve when innovation accelerates).

First, productivity growth remained fast into the early 1970s, when electricity, the combustion engine and air travel had already been fully metabolized for quite some time. This suggests that innovation can have a long-lived impact on economic growth—we do not believe that the efficiency gains of the first ICT revolution have completely run out of steam.

Second, we are only now beginning to see the impact that the digital revolution can bring to manufacturing, the higher-productivity part of the economy—we will return to this point shortly.

Moreover, to judge whether innovation can boost productivity we have to look at the ‘frontier’, where these innovations are being developed and adopted by the firms that are most advanced in technology and efficiency. Innovations will impact average productivity growth as they spread through the economy, but initially their impact can only be seen at the frontier.

A recent OECD study shows that productivity growth for the globally most productive firms has remained strong—at around 3 ½% in the manufacturing sector. The gap between ‘the best and the rest’, however, has widened, contributing to the slowdown in average productivity.

This suggests it is not innovation that has broken down, but the diffusion of innovation. Technology and knowledge are no longer spilling over as quickly from the “global champions” to the “national champions” and then to the rest of the economy. Why? The OECD study identifies a few key factors.

- An increasing skills mismatch and labor market rigidities make it harder to find the right talent and get it to the right places;
- Excessive regulations, complex and heavy tax burdens, cumbersome bankruptcy legislation and other rigidities prevent economies from phasing out inefficient firms and reallocate resources to new and more dynamic ones;
- Rising protectionism: innovation at the frontier is driven by the most competitive multinational corporations, and its benefits are shared via trade and by national firms participating in global supply chains—protectionism negates these benefits.

In the US, an important role has been played by the significant increase in regulations over the last several years. This has been most notable in finance, but has extended to a range of other areas. Together with the well-known complexity of the tax system, increased regulations pose a further obstacle to investment. The US ranks at number 7 in the latest World Bank’s ease of doing business rankings. A good placement overall, but one that hides much poorer scores in the ease of paying taxes (153rd) and in the ease of starting a business (44th). This might also have adversely impacted the pace at which new businesses are being created: the Kauffman Index of Startup Activity shows a significant decline from 2009 to 2014, though with an encouraging bounce in 2015. While this decline has probably a multiplicity of reasons, the increased regulatory burden is likely to have played a role. John Cochrane of Stanford’s Hoover Institute has also argued in a Wall Street Journal OpEd that “a dramatic legal and regulatory simplification” would be the best way to accelerate US productivity growth.

Another important factor in our view is a misallocation of resources that predates the global recession. A 2015 study by the Bank for International Settlements (BIS) shows that credit booms tend to reduce productivity growth by skewing the allocation of resources towards less productive sectors such as construction. The adverse impact on productivity occurs even as the credit boom fuels an acceleration in overall GDP growth. If the credit boom results in a financial crisis, the damage is compounded as the economy then has to reallocate resources in an adverse context of deleveraging, reduced aggregate demand, and a crippled financial sector.

The BIS study finds that on average, a credit boom reduces productivity growth by 0.25% during the expansion period; two-thirds of this can be traced to a mis-allocation of labor. If a financial crisis follows, it causes a further reduction by 0.50%. In other words, excess credit can reduce productivity growth by three-quarters of a percentage point via a mis-allocation of resources. The authors note that during the credit boom, productivity growth in individual sectors remains unchanged: high-productivity growth sectors—notably manufacturing—remain high-productivity, the problem is that they lose resources in favor of less productive sectors—especially construction.

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34 The Kauffman index of startup activity 2015
35 Cochrane (2016) “Ending America’s slow-growth tailspin”
36 BIS (2015) “Labour reallocation and productivity dynamics. financial causes. real consequences”
Unleashing the power of innovation

Our view on productivity is the following:

- The growth-boosting impact of the first computer revolution was losing some steam by the mid-2000. At the same time, the credit bubble fueled by low interest rates and loose credit standards caused a reallocation of resources from manufacturing to the less productive construction and finance sectors, with a significant adverse impact on productivity growth.

- The Global Financial Crisis amplified the negative effect of the misallocation of resources. The financial sector had been crippled by the deepest crisis since the Great Depression, and while the cleaning up and bolstering of balance sheets was prompt, it was accompanied by a tightening of regulations that continues to this day.

- Moreover, investment fell sharply in ensuing recession, and recovered only in part. This has left the economy with a more obsolete capital stock, and has slowed the adoption of new technologies, preventing innovation from scaling and driving a significant further reduction in productivity growth.

- This has been compounded by a widespread increase in regulation, while tax rates have increased within a tax system that remains complex and distortionary. As a consequence, the pace of new business creation slowed, hampering productivity growth.

- Monetary policy has remained exceptionally loose even as growth and employment climbed back to normal levels—and might now be hindering the efficient reallocation of resources in the economy.

- Finally, digital innovations have so far been concentrated in the consumer sector and in services; many have created substantial value for consumers, but a value that is free or almost free, and therefore not captured by official statistics. Traditional measures of output are becoming increasingly outdated, and productivity is therefore underestimated.

Looking forward, we believe that innovation has enormous potential to boost productivity growth. We think some of the benefits of the first ICT revolution are still feeding through, but have been muted by the misallocation of resources of the credit bubble, and by the fall in investment during the great recession. More importantly, as we have argued in other studies, we have just entered a new and far more powerful stage of the digital-industrial revolution:

- Thanks to digital innovation, industrial machines are now becoming intelligent interconnected devices, with a greater range of functionalities that can be more easily extended and upgraded. The first phase of the ICT revolution was centered on improvements in management and business practices enabled by the new information and communication technologies. Now digital technologies are transforming the capabilities of the industrial hardware as well, opening the way for massive efficiency gains. As we noted last September, the industrial internet solutions already developed by GE are delivering to our customer an average efficiency gain of 20%. 37

- Digital innovations are augmenting the capabilities of workers at all skill levels, thanks to portable and wearable devices and other solutions. They are making the production process faster and more flexible thanks to new production techniques like additive manufacturing. Moreover, they are turning factory floors into intelligent environments that are digitally connected to supply chains and distribution channels, enabling efficiency-enhancing improvements in processes and operations.

- The nascent industrial app economy will accelerate the creation of new industrial internet solutions and their diffusion across geographies.

We strongly disagree with the view that digital innovations are incremental and cannot have a transformational impact on economic growth like those of the industrial revolution. Digital innovations are delivering universal and instantaneous access to the entire accumulated stock of human knowledge, and they are accelerating scientific progress and the creation of new knowledge through unprecedented ease of communication and collaboration, and by allowing hundreds of millions of new brains to participate in the process. This is as revolutionary as the harnessing of electricity.

Digital innovations are now beginning to transform manufacturing, the high-productivity engine of economic growth. They are blurring the traditional lines between industry and services, creating a new generation of high-productivity services.  

The productivity-enhancing power of digital-industrial innovations is already apparent at the microeconomic level: a number of solutions developed and launched across a range of industrial sectors, from energy to aviation to rail transportation to health care, have demonstrated a transformational impact on efficiency. Once these solutions are scaled across the industrial world, and as new ones continue to be developed, the impact will become visible at the macro level as well.

These innovations, therefore, have all the potential to reboot US productivity growth, pushing it back to 3% and possibly beyond. But there are a number of conditions to be fulfilled—and risks to be avoided—that will determine if and how quickly these benefits can be reaped.

- Investment must continue to recover, so that new technologies can be incorporated in the country’s capital stock at a faster pace. The uncertainty, volatility and pervasive pessimism that still characterize the global macro environment could create headwinds; further increases in regulations would have a similar adverse impact.

- The economy needs to maintain a high degree of flexibility to efficiently reallocate resources, adopt business processes, build new skills in the workforce, create new businesses and phase out those that become obsolete. Dynamism, flexibility and entrepreneurship are in the very DNA of the US economy. An increased regulatory burden, however, has already hampered this traditional dynamism; a further increase in the number and complexity of regulations could hamstring the economy and prevent it from leveraging the new innovations.  
  Looking further into the future, the projected rise in social security and health care outlays under current systems could necessitate a significant rise in taxes, which would subtract resources from new private business creation.

- Finally, the continued exceptionally loose stance of monetary policy is probably holding back the reallocation of resources towards higher-productivity sectors. As the BIS noted in the paper discussed above, the reason why loose monetary policy is unable to further accelerate economic growth is that loose financial conditions are part of the problem in the first place. A more rapid normalization of monetary conditions could reduce the risk of distortions and help bolster business confidence.

5. Conclusions

So what kind of economic growth lies ahead for the US? A useful rule of thumb is that the rate of growth of GDP equals the rate of growth of the labor force plus the rate of growth of labor productivity.  

As we saw in section 2, employment growth could get a boost from a rise in the participation rate over the next few years. In a best case scenario, we have estimated that this would deliver labor force and employment growth of about 1% per year. This would still be weaker than the last five years, when employment growth averaged 1.4% per year, thanks to the steady significant reduction in unemployment. About ten years from now, though, demographic effects will dominate, lowering the rate of labor force growth to about ½ %.

Productivity growth has slowed to less than 1% over the last few years. If it were to recover somewhat and stabilize at 1%, we could hope for GDP growth of at best around 2% per year for the next few years, in our best-case scenario of rising participation. But once labor force growth settles at its new equilibrium of ½ %, the US economy would have a growth potential of just 1 ½ %. Even lower than the disappointing 2.1% recorded in the recovery so far.

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38 The business strategy literature is discussing the shift to the era of everything/anything as a service.
39 Structural rigidities prevented Europe from reaping the productivity gains of the ICT revolution, as we discussed in Industrial Internet: A European Perspective, 2013.
40 This is an approximate rule of thumb, as it assumes for example that the participation rate, the unemployment rate, and the number of hours worked remain constant. But it gives a broadly accurate guideline: over the last five year, the difference with actual GDP growth was on average just 0.1pp.
Boosting productivity growth, therefore, is absolutely necessary if we want to bring overall GDP growth back to 3 – 3 1/2%. This would require productivity growth to accelerate back to the 3% rate that prevailed during 1995-2004.

We believe the digital-industrial innovations being developed have the potential to deliver major efficiency gains; we feel therefore confident that this acceleration in productivity growth is within reach. As we discussed in Sections 3 and 4, however, overall productivity will not accelerate without a stronger recovery in investment, which would allow new technologies to scale across the economy. This in turn will require less policy uncertainty, and a stronger business environment including simpler and better-targeted regulations, a simpler tax system, and a revamping of infrastructure.

Stronger growth is within our reach; whether the US economy booms or stagnates is ultimately a policy choice, The answer lies in boosting innovation, investment and productivity, with policies that improve the business environment and secure macroeconomic stability; well-targeted public investment in infrastructure and education can help, but relying mostly on loose monetary policy and government spending would just lead to higher debt, new financial bubbles and the same mediocre growth.

Appendix -- Population Trends

Slower and older

US population growth has slowed. Even though the Millennial generation is estimated to have surpassed the Baby Boom generation in absolute size this year, the population growth rate has slowed significantly over the past decades. It was close to 2% per year in the 1950s, then slowed to about 1% during the 1960s and remained broadly steady at that rate through the first decade of the new millennium. Over the last few years, however, the rate of population growth has suffered a slight deceleration, which the Census Bureau forecasts will continue in the future, with the rate stabilizing at about 0.5% in about twenty years. 41

As population growth slows, the US population is aging. In 1970, the median age in the US – 28.3 years old – was at its lowest level since 1950. It has risen steadily since then and had increased by more than 9 years, to 38.0, by 2015. This trend is expected to continue, although at a reduced rate. By 2050, the median age of the US population is projected to be 42.0 years42.

41 Colby and Ortmann (2016), “Projections of the size and composition of the US population: 2014 to 2060”, U.S. Census Bureau
The United States is not unique. Many industrial nations face a similar headwind, some to a much greater degree. For example, among the world’s largest economies, Japan has the oldest population, with a median age of 46.5 years, projected to rise to 55.2 by 2050. Germany is not far behind. Among emerging markets, China also faces a rapidly aging population, consequence of the one-child policy that has only recently been relaxed. The median age in China will soon surpass that of the US and rise steeply thereafter.

Immigration has played and continues to play an important role in supporting the US population growth rate and slowing it aging. The Pew Charitable Trust notes that the total immigrant population has increased from 19.7 million in 1990 to about 40 million by 2010. As a share of the total US population, it increased from just under 8% to 13% over the same period. The same study notes that “nearly half of the immigrants admitted between 2003 and 2012 were between the ages of 20 and 40, while only 5 percent were ages 65 or older”, so that immigration gave an important contribution to the size of the working age population. The U.S. Census Bureau expects this trend to continue, and projects that between 2014 and 2060 the foreign-born population in the US will increase by 85%, from 42 million to 78 million, while the native-born population will rise by 22%, from 276 million to 339 million. While these long-term projections are subject to uncertainty, they confirm that immigration plays a crucial role in making US demographic trends more dynamic and supportive of economic growth than in many other advanced economies.

![Median Age USA vs. Selected Countries 1950-2050](image)

Since the middle of the 20th century, the percentage of the US population under 20 peaked in 1965 at 39%. It has declined steadily ever since. Between now and the middle of the 21st century, fewer young people will be ready to enter the workforce—as a share of the total population.

At the same time, a larger share of the US population is reaching retirement age. In 1965, only about 9% of the US population was 65 or older. This rose to 15% by 2015, and is projected to reach 26% by 2050. Again, other major economies face an even greater challenge; by 2050, 29% of the population of China, 34% of Germany, and 38% of Japan will have reached retirement age. Compared to many other advanced economies, and some emerging ones, the US population will remain younger and faster-growing. But this is nonetheless a big shift with important economic consequences.

It might seem counter-intuitive that the US population grows at a slower pace and ages more rapidly even though the Millennial generation is the largest on record. It takes a closer look at the numbers to realize that the explanation is in fact quite intuitive: the Millennial generation is larger than the Baby Boomer generation, but not by a large margin. So even as a large number of Millennials feed into the younger age brackets, an almost equally larger number of Boomers reaches retirement. By contrast, the Baby Boomer generation arrived when the overall population was smaller (hence generating a faster growth rate on the smaller base) and did not face the headwind of large cohorts of retirees.

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Higher dependency ratio

The most powerful economic implication of these demographic trends is a significant rise in the old-age dependency ratio, defined as the retirement-age population (65+) divided by the working-age population (20-64). In the United States from 1950 to 1980 the old-age dependency ratio never exceeded 20%. Between 1985 and 2010 it remained stable at 21%-22%; it then steadily increased to the current 25% and is expected to climb to 41% by 2050. By 2050, old-age dependency will be even greater in China (50%), Germany (65%), and Japan (80%). The rise in the US old age dependency ratio is driven by the aging of the Baby Boomer generation, and is projected to level off around 2030.

Long-term impact

Long-term demographic projections are subject to a margin of uncertainty, which is greater the further out we peer into the future. The direction of the demographic shift already underway in the US is clear, however, and its magnitude can have sizable economic consequences.

Other things being equal, a deceleration in the growth of the working age population will lead to a slower expansion of the labor force, holding back economic growth. A substantial rise in the old age dependency ratio means that every worker will have to bear a greater burden in supporting pension and health care benefits for a larger retired population. In fact, experts including the non-partisan Congressional Budget Office have warned that these demographic shifts could lead to a substantial rise in US pension and health care expenditure obligations, to the point of making the corresponding implicit liability unsustainable.

The impact of these demographic shifts can be attenuated by behavioral and policy changes. For example, reforms of social security and health care spending programs (notably Medicare) could limit the rise in spending. Or an increase in the retirement age, or a tendency for more people to work later in their lives could limit the deceleration in labor force growth and slow the increase in the dependency ratio.