Economic Analysis

In Search of Potential GDP

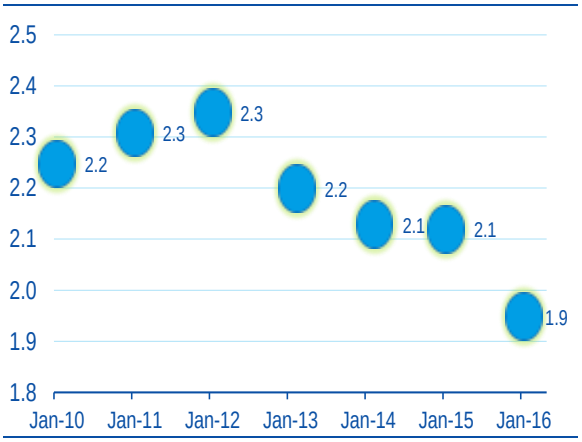
Kan Chen / Shushanik Papanyan

- **Potential GDP growth has slowed to 1.8% as a result of weaker demographics, lower productivity growth and slower capital accumulation**
- **If current trends do not reverse and policymakers continue kicking the can, potential GDP growth could slow down to 1.2%**
- **However, a rebound in productivity growth and policies to boost working age population could lift potential GDP growth up to 2.7%**
- **Stronger investment would further raise potential output to 3.2%**

The assessment of the cyclical position of the economy, meaning the level of Gross Domestic Product (GDP) relative to its potential, is the key to formulating economic policy – specifically monetary policy. That is, the central bank should stimulate the economy when output is below the potential level, and cool down the economy when the output is above the potential level. Therefore, an incorrect estimate of the potential output would mislead the policymaker and result in ill-advised monetary policies.

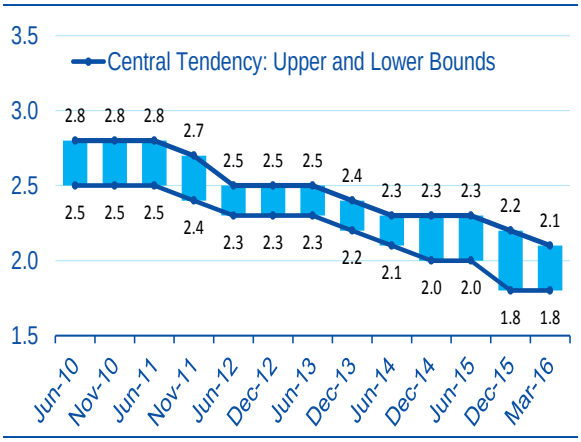
Despite the fact that potential GDP plays an important role in policymaking, its assessment is not uniform since potential GDP is unobservable and can only be estimated as the healthy, non-recessionary long-run trend of GDP. However, how much health is enough? Views diverge and methodologies on potential GDP estimation vary. But despite differences in the methodologies employed and the estimates yielded, one common thread among different agencies has been the continuous downgrade of U.S. expected potential GDP growth.

Chart 1
Potential Ten Year Real GDP Average Growth by Congressional Budget Office, %



Source: BBVA Research & CBO

Chart 2
Long-term Real GDP Projections by Federal Open Market Committee, %



Source: BBVA Research & FRB

Some economists hold a pessimistic outlook on the U.S. potential growth. For instance, prominent economist Robert Gordon, who has written extensively about U.S. potential economic growth, claims that the potential growth rate has declined to as low as 1%, much lower rate than the 1948-2000 average of 3.5%. The major headwinds in Gordon's accounting of supply side potential GDP growth are aging demographics, declining

productivity, and disbelief that digital innovations can match the innovations of the past in terms of boosting economic growth. On the other hand, there are also economists who are more optimistic and argue that potential growth will shift to a higher gear soon due to the diffusion of new technologies, and the current slowdown is only temporary.

Table1
Potential GDP Growth Scenarios Summary with Varying Assumptions for Labor, Capital and Total Factor Productivity (TFP)

	Baseline	Baseline with High TFP	Baseline with Low TFP	Baseline with Working Age Pop Growth	Baseline with Resisdential Assets Growth	Baseline with IP Growth	Dowside	Downside with Working Age Population Growth	Downside with IP Growth	Upside with High TFP, Working Age Population and Resid. Assets Growth
1960-1985	3.6									
1986-2006	3.1									
2007-2015	1.5									
2016-2020	1.9	2.3	1.5	2.6	2.4	2.1	1.0	2.0	1.3	3.8
2021-2026	1.8	2.2	1.4	2.3	2.1	1.9	1.2	2.2	1.6	3.2

Source: BBVA Research

Is the future of U.S. potential growth gloomy or bright? Several alternative and some hypothetical scenarios for supply side factors of labor, capital, and technological growth are examined in order to draw conclusions. Indeed, under the baseline assumptions for labor and capital growth we find potential GDP growth to be bound between 1.2% and 1.8%, depending on whether the technology trend returns to its pre-Great Recession trend or remains at the current low. At the same time, altering baseline assumptions including the inflow of working age population, the recovery in residential asset growth to its pre-2007 trend, an increase in the net stock of intellectual property (IP), and a boost to the utilization of technology can increase potential GDP growth up to 3.2% in the long-run.

How do economists define potential GDP and why do the estimates of potential GDP vary?

How much health is enough? The divergence in the assessment of the cyclical position of the economy arises from the fact that while actual GDP levels are observable, potential GDP is unobservable and there is much uncertainty surrounding estimates of potential GDP. The divergence in the output gap estimates is wide. The Congressional Budget Office (CBO) estimates that U.S. GDP was 2% below its potential level at the end of 2015. A study by San Francisco Federal Reserve Bank President John Williams and his co-author Justin Weidner find that actual GDP has been 1.1% above potential level.[1] At the same time, FOMC voting member James Bullard, President of the St. Louis Federal Reserve Bank, has expressed the opinion that the U.S. economy is at or near potential for the labor market but not for GDP growth.

> "U.S. labor markets are at, or possibly well beyond, reasonable conceptions of full employment" "If you just look at the GDP growth rate — 1.5 percent over the four-quarter sequence…that's below my estimate of potential growth."[2]

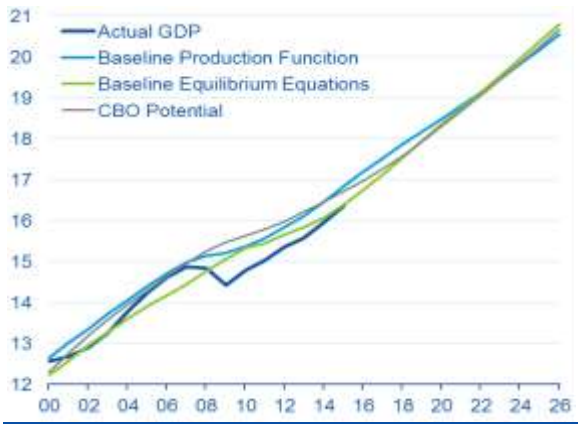
Within one group of econometric methodologies, potential GDP is estimated as the statistical trend. Therefore, the actual GDP level would fluctuate around the potential. It would be below potential during recession – forming an "output gap," and above potential level during the expansions – forming an "inflationary gap." The trend-cycle decomposition models yield an "attainable potential" GDP growth, wherein exceeding the healthy state in the short run is possible. We obtain "attainable potential" estimates with a multivariate dynamic common factor model. The equilibrium potential GDP trend corresponds to an economy wide steady state, where the

[1] Weidner and Williams (2016)
[2] James Bullard, President of FRB St Louise speech on May 23, 2016, and interview given to The New York Times on May 5, 2016

unemployment rate is at its natural rate or the non-accelerating inflation rate of unemployment (NAIRU) and inflation is at its long-term trend.[3]

Another commonly used method for potential GDP estimation is the production function approach, which is a theory-based structural estimation. The CBO, the EU Commission, and the Organisation for Economic Co-operation and Development (OECD) prefer a theoretical production function approach for potential GDP growth. This approach directly builds the link from production input series encompassing labor, capital, and technology to potential output by assuming a functional form of the production function.[4] This methodology yields a potential GDP level that can be referred to as a "full-capacity potential" where the potential level of GDP is an upper bound for the economic performance, and the resulting "output gaps" are wider and deeper in comparison to the trend-potential estimates. The production function approach estimates potential GDP as an optimal combination of resources and technology, implying no distortions from government policies or information frictions.

Chart 3
Real GDP and Potential GDP Estimates, $ Bn.



Source: BBVA Research, BEA & CBO

Chart 4
Real Output Gap Estimates, %

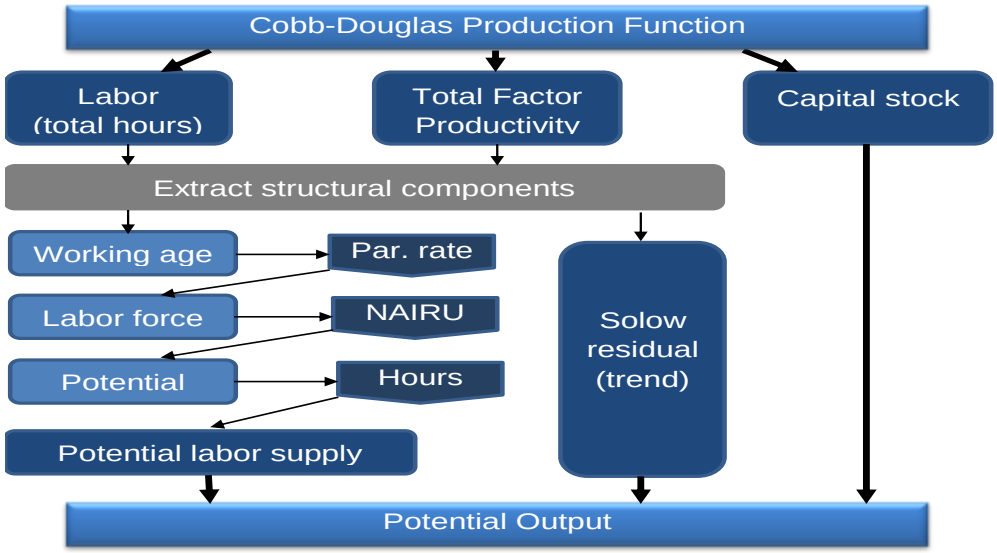
Source: BBVA Research & CBO

Is the future of U.S. potential growth gloomy or bright?

To illustrate insights on constraints to potential GDP growth posed by the structural changes that labor, capital, and technology have undergone in the last decade, the production function approach is a natural fit. The methodology is also a useful tool to assess the U.S. "full capacity potential" GDP growth under altered and hypothetical assumptions of capital, labor, and technology, including extreme adverse shocks like the recent Great-Recession and extremely optimistic upside scenarios wherein all the stars align. We adopt the production function approach used by the EU Commission to calculate potential output and output gaps for EU countries.[5] The methodology employed is also consistent with that of the CBO, while the CBO potential GDP methodology imposes additional assumptions based on sector-level data. Chart 5 illustrates the link between variables in our model.

[3] Doménech and Gómez (2006). Decomposition of output into its trend and cyclical components while accounting for macroeconomic equilibrium relations of Okun's law and Phillips curve.
[4] Please refer to Saxena and Cerra (2000) for more discussions about methods within two categories.
[5] Roeger (2006)

Chart 5
Production Function Model Flow Chart



Source: BBVA Research & Roeger (2006)

TFP does matter but not enough for a strong boost

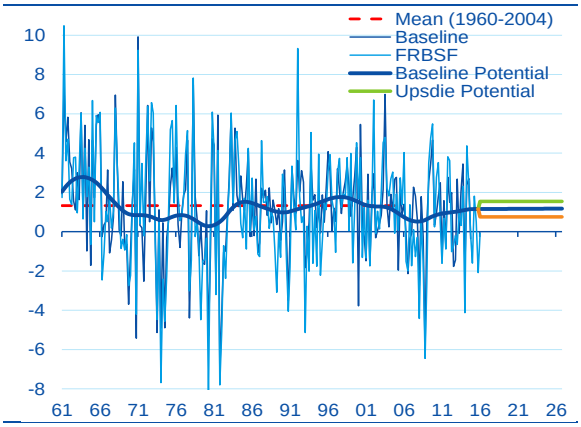
Although we are enjoying one of the greatest eras of technology prosperity, productivity growth has been slow since 2005. Such a productivity slowdown seems counter-intuitive, yet this phenomenon is not unfamiliar to economists. In 1987, Robert Solow famously said: "You can see the computer age everywhere but in the productivity statistics." In a few years, the productivity figures increased dramatically. On the other hand, Gordon (2012) argues that the current wave of innovations, such as social media and big data analysis provide little boost to productivity.[6] Nevertheless, the future of the productivity growth path is highly uncertain and structural shifts in total factor productivity (TFP) are not foreseeable.

To study the range of possible outcomes for the potential GDP growth in the next 10 years under different TFP paths, we employ three credible TFP scenarios: baseline, high productivity growth, and low productivity growth. In the baseline scenario, we forecast the growth rate of TFP using the full sample of data (1960-2015); in the high productivity growth scenario, we adopt an optimistic view of the TFP growth using the subsample between 1990 and 2004; in the low productivity growth scenario, we adopt the more pessimistic view of Robert Gordon, and use the sample after 2005.

With all other variables unchanged at the baseline level, under the baseline TFP scenario, the average annual TFP growth rate is 1.2%, and the average annual potential GDP growth will be 1.8% between 2015 and 2026. With the upside TFP scenario, the average TFP growth increases to 1.5%, and the potential GDP growth increases to 2.2% per year. In the downside TFP scenario, the TFP growth drops to 0.8%, and potential GDP growth deceases to 1.4% per year.

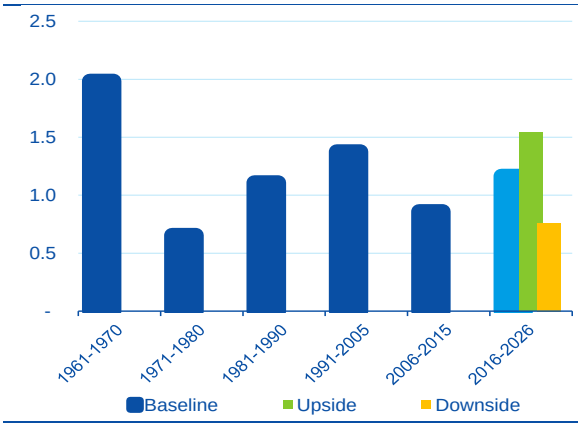
[6] For more details on productivity growth and current technological innovations, please refer to Papanyan (2015)

Chart 6
The U.S. Total Factor Productivity
%



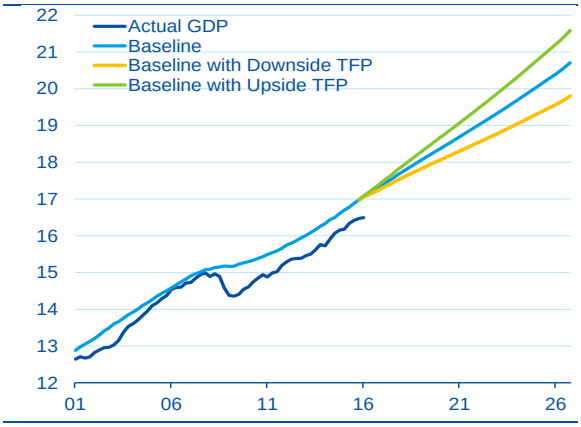
Source: BBVA Research & FRBSF

Chart 7
Average Total Factor Productivity Growth
%



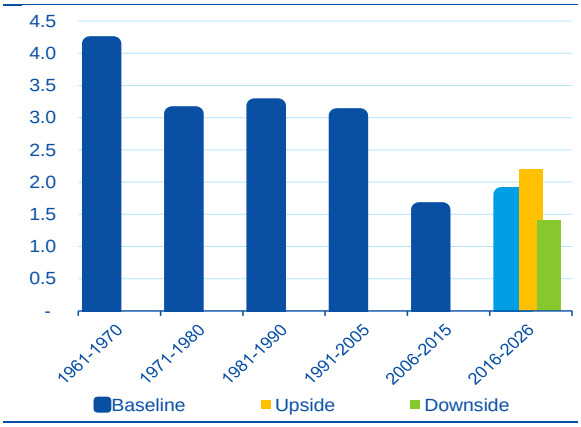
Source: BBVA Research

Chart 8
Potential GDP under Three TFP Scenarios
Trillion 2009$



Source: BBVA Research & BEA

Chart 9
Average Potential Output Growth under Three TFP Scenarios, %



Source: BBVA Research

Weaknesses in capital growth and importance of population growth

Capital accumulation is an important source for output growth and a critical component for the estimate of potential GDP. Although the growth of capital is generally smooth from a short-run perspective, the long-run growth rate can differ considerably due to many factors. For instance, historically residential assets have had a high growth rate and have strongly contributed to the total assets prior to the Great Recession. However, the devastating housing bust has significantly lowered the asset growth rate of the real estate sector and the overall capital growth rate.

Due to the highly complex nature of the form of capital, the practical way to assess the impact of capital to potential output is to analyze output growth under different scenarios within a certain range. The scenarios' assumptions for capital are summarized in the table below. For the annual growth rate of the total asset, the historical average is 3.3% before the Great Recession, and 1.5% after the recession. Therefore, we construct our three scenarios (baseline, upside, downside) by using the full sample, the pre-2005 sample, and the post-

2005 sample respectively. Moreover, due to the strong demand for infrastructure investment,[7] we add scenarios on non-residential structures and residential capital to our capital scenarios. Additionally, we employ a scenario of upside growth of intellectual property. This scenario is to take into account the upward trend in growth of the IP net stock.

Table 2
Capital Growth Scenarios Summary

		Net Stock of Fixed Assets	Equipment	Nonresidential Structures	Intellectual Property	Residential Assets
10Y Forecast Baseline	2017-2026	2.0%	3.6%	0.9%	2.9%	1.1%
10Y Forecast Downside	2017-2026	1.6%		0.2%		0.1%
10Y Forecast Upside	2017-2026	3.0%	3.8%	1.2%	4.1%	2.9%
Post 2005, Including Recession	2006-2015	1.5%	2.6%	1.1%	3.0%	0.8%
Historic Growth Rate	1950-2005	3.3%	3.7%	2.5%	5.8%	3.0%

Source: BBVA Research & BEA

Another key determinant of sustainable potential GDP growth is growth in the labor force. However the decline in the labor force participation rate pre-dated the Great Recession and has been at most due to structural and demographic shifts. The labor force participation rate that peaked in the 1990s at 67% consistently declined since 2000 to its current level of 63%. Studies indicate that at least half of the decline can be explained with the increased share of the aging population – retiring baby boomers.[8]

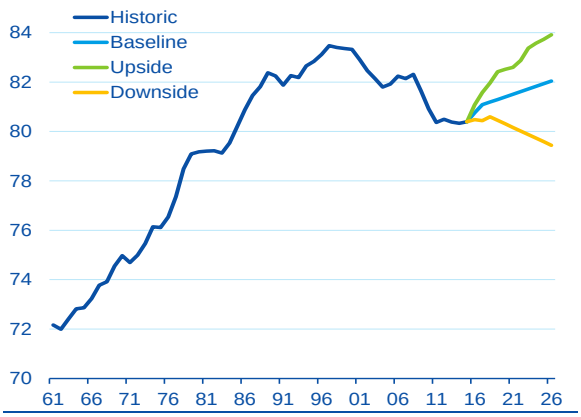
At the same time, the relationship between the labor force and the working age population underwent a structural shift in late 1990s. The ratio of the labor force to the working age population has declined by 3% from 83.5% in 1997 to 80.4% today. The phenomenon is mostly explained by the plateau in the women's labor force participation rate in the late 1990s which has been followed by a decline in that rate.

Due to the fact that an increase in the labor force to working age population ratio as well as a change in the working age population itself can be addressed with targeted policies (such as expanding family-friendly policies and targeted immigration policies)[9] we employ baseline, upside and downside scenarios for the labor force to working age population ratio. In the baseline scenario, the ratio for the extrapolated 10-year average normalizes around 81.6%. In the downside scenario, it continues to decline to an average of 80.1%. And in the upside scenario, it increases to reach the 1990s rate by the end of the forecast period. For the working age population baseline, we utilize U.S. Bureau of the Census projections for resident working age population aged 18 to 64 years. For the upside scenario, we use a hypothetical average of 1% growth in the working age population, which is milder than the actual 1990s growth rate of 1.2%. The combination of scenarios on working age population and labor force to working age population ratio yields five labor force participation rate assumptions to be employed within the production function framework.

Additionally, to study a complex range of possible outcomes for potential GDP growth under different labor market assumptions, we combine the policy inspired assumptions along with the additional structural assumptions of NAIRU and labor hours to enact a downside scenario that is similar to the Great Recession and a highly efficient labor market outcome for the upside scenario.

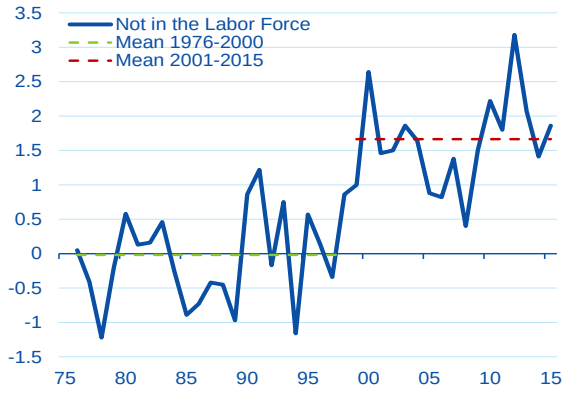
[7] Early this year, The American Society of Civil Engineers gave America a D+ rating in terms of infrastructure, and all three remaining president candidates promise to dramatically raise infrastructure spending once they are elected.
[8] Hall (2014)
[9] Blau and Kahn (2013), Hotchkiss (2005)

Chart 10
Labor Force to Working Age Population 18-64 Ratio Assumptions, %



Source: BBVA Research & Bureau of the Census

Chart 11
Women 16-Years and Up, Not in Labor Force %, Year over Year



Source: BBVA Research & BLS

Table 3
Population Growth Scenarios Summary: 2016 – 2026 Average

		Labor Force to Working Age Population Ratio		
		Baseline 81.6%	**Downside 80.1%**	**Upside 82.9%**
Working Age Population Growth	**Baseline 0.3%**	**Labor Force Participation Rate - 61.2%** Weekly Labor Hours - 32.8 NAIRU - 4.6% Capital Growth - 2.0%	**Labor Force Participation Rate - 60.1%** Weekly Labor Hours - 32.6 NAIRU - 5.9% Capital Growth - 1.6%	
	Upside 1.0%	**Labor Force Participation Rate - 62.0%** Weekly Labor Hours - 32.8 NAIRU - 4.6% Capital Growth - 2.0%	**Labor Force Participation Rate - 60.9%** Weekly Labor Hours - 32.6 NAIRU - 5.9% Capital Growth - 1.6%	**Labor Force Participation Rate - 63.0%** Weekly Labor Hours - 33.4 NAIRU - 4.1% Capital Growth - 3.1%

Source: BBVA Research

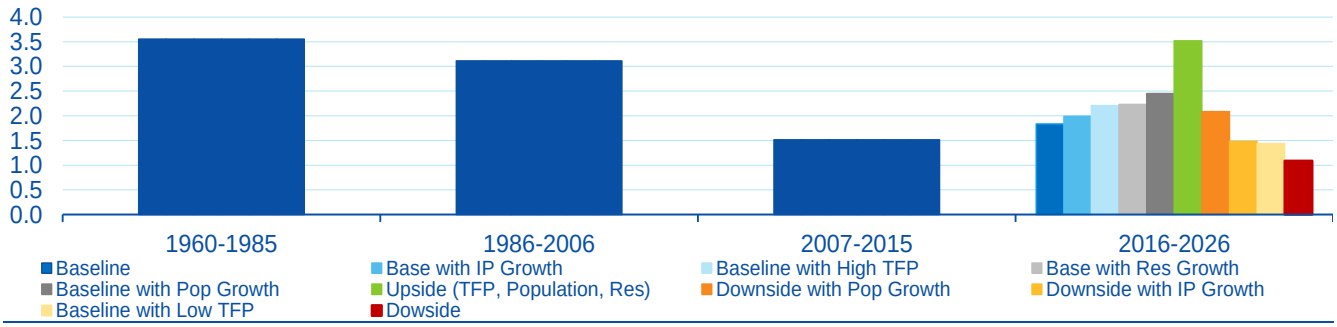
The range of future potential growth essentially reflects different visions of the opportunities and challenges for the U.S. economy. Both optimists like John Fernald of the Federal Reserve Bank of San Francisco who argues that the development of modern technologies, such as artificial intelligence, will boost economic performance, and pessimists like Robert Gordon have made valid points in their studies. Our analysis does not try to resolve this debate. Instead, we build a range of diverse outcomes for the U.S. potential GDP growth projections, including the most optimistic and pessimistic scenarios based on historical data to put in place upper and lower bounds for future potential output.

Among the wide range of outcomes for the projected potential GDP growth, the one hypothetical assumption that significantly raises potential growth within both baseline and downside scenarios is the higher working age population growth assumption. Potential GDP averages at 2.5% and 2.1% for the high population growth baseline and downside scenarios respectively, in comparison with the baseline population growth potential GDP outcome of 1.8% and 1.1% growth rates.

Within the alternative baseline assumptions for capital growth, the higher growth rate in the net stock of residential assets yielded more favorable outcomes for the potential GDP growth – 2.2%. This is in contrast to a higher growth in the net stock of intellectual property – 2.0% – and a similar outcome to a higher productivity rate scenario – 2.2%.

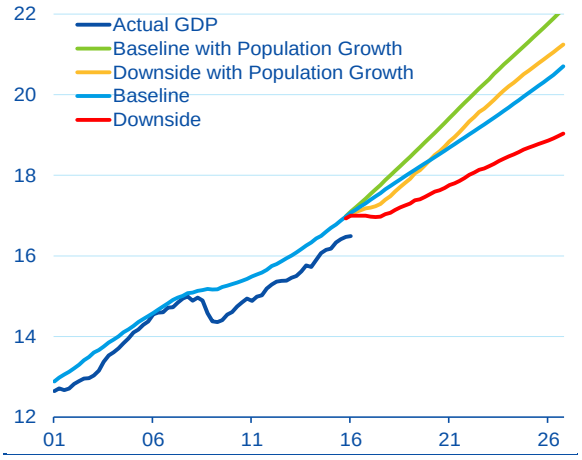
In our most optimistic scenario, we have high growth in the working age population, a high labor participation rate, low NAIRU, high capital growth, and high TFP growth. All upside factors together will give us an annual growth rate of 3.5% for potential output, matching the 1960-1985 average potential GDP growth. Similarly, all downside factors together will give us an annual growth rate of 1.1% for potential output, which is in line with the "headwind" narrative by Robert Gordon.

Chart 12
Potential GDP Growth Scenarios Summary



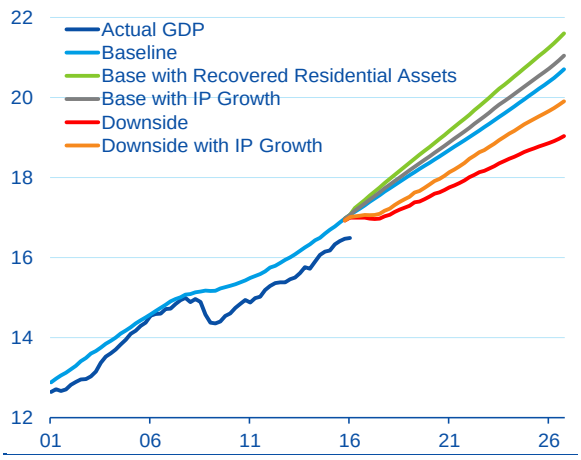
Source: BBVA Research

Chart 13
Potential GDP under Labor Scenarios
Trillion 2009$



Source: BBVA Research & BEA

Chart 14
Potential GDP under Capital Scenarios
Trillion 2009$



Source: BBVA Research & BEA

Bottom Line

The "full capacity potential" GDP estimation based on the production function framework matters much because it could have significant policy implications. The state-of-the-art approach employed to estimate potential output for the U.S. yields 1.8% average potential GDP growth in the baseline. However, the degree to which 1.8% potential output growth for the next decade is alarming is hard to judge. The theory-based productivity function accounting is challenged by the rise of digital capital, declining share of labor income, and changes in the mixes of capital-augmented and labor-augmented technologies. The framework also misses out on structural changes that cancel each other in the aggregation, such as large reallocations of production and resources from the manufacturing sector to the service sector. Thus, there is a possibility that the "full capacity potential" GDP

growth may understate the true living standard. Nevertheless, the heavy downward weight of recent economic trends that were illustrated under different potential growth scenarios is hard to reject. The low growth rate of the net stock residential assets, the deceleration of the working age population growth, and the decline in the labor force to working age population ratio come at the cost of lower potential growth.

Under the luckiest circumstances, the long-run trend of the output can be as high as 3.5% per year for the next decade. The probability that all the stars align is low, but more proactive federal policies aiming at immigration, expanding family-friendly policies, and raising infrastructure spending will bring U.S. potential growth closer to its optimal 3.5%.

The policy implications of the potential GDP outlook can be critical. As interest rates are closely related to the output gap, which is the percentage difference between actual and potential GDP, a lower potential GDP implies a narrower output gap and supports more interest rate hikes and at a faster pace. On the contrary, a wider output gap supports fewer rate increases and a slower pace of monetary policy normalization.

References

Blau, Francine D. and Lawrence M. Kahn. 2013. "Female Labor Supply: Why is the US Falling Behind?" NBER Working Paper No. 18702

Bullard, James. 2016. "Slow Normalization or No Normalization?" The Official Monetary and Financial Institutions Forum's City Lecture, Singapore, May 26, 2016 https://www.stlouisfed.org/~/media/Files/PDFs/Bullard/remarks/Bullard-OMFIF-Singapore-26-May-2016.pdf

Bullard, James. 2016. "Outspoken Fed Official Frets about Following Japan's Path." The New York Times Interview, May 4, 2016

http://www.nytimes.com/2016/05/05/upshot/outspoken-fed-official-frets-about-following-japans-path.html

Doménech, Rafael and Víctor Gómez. 2006. "Estimating Potential Output, Core Inflation, and the NAIRU as Latent Variables," Journal of Business and Economic Statistics, Vol. 24(3)

Gordon, Robert. 2012. "Is U.S. Economic Growth Over? Faltering Innovation Confronts The Six Headwinds." NBER Working Paper 18315.

Hall, Robert E. 2014. "Quantifying the Lasting Harm to the U.S. Economy from the Financial Crisis." NBER Working Paper 20183.

Hotchkiss, Julie L. 2005. "Employment Growth and Labor Force Participation: How Many Jobs Are Enough?" Econometric Review, First Quarter, Federal Reserve Bank of Atlanta

Papanyan, Shushanik. 2015. "Digitization and Productivity: Measuring Cycles of Technological Progress." BBVA Research Working Paper Nº 15/33

https://www.bbvaresearch.com/en/publicaciones/digitization-and-productivity-measuring-cycles-of-technological-progress/.

Roeger, Werner. 2006. "The Production Function Approach to Calculating Potential Growth and Output Gaps Estimates for EU Member States and the US." Working paper, EU-Commission, DG ECFIN

Saxena, M.S.C. and Cerra, M.V., 2000. "Alternative Methods of Estimating Potential Output and the Output Gap: an Application to Sweden." International Monetary Fund.

Weidner, Justin and John C. Williams. 2016. "Update of "How Big is the Output Gap?"" Working Paper