# Potential Growth in Advanced Economies

Ivailo Arsov and Benjamin Watson[*]

Photo: yongyuan – Getty Images


## Abstract

Potential growth is the rate of growth that an economy can sustain over the medium term without generating excess inflation. Potential growth has declined in the advanced economies in recent decades due to lower growth in the labour force, capital stock and productivity. Current projections and long-term growth expectations suggest that the low rates of potential growth in advanced economies will persist for some time.


To assess economic performance, economists often estimate potential output and potential growth. Potential output is typically defined as the highest level of output an economy can sustain in the medium term without generating excess inflation (Andersson *et al* 2018). Actual GDP growth rates can vary due to temporary factors, such as natural disasters. Estimates of potential growth attempt to abstract from such temporary fluctuations. Other variations in actual growth are longer lasting, such as those from the development and adoption of new technologies or demographic changes, and can cause changes in potential growth.

Policymakers are interested in potential growth and the level of potential output for a number of reasons. The output gap – the difference between actual output and potential output – is a key indicator of inflationary pressures. Growth in potential output helps policymakers understand what rate of growth the economy can sustain in the medium term and provides useful guidance for GDP growth forecasts. Estimates of potential output also help to assess the underlying fiscal position of the government because they can be used to adjust measures of tax revenues and government spending for the effects of the business cycle (Girouard and André 2005). From the perspective of the Reserve Bank, estimates of potential output and potential growth in overseas economies help in assessing the economic conditions in our trading partners. They can also represent a basis for

comparison that provides insights into the determinants of potential growth in Australia.[1]

GDP growth in advanced economies has slowed over the past four decades (Graph 1). In most advanced economies, average GDP growth since 2000 has been ½ to 1 percentage points lower than the growth recorded over the preceding two decades. Part of the sluggishness in growth since the global financial crisis reflects the typical experience of slow recoveries after deep financial crises (Reinhart and Reinhart 2010), but it also reflects slowing growth over a longer period. The slowdown in potential growth pre-dates the global financial crisis and some have argued that it started as far back as the 1970s (Fernald *et al* 2017).

In this article, we examine a variety of estimates of potential growth for the advanced economies. We discuss how potential growth in these economies has evolved. We also discuss the difficulties in measuring potential growth and propose a method for quantifying the uncertainty in potential growth estimates using revisions to past estimates. Taking into account this uncertainty when assessing current growth against potential growth is important because it is difficult to estimate potential growth accurately in real time.

## Measuring Potential Growth

There are a variety of approaches to measuring potential output and potential growth. The *univariate approach* uses statistical techniques to decompose output into trend and cyclical components; the trend component is assumed to be potential output. The *multivariate approach* treats potential output, the output gap, or potential growth as unobserved variables whose values are inferred from the behaviour of other observed variables, such as inflation and the unemployment rate, that are related to potential output. For example, when inflation falls below the central bank's target for a sustained period, these methods would generate higher estimates for potential output. These methods for estimating potential output originated with Okun (1962) and they continue to be used (for example, see Blagrave *et al* 2015); their key advantage is that they more closely align with the definition of potential output. Both the univariate and multivariate approaches provide little information about what drives the changes in the growth in potential output.

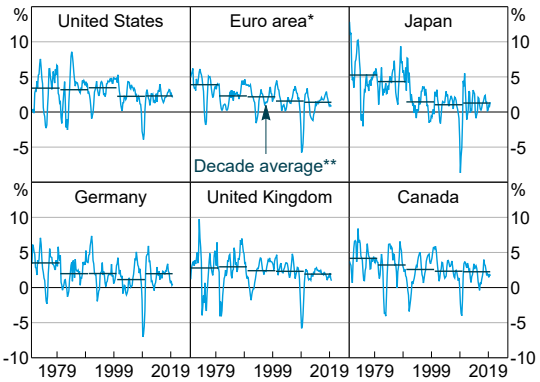
*Growth accounting* is another method to estimate potential growth. It does so by splitting potential growth into its three main supply-side sources: employment, the capital stock and total factor productivity (TFP). The trend in each supply-side component is estimated separately; for example, the labour component assumes that the economy is at full employment and that the participation rate is at its sustainable level. The individual supply-side components are then aggregated, usually with a simple Cobb-Douglas production function, to give an estimate of potential growth.[2] While this approach allows us to get a better understanding of the drivers of potential growth, it still requires the estimation of the trends in many variables, which can be challenging as discussed later.

A range of estimates of potential growth are available for the advanced economies. Some of these are provided by international organisations such as the Organisation for Economic Co-operation and Development (OECD), the International Monetary Fund (IMF) and the European Commission (EC), which construct them using similar growth accounting based approaches.[3] National agencies, such as the Congressional Budget Office (CBO) in the United States, and some central banks also provide estimates for potential growth (see for examples,

**Graph 1**

**GDP Growth**

Year-ended




* PPP GDP-weighted average of France, Germany, Italy and Spain

** 80 per cent trimmed mean to control for volatility during recessions and initial stages of recoveries

Sources: IMF; RBA; Refinitiv

CBO (2014), Agopsowicz *et al* (2018) or Holston, Laubach and Williams (2017)). The potential growth measures from the various sources are generally very similar, which at least partly reflects that they are estimated using similar methods.

## How Has Potential Growth Evolved?

Potential growth in the advanced economies has declined steadily since the mid 1980s (Graph 2). The decline was interrupted in the late 1990s and early 2000s, when potential growth increased possibly because of widespread adoption of information and communication technology led by the United States (Jorgenson, Ho and Stiroh 2008). The decline accelerated during the global financial crisis because the crisis had long lasting economic effects. Although potential growth has picked up a little since 2013, it is currently only around half its rate in the mid 1980s.

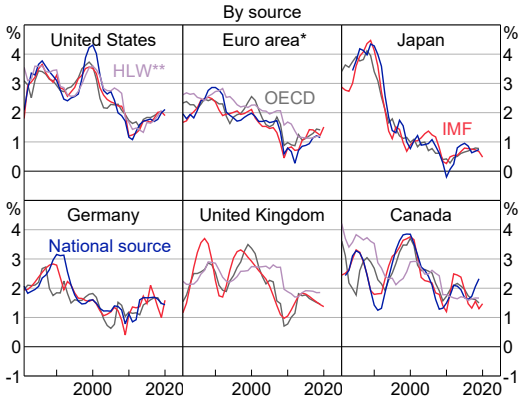
The decline in potential growth has been broad based across the advanced economies (Graph 3). It has been most pronounced in Japan due to slowing population growth and the related slowing in capital accumulation. This has caused Japan's potential growth to decline from around 4 per cent in the early 1990s to be a little below 1 per cent recently. Potential growth has declined the least in the euro area, including Germany, from around 2 per cent in the 1980s to around 1½ per cent because population growth has not slowed as sharply as in other economies; although, population growth and potential growth are lower in the euro area than in some other large advanced economies.

Another related measure of trend economic growth is the longer-run forecast of GDP growth made by professional economists. Economists' forecasts for growth over shorter horizons are affected by the business cycle, while their forecast over longer horizons mainly reflect their views of (future) potential growth. Economists' longer-run growth forecasts for the advanced economies have declined since the late 1980s to a similar degree as the estimates for potential discussed above (Graph 4).

**Graph 3**

**Potential Growth Estimates**

By source

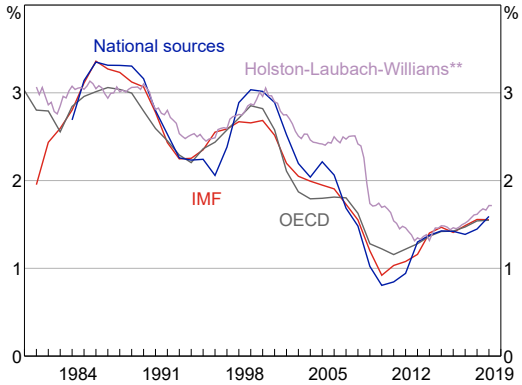



* PPP GDP-weighted average of France, Germany, Italy and Spain
** Holston-Laubach-Williams estimates

Sources: Bank of Canada; Bank of Japan; CBO; European Commission; Federal Reserve; IMF; OECD; RBA

**Graph 2**

**Advanced Economies – Potential Growth***

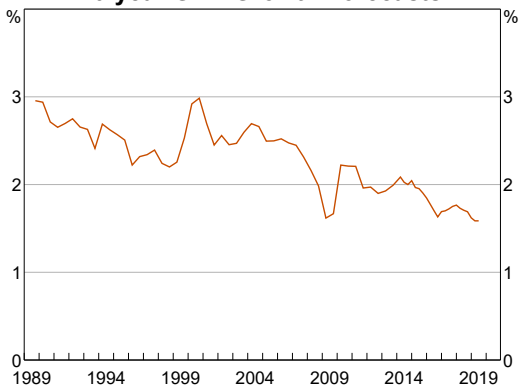



* PPP GDP-weighted average of Canada, France, Germany, Italy, Japan, Spain, United Kingdom and United States
** Excludes Japan

Sources: Bank of Canada; Bank of Japan; CBO; European Commission; Federal Reserve; IMF; OECD; Office for Budget Responsibility

**Graph 4**

**Advanced Economies – 10-year GDP Growth Forecasts***




* PPP GDP-weighted average of Canada, France, Germany, Italy, Japan, Spain, United Kingdom and United States

Sources: Consensus Economics; IMF

## Why Has Potential Growth Declined?

The slowdown in potential growth in the major advanced economies over the past four decades has been driven by slower growth in each of the three supply-side factors: employment, capital stock and TFP (Graph 5). In relative terms, the slowdowns in the United States and the euro area are mainly explained by lower potential employment growth. In Japan, the slowdown is largely due to slower capital accumulation, even though Japan, unlike the other advanced economies, has also experienced a decline in the level of potential employment.

### Potential employment

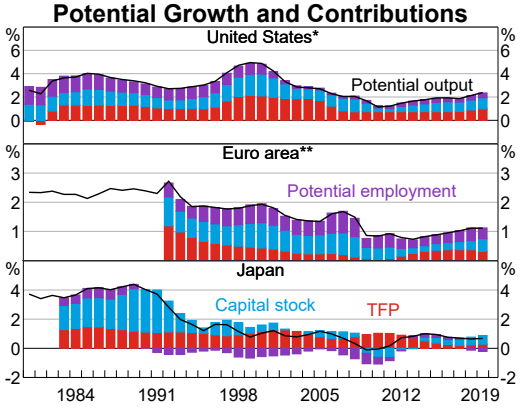
Potential employment measures the labour supply in the economy, adjusted for cyclical variations, that is consistent with stable inflation. Potential employment can be decomposed into the product of the working-age population, the trend participation rate, (one minus) the non-accelerating inflation rate of unemployment (NAIRU) and the trend average hours worked. Slowing population growth and ageing have lowered working-age population growth rates in most of the advanced economies (Graph 6). The effects of this on potential employment have been partially offset in some economies by an increase in the share of the working-age population working or looking for work (i.e. higher participation rate) and a decline in the level of unemployment consistent with stable inflation (i.e. lower NAIRU). On balance, however, potential employment growth has declined, which has weighed significantly on potential growth in the advanced economies.

The demographic drag has been the largest in Japan, where potential employment declined during much of the 1990s and 2000s. Since 2014, however, the rapid and persistent increase in female employment in Japan has had an offsetting effect. More generally, increasing female participation has boosted labour supply across the advanced economies since well before the 1980s (Graph 7). The extent of this has varied across countries and time. The boost in the United States occurred earlier than in the other advanced economies and ended by the early 2000s, but is continuing in most other economies. Participation in the labour market by older workers (those 65 years or older) has also increased over the past two decades, after declining in the 1970s and 1980s. The population in the advanced economies is expected to continue ageing, which will further lower potential employment growth due to older workers leaving the labour force as they retire. Further increases in older workers' participation are unlikely to fully offset this effect on labour supply (Brown and Guttmann 2017).

The boost to potential employment from the increase in participation rates has been muted by a decline in the average number of hours that employed people are working. This is because females and older workers, whose participation has increased, are more likely to be in part-time employment (Graph 8). Average hours worked have

**Graph 5**

**Potential Growth and Contributions**



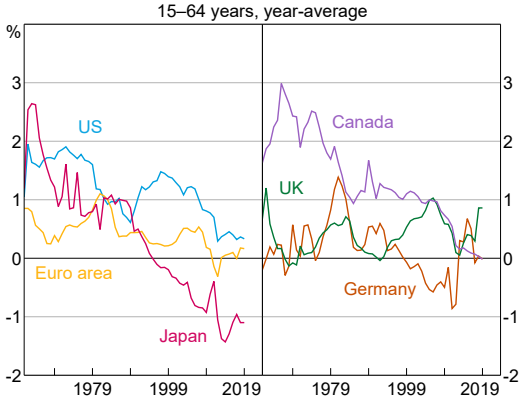

* Non-farm sector
** PPP GDP-weighted average of France, Germany, Italy and Spain; data unavailable prior to 1992

Sources: Bank of Japan; CBO; OECD; RBA

**Graph 6**

**Working-age Population Growth**

15–64 years, year-average




Source: European Commission

declined the most in the euro area and Japan where the increase in participation by these population groups has been the largest; the decline in average hours worked in European countries may partly reflect changes to tax and transfer policies that have reduced incentives to work longer hours (Prescott 2004).

Potential employment has also been supported recently by the decline in estimates of the NAIRU in advanced economies (Graph 9). Estimates for the NAIRU have declined in part because the reductions in unemployment rates have not been accompanied by as much inflation as expected since the financial crisis (these estimates have also been revised signficantly, see discussion in *The Uncertinaty of Potential Growth Estimates* section). The decline in estimates of the NAIRU raises potential employment and output because a larger share of the labour force could be sustainably employed.

## Capital stock

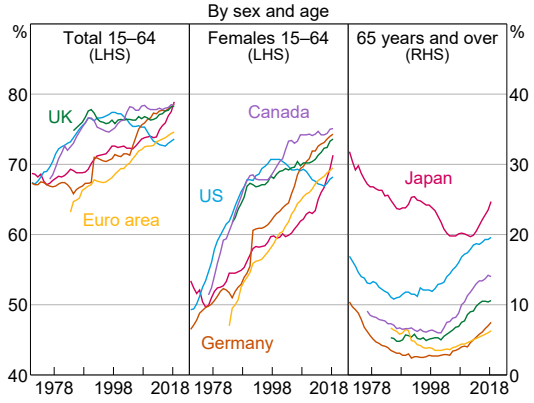
Lower trend growth of the capital stock has also weighed on potential growth in the major advanced economies since the 1980s. The slowing in capital accumulation has been the sharpest in Japan, with its contribution to potential growth falling from around 3 percentage points to be slightly negative in the early 2010s; capital accumulation has increased more recently in Japan, making ½ percentage point contribution to potential growth since 2014. Trend growth in the capital stock has declined as well in the United States and the euro area, reducing the contribution of the capital stock to their respective potential growth rates by around ½ percentage point. Much of the decline in investment has come from public and residential investment rather than business investment (Graph 10).[4]

The slowing in the growth of the capital stock may be related to the slowing in population growth through two distinct channels. Firstly, lower growth in the labour force requires less growth in the capital needed to sufficiently equip the workers. Secondly, the slower growth in the population reduces the need to invest in new dwellings and public infrastructure. Some of the reduction in residential investment, as a share of GDP, is related to the global financial crisis, and has been most apparent in the United States and parts of the euro

**Graph 7**

**Participation Rate**

By sex and age

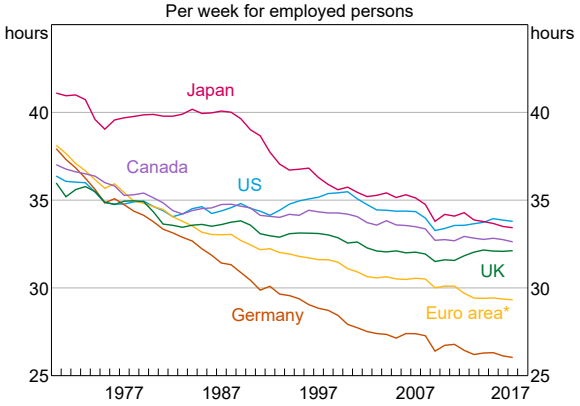



Sources: OECD; RBA

**Graph 8**

**Average Hours Worked**

Per week for employed persons



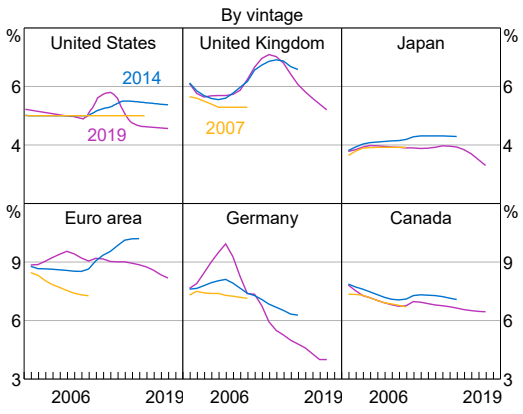

* PPP GDP-weighted average for France, Germany, Italy and Spain

Sources: Penn World Table; RBA

**Graph 9**

**NAIRU Estimates***

By vintage




* Congressional Budget Office estimates for United States and OECD for other economies

Sources: CBO; OECD; RBA; Refinitiv

area where residential investment was at elevated levels in the mid 2000s. The decline in public investment may also reflect more conservative management of public finances following the accumulation of government debt in recent decades.

### Productivity

Trend growth in TFP, and its contribution to potential growth, has declined since the 1960s, but the experience has varied significantly across the major advanced economies (Graph 11). Trend TFP growth increased noticeably in the United States in the late 1990s and early 2000s alongside the large-scale uptake of information and communication technology. US TFP growth has declined over the past decade but has been only a little below its rate in the 1970s. The decline in TFP growth is more obvious in Japan since the 1980s. The reasons for the lower productivity growth across advanced economies are still debated. Some have argued that productivity is driven by the widespread adoption of new technologies, and that most transformative technologies have been already invented and adopted (Gordon 2012). Others have focused on the role of government policies in encouraging innovation (for example see, Herkenhoff, Ohanian and Prescott (2018), Glaeser and Gottlieb (2009), Backus (2019) or Pike (2018)).

Weakness in investment and productivity may be related. For example, insufficient investment to replace depreciated infrastructure could increase congestion and lower investment in research and development could also lower productivity growth (Guellec and van Pottelsberghe de la Potterie 2003). Lower productivity growth may have also reduce incentives for business investment because it lowers expected returns on new investments.

## The Uncertainty of Potential Growth Estimates

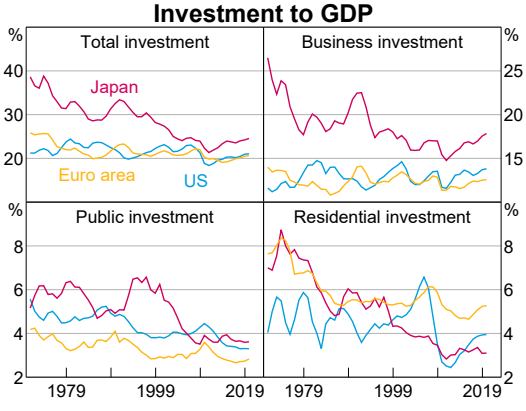
Estimating potential growth is difficult because it requires an assessment of trend developments in real time. These estimation challenges are clear when focusing on the growth accounting approach, but all potential growth estimation methods face some challenges of this kind.

Potential employment requires estimates of the working-age population, trend participation rate and the NAIRU.[5] Estimating trend participation is difficult because labour force participation can be affected by the cyclical conditions in the economy and the trend estimates need to adjust for this. Estimating the NAIRU is challenging in its own right and estimates are highly uncertain (for example, see Cusbert (2017) or Crump *et al* (2019)).

Measuring the capital stock is difficult and the measurements are imprecise, which compounds the difficulty in estimating its trend growth.[6] For example, firms are likely to invest when they are operating closer to their full capacity and when they assess demand conditions to be strong. This makes investment procyclical, which increases the difficulty of discerning the trend growth rate of capital.

**Graph 10**

**Investment to GDP**

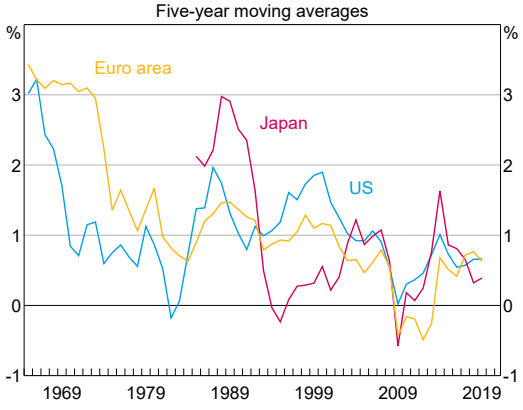



Sources: RBA; Refinitiv

**Graph 11**

**Total Factor Productivity Growth**

Five-year moving averages




Sources: European Commission; RBA; Refinitiv

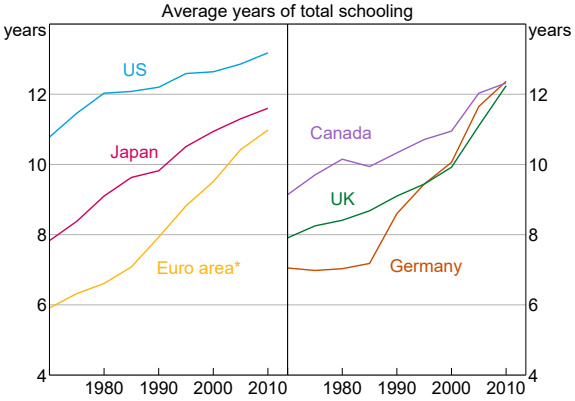
Estimating trend productivity is even more challenging. In practice, TFP is measured as the residual in GDP growth that is not explained by the growth in labour and capital inputs (Harberger 1998). In addition, the fact that capacity utilisation varies over the business cycle can introduce procyclicality in estimated trend TFP growth (Fernald and Wang 2016). An example of this difficulty is in the experience in the United States, where estimated potential output growth was high in the late 1990s due to increased investment in information technology and the lift in productivity from the wider adoption of this technology. Potential growth estimates for this period were revised higher in the early 2000s because it took some time before the increase in productivity was fully recognised. By the time potential growth was revised higher, the period of faster growth was coming to an end.

Trend productivity growth is partly determined by human capital (the quality of labour), which increases the efficient utilisation of physical capital by the labour force. Measuring human capital is difficult and, in practice, it is usually done with proxies such as average years of schooling or completion rates across different education levels (Graph 12). Given the measurement difficulties, trends in human capital accumulation are not usually explicitly accounted for when estimating potential growth which may lead to mismeasurement of potential growth when education trends change.

**Graph 12**

**Educational Attainment**

Average years of total schooling




* PPP GDP-weighted average of France, Germany, Italy and Spain

Source: Barro, Robert and Jong-Wha Lee (2013), A New Data Set of Educational Attainment in the World, 1950-2010

The difficulty of discerning the effects of longer-lasting structural forces from those of temporary cyclical factors can lead to estimates of potential growth rising and falling with the business cycle. A recent example is the large downward revisions to potential growth and output in the wake of the global financial crisis. Most potential growth estimates for 2009 to 2012 were revised lower as GDP declined sharply in many economies and the recovery was sluggish. The more recent estimates for this period have been revised up, although they remain well below the pre-crisis potential growth estimates. Rather than this being an isolated problem, this episode highlights the systematic difficulty in estimating potential growth. Coibion, Gorodnichenko and Ulate (2018) have argued that the popular estimates of potential growth systematically respond to temporary shocks. Such biases in potential growth estimates suggest that they should be used with caution, and the uncertainty in the estimates should be taken explicitly into account when using them.

The IMF's real-time estimates for potential GDP growth, like other estimates for potential growth, are revised regularly and significantly as can be seen from the shaded areas in Graph 13, which show the range of estimates for potential growth at each point in time since 2000. To quantify how estimates for potential GDP growth vary over time, we use a pooled sample of the IMF's estimates published from 2000 to 2019. The estimates tend to stabilise within about five years of their initial publication, which suggests that the size of the revisions at that point is a useful measure of the uncertainty in the potential growth estimates. The IMF has typically revised its potential growth estimates within a range of −1 to 0.5 percentage points within the first five years after its initial publication (Graph 14).[7] For example, if the IMF's estimate in 2000 for that year's potential growth was 3 per cent, five years later, we would generally (with 90 per cent confidence) expect the estimate for potential growth in 2000 to have been changed to between 2 and 3½ per cent. Estimates for potential growth were more likely to have been revised lower, at least for the period for which we have data (i.e. from 2000 to 2019). This may reflect the slowing in

**Table 1: Current GDP Growth and Potential Growth Estimates**

Select advanced economies, per cent

| | Potential growth | | Current GDP growth |
|---|---|---|---|
| | Point estimate | 70 per cent interval[(a)] | Year-ended[(b)] |
| United States | 2.0 | 1.5–2.3 | 2.0 |
| Euro area | 1.1 | 0.6–1.4 | 0.9 |
| Japan | 0.6 | 0.1–0.9 | 1.4 |
| Germany | 1.3 | 0.7–1.5 | 0.5 |
| United Kingdom | 1.5 | 0.9–1.8 | 1.0 |
| Canada | 1.7 | 1.2–2.0 | 1.7 |

(a) Based on historical revisions after five years

(b) Year-ended growth to September 2019

Sources: IMF; RBA; Refinitiv

potential growth during the period, which took some time to be fully recognised in the estimates. The estimated level of uncertainty is significant, especially in the context of the current estimates for potential growth in the advanced economies that for the most part are in the range of 1 to 2 per cent. The uncertainty in the potential growth estimates appears to be larger in some economies such as the United Kingdom.

Comparing the IMF's current potential growth estimates for 2019 with the latest observed GDP growth rates shows that most large advanced economies are growing around potential because their current GDP growth rates are within the 70 per cent interval based on the size of historical revisions (Table 1). Japan is currently the only major advanced economy growing significantly above potential, while Germany is growing significantly below its potential rate.

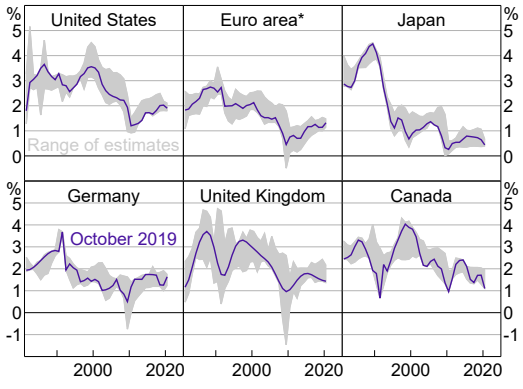
## Conclusion

The level of and growth in potential output are useful concepts, although they are difficult to estimate accurately. Estimates of potential growth have been subject to sizeable revisions after their initial publication. Notwithstanding the uncertainty about the estimates, the overwhelming evidence is that potential growth in the advanced economies has declined since at least the mid 1980s. The decline has been driven by slower population growth and ageing, slower investment growth and weaker productivity.

**Graph 13**

**Potential Growth Revisions**

IMF estimates 2000–2019



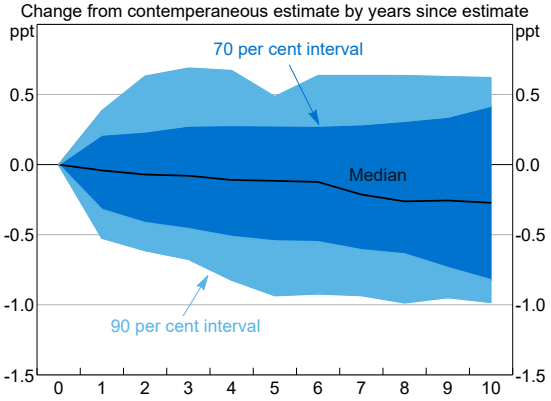

* PPP GDP-weighted average of France, Germany, Italy and Spain

Sources: IMF; RBA

**Graph 14**

**Potential Growth Uncertainty***

Change from contemperaneous estimate by years since estimate




* IMF estimates from 2000 to 2019 for Canada, France, Germany, Italy, Japan, Spain, United Kingdom and United States

Sources: IMF; RBA

## Appendix

**Table 2: Sources of Potential Growth Estimates**

For advanced economies

| | Countries | Method | Update frequency |
|---|---|---|---|
| IMF | Advanced economies and some emerging economies | Growth accounting measure, aggregated using Cobb-Douglas production function | Semi-annual |
| OECD | Advanced economies | Growth accounting measure, aggregated using Cobb-Douglas production function | Annual |
| European Commission | 28 members of European Union | Growth accounting measure, aggregated using Cobb-Douglas production function | Semi-annual |
| Bank of Canada | Canada | Growth accounting measure, aggregated using Cobb-Douglas production function | Quarterly |
| Bank of Japan | Japan | Growth accounting measure, aggregated using Cobb-Douglas production function | Quarterly |
| Federal Reserve Bank of New York (Holston-Laubach-Williams) | Canada, euro area, United Kingdom, United States | Multivariate estimator | Quarterly |
| Congressional Budget Office | United States | Growth accounting measure, aggregated using Cobb-Douglas production function | Semi-annual |
| Office for Budget Responsibility | United Kingdom | Multivariate estimator | Annual |
| Japan Cabinet Office | Japan | Growth accounting measure | Quarterly |

## Footnotes

[*] Authors are from Economic Analysis Department. The authors are grateful to Joan Zhang for her excellent assistance with collating some of the data used in the article.

[1] The article focuses on the advanced economies because potential growth estimates are less readily available for emerging markets. The article does not examine developments in Australia's potential growth. For more information on Australian potential growth, see Lancaster and Tulip (2015).

[2] A Cobb-Douglas production function assumes that labour and capital make up a fixed share of the economy and that they can be aggregated together with some exogenous technology to produce output. For more information on the use of the Cobb-Douglas production function and estimates of potential output, see Miller (2008).

[3] The OECD and EC use uniform methodology and so does not account for differences across economies (OECD 2019) and (Havik *et al* 2014). The IMF does not publish potential per se, but publishes output gaps which measure the difference between actual GDP and potential output. The IMF's estimates for potential output reported in this article are backed out of the IMF's estimates for the output gap by the authors. Unlike the OECD, the IMF estimates account for country-specific factors (Masi 1997).

[4] The treatment of the housing stock differs across the various sources of potential output estimates. Some estimates, such as the OECD's, exclude housing from the capital stock, while others, such as the CBO's, include it in the capital stock. Even when it is not included in the potential capital stock, the housing stock produces housing services which are included in actual GDP and as such the contributions of the housing stock to potential growth would be captured in the measures of potential TFP.

[5] It should be noted that even working-age population, which is a slow moving variable that can generally be estimated with some precisions, can also be subject to large revisions. Population censuses provide the most complete picture of demographics but they are infrequent. Between censuses, working-age population needs to be estimated and occasionally these estimates may be revised with substantial implications. For example,

following the 2011 census, Germany's working-age population was revised down by around 2 per cent because this was the first census conducted following the reunification of West and East Germany (Kulish and Cottrell 2013).

[6] The change in the capital stock is measured by adding the gross investment and subtracting depreciation from the previous period's estimate for the capital stock. This requires an assumption about the economic depreciation rate, which is not readily available and is typically assumed to be constant.

[7] IMF vintages are available since 2000 only.

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