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The (Mostly) Long and Short of Potential Output

Introduction

Thank you for inviting me here today.

An important, if sometimes underappreciated, purpose of central bank speeches is to help the public understand what we are trying to achieve, and why. A greater understanding of our monetary policy actions helps make them more effective. And as a public institution, we have an obligation to highlight and demystify the concepts that guide our thinking in a way that all interested citizens, not just the experts in this room, can grasp.

Few in the public likely give much thought to potential output, for example. Yet this somewhat abstract notion is vital to how most central banks evaluate inflationary pressures and conduct monetary policy. At the Bank of Canada, being able to estimate and project potential output has contributed notably to our strong track record of meeting our inflation objectives.

At the same time, the dynamics of potential output are primarily shaped by slow-moving forces that can take time to have a material impact, such as demographic shifts, capital accumulation and technological change. Equally important, many of these same forces influence a country's standard of living.

A significant development in recent decades is that growth in potential output has been on a generally downward trend in most major advanced economies, including Canada, largely owing to the aging of our populations. This trend has important implications for our macroeconomic policy frameworks and for our economic prospects.

I would like to thank Dany Brouillette for his help preparing this speech.

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My remarks today are organized around four separate but closely related questions:

1. What is potential output?
2. How do we measure it?
3. Why is it important for policy?
4. What policies have supported potential output growth in the past and could again in the future?

The answers to these questions should help you better understand not only our policy in the near term, but also our thinking about policy-making over a longer horizon.

What is potential output?

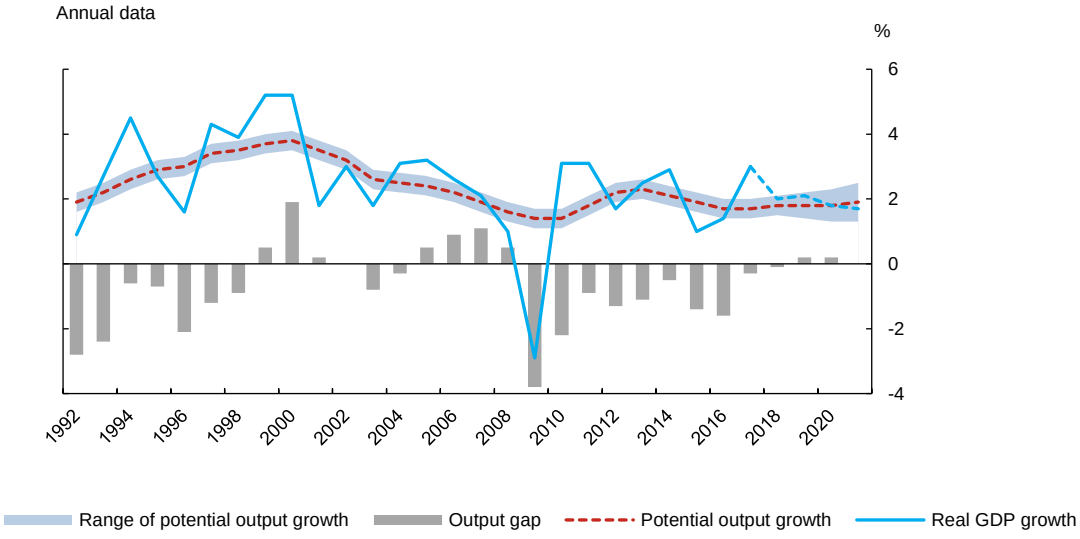
Turning to the first question, we usually refer to "potential" in the context of individual achievement, as in "realizing one's potential." When I was much younger, for example, my aspirations for my own potential included growing as tall as my favourite player on the Dallas Cowboys, becoming a pitcher for the Toronto Blue Jays, and obtaining a PhD. My immigrant parents placed more value on education than sports, so they were quite relieved that I only managed two out of three.

Central banks apply "potential" in a similar way—to assess what an entire economy, rather than a single person, can achieve on a sustainable basis. So "potential" can be viewed as a measure of aggregate, or total, supply in an economy. Essentially, it refers to an economy's capacity to produce goods and services when all available productive resources—specifically, labour and capital—are used to their fullest.

In practice, we pay close attention to the *growth rate* of potential output as well as to its *level*. An economy's productive capacity is normally always growing as available resources and their productivity expand. But the speed at which potential output grows has important short- and long-run implications. In the short run, the rate of potential output growth indicates how quickly an economy can grow on an ongoing basis without stoking inflationary pressures. In the long run, potential output growth is a useful gauge of an economy's prospects, namely the outlook for national income and standard of living, because these are largely determined by the forces of supply.

Digging a little deeper, most central banks including the Bank of Canada-, interpret an economy's *actual* output growth, its gross domestic product (GDP), as being determined in the short run by the forces moving aggregate demand. An economy's *potential* output growth, meanwhile, reflects the evolution of aggregate supply over a longer horizon (**Chart 1**).[i] Aggregate demand growth tends to move with short-term factors—such as shocks to foreign demand and exports—which may trigger cyclical movements in, for example, inventories and consumer purchases of durable goods. Aggregate supply growth is affected more by the slow-moving forces that I noted earlier.

Chart 1: **Potential output growth is less variable than actual output growth**



Sources: Statistics Canada and Bank of Canada calculations, estimates and projections

Last data plotted: 2021

So, a central challenge in pinning down potential output growth is disentangling the short-term fluctuations in GDP caused by demand shocks from long-term fluctuations that are due to the underlying forces that affect aggregate supply.[ii] Since the forces that determine aggregate supply tend to change slowly, we focus on *trends* when thinking about and measuring potential.

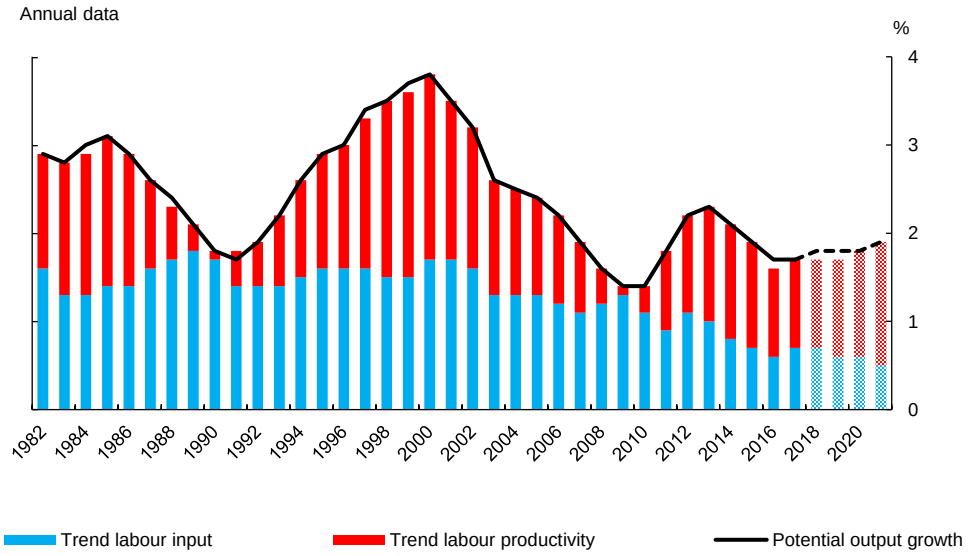
Now, it's rarely as simple as just separating short-term phenomena from long-term. The Great Recession was a once-in-a-lifetime shock to aggregate demand that, because of its severity, also affected aggregate supply. Consequently, a decade later, this experience continues to have an impact on potential output in advanced economies. So, the disentanglement challenge is two-fold: first, identifying the trend movements, as opposed to temporary or cyclical ones; then, identifying the forces *driving* the trend movements, which also helps us predict how long they'll persist.

I'll go into more detail shortly about how we measure potential output growth.
But one way to look at it is to break it into two components:

- the long-run growth rate of total hours worked in the economy—known as trend labour input (TLI); and
- the long-run growth rate of how much output is produced per hour of work—known as trend labour productivity (TLP).

To illustrate the TLI-TLP decomposition, **Chart 2** shows each component's respective contributions to Canadian potential output growth since 1992.[iii] The chart reflects the findings of the Bank's annual reassessment of potential output growth, which we recently published as an appendix to our April *Monetary Policy Report* (MPR).

Chart 2: Potential output growth has been on a downward trend since 2000, but is expected to remain flat in the near future



Source: Bank of Canada estimates and projections

Last data plotted: 2021

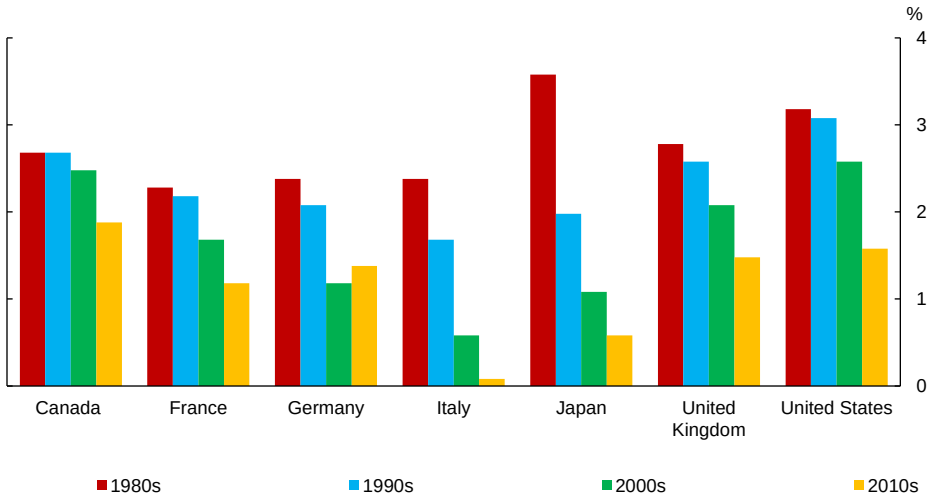
Two observations are important. First, the chart shows a secular, or persistent, decline in TLI and, thus, in potential output growth. Population aging is the biggest reason, and it is only partly offset by immigration.[iv] Second, TLP's contribution to potential output growth has also declined somewhat from the period before the global financial crisis.

TLP growth is expected to increase modestly in the coming years. This is mainly because the slowdown in investment and productivity growth that followed the sharp decline in commodity prices in 2014–15 turned out to be less pronounced than we initially expected, and the economy's adjustment from it is now mostly behind us. That is good news because TLP growth is expected to play a larger role in potential output growth over the projection and beyond. There is, however, considerable debate about how much we can expect productivity growth to rise in the future, even as the emerging digital economy promises to transform how firms operate and how they use their workforces.[v]

Canada's experience is similar to that of other advanced economies. **Chart 3** shows that potential output growth in Japan, the United States and key countries in the euro area is also much lower now than it was in the 1980s, largely due to the same forces

causing the slowdown in Canada. For Canada specifically, the Bank's reassessment found that annual potential output growth from 2009 to 2021 would average 1.8 per cent, much lower than the 2.7 per cent average from 1982 to 2008.

Chart 3: Potential output growth has slowed in most advanced economies since the 1980s
Annual data



Note: The 2010s period includes estimates up to 2021.

Sources: International Monetary Fund and Bank of Canada estimates and projections

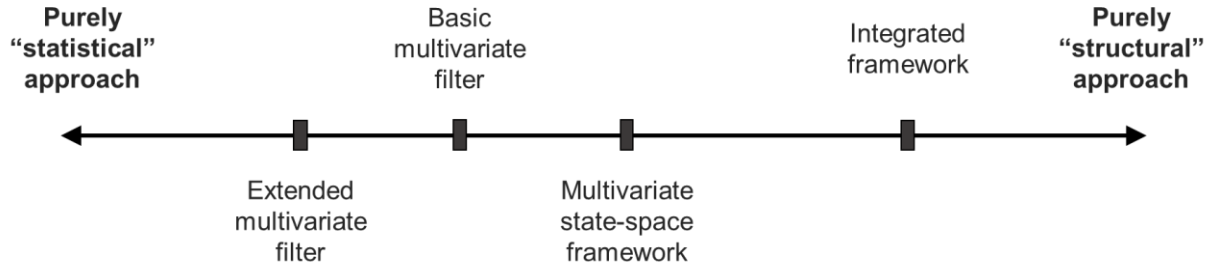
With all of this in mind, let's tackle the hard question of how to measure potential output.

How do we measure potential output?

The main challenge in measuring potential output is that it is hypothetical, so it is not directly observable. We can only estimate it. Over the years, though, the Bank has put a lot of research effort into refining our methods for assessing this very important variable.

Techniques for estimating potential output growth can be viewed as being along a spectrum (**Chart 4**). At one end are simple statistical models that aim to capture underlying trends in output growth by mechanically filtering out short-term fluctuations. The problem with these techniques is they are essentially a "black box"—the data going in and the estimates coming out are known, but there's little economic explanation of how they are connected. At the other end of the spectrum are structural models that rely primarily on relationships between variables, based on economic theory, to identify and

Chart 4: Different ways to estimate potential output, along a spectrum



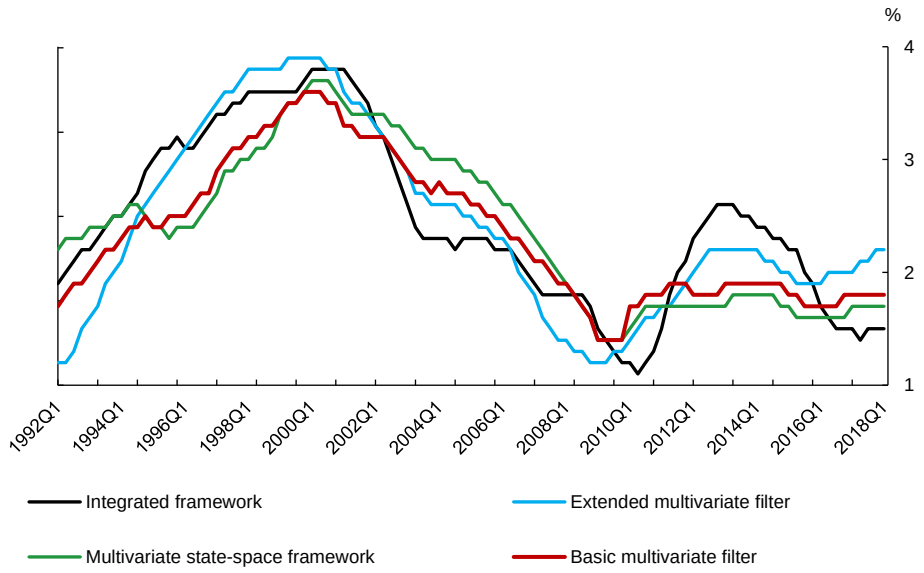
quantify the impacts of different sources of potential output growth. For example, higher levels of investment will cause the capital stock to rise faster, leading to more rapid TLP and potential output growth. However, structural models may produce inaccurate estimates if the economic theory on which they are based is incorrect or incomplete.

To help manage the uncertainty around measuring potential output growth, the Bank uses a variety of models along this spectrum that combine statistical filters and theory-based structural approaches.

This is done so that we can cross-check the estimates from each model and then combine them to get a reasonably robust assessment.[vi] **Chart 5**, for example, displays estimates for potential output growth from four separate models along the spectrum that are part of the Bank's staff tool box.[vii]

Chart 5: Estimates of potential output growth from four different models

Year-over-year percentage change



Source: Bank of Canada estimates

Last observation: 2018Q1

Models that incorporate an economic structure are especially useful for projecting TLP growth, since TLP is based on variables and relationships that are difficult to measure and predict. TLI growth is comparatively easier to forecast because it is based on accurately observed labour market outcomes: the employment rate, the working-age population and average hours worked.

In contrast, TLP growth depends on two variables that are less concrete and therefore more challenging to observe precisely. The first of these, *capital deepening*, is a measure of growth in the ratio of capital per hour worked.[viii] The second is a more elusive concept called trend *total factor productivity*, or TFP. While we have some observable measures of investment and capital stock growth, we do not have the same for trend TFP—which essentially includes everything affecting firms' productivity that isn't captured by capital stock growth. These "residual" factors include, for example, technological improvements and the impact of education and training.[ix]

Another way that the Bank manages the uncertainty around potential output growth is by conducting an in-depth review of our projections on an annual basis. First, economic data are regularly revised, so for that reason alone an annual review makes sense. Also, our empirical techniques are "living" in a sense—we are continually improving them as we learn from experience and ongoing research.[x]

Plus, in the annual reassessment, we further account for uncertainty by publishing ranges around our estimates and projections that *expand with time*. We also list the factors that could lead potential growth to be lower or higher within those ranges.[xi]

I would like to stress that the Bank recognizes the difficulties associated with measuring potential and the related uncertainty, and so takes a deliberate and rigorous approach to managing this uncertainty. We work hard to ensure that our models evolve in line with prevailing best practices. And on top of using multiple techniques, we corroborate the models' results against other measures of capacity and inflation, and then apply well-informed judgment. Finally, the uncertainty around these estimates is taken into account in the formulation of monetary policy. This helps us ensure that our estimates and our policy decisions are consistent with our broader economic outlook.

Now, let me expand on why potential output is important for policy.

Why is potential output important for policy?

The conduct of monetary policy

For the conduct of monetary policy, the difference between the *level* of actual and potential output—the "output gap"—is a critical element.[xii] It indicates how much slack there is in the economy, and so it is an important determinant and useful gauge of

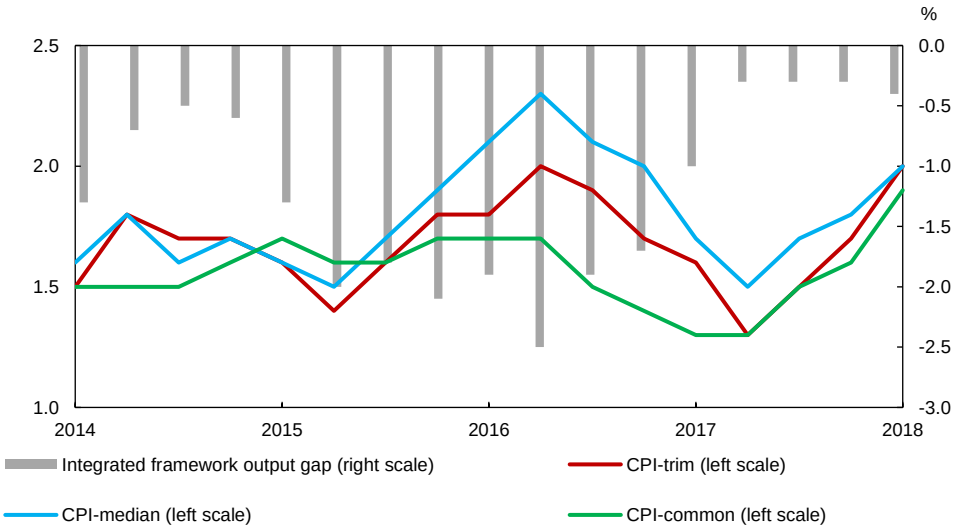
underlying inflationary pressures. As an inflation-targeting central bank, the Bank of Canada's assessments of both the current output gap and its projected evolution have direct bearing on our inflation outlook and policy decisions. Because monetary policy operates with a well-known lag, the Bank must be forward-looking as we set the policy interest rate to affect aggregate demand, close any output gap and return inflation to target on a sustainable basis.

A higher level of potential output for a given level of GDP will mean a more "negative" output gap—implying (other things being equal) inflation below the 2 per cent target, greater economic slack and a possible need to ease the policy rate—and vice versa. Along with the output gap, expectations of inflation are also important in explaining current inflation. As inflation targets have become more credible, expectations have become better anchored at the target rate and, in turn, have had a larger influence on inflation itself.[xiii]

To illustrate the relationship between the output gap and inflation, consider **Chart 6**. It shows that the Bank's three measures of core inflation all increased steadily over the past year following, with a short lag, the narrowing of our measure of the output gap. This demonstrates how we use other data to corroborate our estimates of the output gap, which helps ensure a coherent economic outlook.

Chart 6: **Measures of core inflation have risen in line with the rapid absorption of past excess capacity**

Year-over-year percentage change, quarterly data



Sources: Statistics Canada and Bank of Canada estimates

Last data plotted: 2018Q1

The higher the projected growth rate of potential output, the faster the economy can grow without inflation rising persistently above our target. For example, our 2018 reassessment revised the profile for potential higher than it was in the 2017 reassessment, both in terms of its level and growth rate. That means that, in the near term, we have a bit more room than we thought to support demand without sparking undue inflationary pressures.

Challenges to the monetary policy framework

Although the inflation-targeting framework has been very successful in the past, looking ahead, the decline in potential output growth in many advanced economies represents a notable challenge and has prompted central banks in those countries to revisit their monetary policy frameworks.[xiv]

Let me explain. Lower potential output growth in advanced economies is one of the factors likely contributing to a decline in global real interest rates. For monetary policy, this implies that the policy rate that is considered neutral—where it will neither stimulate nor cool the economy because GDP is growing at its potential level, inflation is at target, and the effects of any shocks have faded—is lower than it would be otherwise.[xv] The lower neutral rate has important implications for monetary policy. To effectively buffer the economy in response to a harmful shock, it's desirable that a central bank has sufficient room to lower the policy interest rate without going to zero or below, thus being forced to use unconventional tools such as large-scale asset purchases (i.e., quantitative or credit easing) or negative interest rates.[xvi]

Our next inflation-target renewal with the Government of Canada, which represents an opportunity to review our monetary policy framework, is slated for 2021.[xvii] As part of that process, we will examine ways to meet this challenge and strengthen the framework to enhance the resilience of the Canadian economy.

Lower potential output growth also has implications for fiscal policy because it implies less tax revenue than otherwise. Less revenue could limit governments' abilities to implement countercyclical fiscal policy when needed, particularly as demands for public expenditures rise with an aging population. This aspect is important for monetary policy, too. The credibility and success of our inflation-targeting regime depends critically on the coherence of the overall macroeconomic policy framework.[xviii]

What policies have supported potential output growth in the past and could again in the future?

To maintain solid potential output growth and rising living standards in the future, what policy lessons can be drawn from the past?

Historically, Canada has benefited from strong growth and rising living standards. Great economic opportunity has stimulated employment and investment in capital, while also

encouraging investment in individuals through accessible, quality education and an inclusive social safety net. We also have benefited from robust political, legal and economic institutions, and from openness to trade, investment and immigration.

Despite those advantages, developing the appropriate policies to maintain solid potential output growth in the face of an aging population is a formidable challenge. Moreover, even the most effective policies can take some time to have a meaningful impact. That said, I'd like to touch on three policy areas that have been successful at promoting potential output growth in the past:

- **education**—I have benefited from the opportunity created by my own access, and my parents' commitment, to good-quality education at all levels;
- **immigration**—which is something I know a bit about since my parents arrived in Canada from Europe during the 1950s; and
- **trade liberalization**—which I have studied and analyzed for my entire professional life.

Education

As Alfred Marshall—a founder of neoclassical economics—emphasized more than a century ago, education is critical to economic progress.[xix]

In a period of accelerating technological change, boosting skills and the flexibility of the labour supply may be as important for potential output growth as the size of the workforce.[xx] Improvements to education and training will help make workers more productive, which should in turn boost their employers' overall productivity and lift the economy's potential. In Marshall's era, the main impediment to the quality of the labour force was illiteracy. This was a huge obstacle to lifelong learning and self-improvement. The vast majority of Canadians, of course, can read and have basic numeracy skills. But this wasn't always the case. Our economy's transition around the turn of the 20th century from agriculture to industry was facilitated by promoting public and private investment in education that provided broader access. The question today is whether education and training can equip a growing share of the workforce with the right skills for an increasingly technology-driven economy.

While the challenge today may seem more daunting, it also appeared insurmountable in Marshall's time. Yet, the expected private and social returns were great, so investment followed. History needs to be repeated. New technologies should be harnessed to provide broad access to the types of education and training that will help Canadians prosper amid rapid change. This would also help to address rising income inequality, much of which is due to technological change that favours those with greater skills.[xxi]

Immigration

Higher immigration levels offer an obvious avenue for boosting potential by increasing the supply of labour, given that immigration already accounts for two-thirds of the growth in Canada's workforce. Canada's immigration policy has long been considered a success because of its record of attracting immigrants with the necessary skills to be absorbed into the labour force and to make important economic contributions. This approach will be particularly crucial going forward as the workforce gets older.

An important challenge, though, is whether Canada's immigration policy can raise the levels accepted each year while continuing to be as successful as in the past at matching immigrants' skills to the jobs that are available.[xxii] As Governor Poloz noted recently, more could be done to speed up immigrants' integration into the workforce, particularly given the elevated number of job vacancies in Canada.

Trade liberalization

Given demographic constraints, the most promising remedies for lifting potential may be measures that stand to increase productivity.

This speaks not only to the importance of education, as I mentioned, but also to that of creating a climate that encourages capital investment. This can be done through, for example, infrastructure spending and other efforts to ease transportation constraints.

Perhaps most helpful in this regard, though, is trade liberalization. Our experience with past and existing trade arrangements demonstrates the benefits of lowering barriers, both external and internal, including improvements in productivity that supported growth in the overall earnings of workers—a direct boost to living standards. As my Governing Council colleague Tim Lane noted in remarks last September, expanding Canadian firms' access to overseas markets spurs them to invest, innovate and increase their productivity.[xxiii]

As in other advanced economies, there is renewed focus in Canada on ensuring that we help the workers who are displaced by trade agreements. Again, education and training can help people adjust. Still, there is no question that Canada has benefited from being one of the world's most diversified, trade-driven economies. Even as uncertainty about US trade policy currently weighs on business investment and export growth, Canada's recent agreements with the European Union and with countries in the Pacific region, in addition to efforts at the interprovincial level, are helping reduce barriers and create opportunities for Canadian companies. [xxiv] Our history tells us that our firm commitment to trade liberalization will remain important for supporting solid potential growth in the future.

Conclusion

Allow me to conclude with three key messages.

First, potential output is an indispensable input into the formulation of monetary policy, because the output gap is important in determining inflationary pressures in the economy. Using the output gap as our guide has helped underpin the success of the Bank of Canada's inflation-targeting regime, which has, on average, delivered inflation roughly at the 2 per cent target on a consistent basis for more than a quarter-century.

Second, the Bank's multifaceted approach to measuring and using potential output—drawing on diverse tools and on different sources of information—helps to manage uncertainty and ensure reasonably robust estimates. This deliberate and regularly updated approach has also contributed to our success.

Third, like other advanced economies, Canada faces important challenges to our policy frameworks and to our economic prospects from lower rates of potential output growth. Nonetheless, we have a rich history of generating economic opportunity and supporting growth, and we should draw from past successes in developing future policies.

In closing, I mentioned earlier that although potential is mostly a function of longer-term, slow-moving forces, the Great Recession had a severe and protracted impact on potential output. With the economy now operating close to potential, solid demand growth is spawning business investment, firm entry and improved labour-market conditions—all of which are helping to repair that damage.

As noted in recent policy statements, we are closely monitoring this expansion in economic capacity. It will help guide us in achieving our goal of low, stable and predictable inflation, which is the best contribution monetary policy can make to support sustainable growth and rising living standards in Canada.

[i] The concept of output being largely determined by aggregate demand in the short run was a critical insight of J.M. Keynes in his book *The General Theory of Employment, Interest, and Money* (London: Macmillan, 1936) and is incorporated in most macroeconomic models employed by central banks.

[ii] This identification strategy has been proposed by O. J. Blanchard and D. Quah, "The Dynamic Effects of Aggregate Demand and Supply Disturbances," *The American Economic Review* 79, no. 4 (1989): 655–673. Demand shocks are neutral for GDP in the long run, while supply shocks have permanent effects on GDP in the long run.

[iii] See A. Agopsowicz, D. Brouillette, B. Gueye, J. McDonald-Guimond, J. Mollins and Y. Park, "Potential Output in Canada: 2018 Reassessment," Bank of Canada Staff Analytical Note No. 2018-10 (April 2018).

[iv] The fact that some workers are staying in the labour force longer is also partially offsetting the impact of an aging workforce, although this effect is limited because older workers have lower employment rates than prime-age workers and usually work fewer hours per week. Another factor suppressing TLI is the rising share of workers employed in the services sector, where average hours worked tend to be fewer than in goods-producing sectors.

[v] Some economists argue that the low-hanging fruit has already been picked, so productivity growth will remain tepid despite advances such as automation and artificial intelligence. Others say because such technologies are starting to be adopted more widely, large gains could be coming, and soon. See D. E. Sichel, "Two Books for the Price of One: Review Article of The Rise and Fall of American Growth by Robert J. Gordon," *International Productivity Monitor* 31 (fall 2016): 57–62; B. van Ark, "Total Factor Productivity: Lessons from the Past and Directions for the Future," National Bank of Belgium Working Paper Research No. 271 (October 2014); B. van Ark, "The Productivity Paradox of the New Digital Economy," *International Productivity Monitor* 31 (fall 2016): 3–18; and R. J. Gordon "Comments on Daniel E. Sichel's Review Article on *The Rise and Fall of American Growth*," *International Productivity Monitor* 31 (fall 2016): 63–67.

[vi] In a similar vein, the Bank also looks to multiple gauges for measuring underlying (or "core") inflation. See L. Schembri, "Getting to the Core of Inflation" (remarks to the Department of Economics, Western University, London, Ontario, February 9, 2017).

[vii] Since the late 1990s, Bank staff have used a model called the extended multivariate filter (EMVF), which filters out short-term business cycle movements to capture trends without offering an in-depth economic explanation for them. A few years ago, staff developed an additional methodology called the integrated framework (IF), which explicitly accounts for more long-term structural changes in the economy; notably, capital formation and population aging. The IF, though, is limited in that one of its key inputs is the level of the country's capital stock, which makes its projections sensitive to short-term fluctuations in investment. To further validate our estimates, we recently adapted and employed two more models: the basic multivariate filter (BMVF), proposed by Blagrave et al. in 2015, and the multivariate state-space framework (MSSF). The latter is an enhanced version of the BMVF that is sufficiently flexible to incorporate a range of assumptions about economic relationships. See P. Blagrave, R. Garcia-Saltos, D. Laxton and F. Zhang, "A Simple Multivariate Filter for Estimating Potential Output," International Monetary Fund Working Paper, WP/15/79 (April 2015); L. Pichette, P. St-Amant, B. Tomlin and K. Anoma, "Measuring Potential Output at the Bank of Canada: The Extended Multivariate Filter and the Integrated Framework," Bank of Canada Staff Discussion Paper No. 2015-1 (January 2015); and L. Pichette, M. N. Robitaille, M. Salameh and P. St-Amant, "Dismiss the Gap? A Real-Time Assessment of the Usefulness of Canadian Output Gaps in Forecasting Inflation," Bank of Canada Staff Working Paper No. 2018-10 (March 2018).

[viii] Capital includes measures of machinery and equipment, engineering, and structures as well as three types of "intangible" expenditures that are currently capitalized in Statistics Canada's national accounts data: research and development, software, and mineral exploration and evaluation. Other intangible investments, such as expenditures to build databases or to increase firm-specific human capital, are not currently capitalized and included in the capital stock. For more information, see J. R. Baldwin, W. Gu and R. Macdonald, "Intangible Capital and Productivity Growth in Canada," Statistics Canada Catalogue No. 15-206-X, No. 029 (2012).

[ix] Estimates of TFP should be interpreted with caution. They are not solely measures of economic or technological progress, but also include other factors such as measurement error.

[x] We also do a less in-depth review for other major economies that are Canada's biggest trading partners. As new data arrive between annual reassessments, especially for GDP and business investment, we regularly update the starting-point level of potential output and sometimes also the growth outlook for Canada. We occasionally make

similar adjustments for these other economies. Any such changes are explained in the *Monetary Policy Report*. For more detail, see R. Beard, A.-K. Cormier, M. Francis, K. Gribbin, J.-D. Guénette, C. Hajzler, K. Hess, J. Ketcheson, K. Mo, L. Poirier and P. Selcuk, "Assessing Global Potential Output Growth: April 2018," Bank of Canada Staff Analytical Note No. 2018-9 (April 2018).

[xi] In our 2018 reassessment, we project that potential output growth will be 1.8 per cent from 2018 to 2020 before inching up to 1.9 per cent in 2021—while showing each year's projection as the midpoint of a range. For 2018, the range is plus or minus 0.3 percentage points, while for 2021 it is plus or minus 0.6 percentage points.

[xii] The output gap is normally expressed as a percentage of potential output.

[xiii] This conceptual framework for the relationship between the output gap and the deviation of inflation from target is based on the expectations-augmented Phillips Curve, originally developed 50 years ago by Milton Friedman. See M. Friedman, "The Role of Monetary Policy," *American Economic Review* 58, no. 1 (March 1968): 1–17. In practice, this relationship hinges critically on inflation expectations being well-anchored at our 2 per cent target, which they are. This outcome reflects our success in using this framework since 1991 to achieve our inflation target. As a result, the target has become very credible. See L. Schembri, "Anchoring Expectations: Canada's Approach to Price Stability" (remarks to the Manitoba Association for Business Economists, Winnipeg, Manitoba, February 15, 2018).

[xiv] See L. Schembri "Anchoring Expectations: Canada's Approach to Price Stability" (remarks to the Manitoba Association for Business Economists, Winnipeg, Manitoba, February 15, 2018). Also, for a discussion of demographic effects in particular, see S. Ambler and J. Kronik, "Faulty Transmissions: How Demographics Affect Monetary Policy in Canada," C.D. Howe Institute, Commentary No. 506 (March 2018).

[xv] The neutral policy rate is measured as the equilibrium real interest rate plus the 2 per cent target inflation rate. The policy rate has declined because of a decrease in the equilibrium real interest rate, which has occurred as lower potential output growth has reduced the demand for investment. For further details, see R. Mendes, "The Neutral Rate of Interest in Canada," Bank of Canada Staff Discussion Paper No. 2014-5 (September 2014).

[xvi] During 2009 and 2010, when the policy rate was at 0.25 per cent, the Bank of Canada employed conditional forward guidance about the likely path for interest rates to provide additional monetary stimulus. Large-scale asset purchases were not conducted in Canada. However, central banks in many advanced economies did use such tools and, in the aftermath of the crisis, questions have been raised about the tools' effectiveness, their impact on financial vulnerabilities and their possible implications for central-bank independence.

[xvii] Such renewals are conducted every five years. The last one was in 2016.

[xviii] For example, if a shock were to occur that required a substantial degree of monetary stimulus for a prolonged period, strong financial regulation and supervision and effective macroprudential policy would be needed to mitigate any resulting financial vulnerabilities and preserve financial stability.

[xix] Marshall, in his *Principles of Economics* (8th edition, p. 179), described education as a national investment. He wrote: "We may then conclude that the wisdom of expending public and private funds on education is not to be measured by its direct fruits alone. It will be profitable as a mere investment, to give the masses of the people much greater opportunities than they can generally avail themselves of."

[xx] That said, another example of a policy that could increase potential output would be efforts to develop untapped labour supply by increasing participation in the workforce of underrepresented groups such as women, youth, Indigenous Canadians, older workers and disabled people—a point that Governor Poloz made earlier this year. See S. S. Poloz, "Today's Labour Market and the Future of Work" (remarks to the Smith School of Business, Queen's University, Kingston, Ontario, March 13, 2018).

[xxi] See C. A. Wilkins, "At the Crossroads: Innovation and Inclusive Growth" (remarks to the G7 Symposium on Innovation and Inclusive Growth, Montebello, Quebec, February 8, 2018).

[xxii] According to data from Immigration, Refugees and Citizenship Canada, the country aims to admit 320,000 immigrants this year, a number that rises to 340,000 in 2020. For comparison, in 2015 Canada admitted 272,000 immigrants. Bank staff recently conducted a hypothetical exercise to estimate the impact on potential output growth of increasing Canada's current level of immigration 33 per cent by 2020. Holding natural population growth constant, they found that this would permanently lift the labour supply by an equivalent of about 50,000 full-time workers—providing a 0.2 per cent boost to the level of potential output.

[xxiii] See L. Schembri, "Wood, Wheat, Wheels and the Web: Historical Pivots and Future Prospects for Canadian Exports" (remarks to the Atlantic Institute for Market Studies, Halifax, Nova Scotia, November 8, 2016); and T. Lane, "How Canada's International Trade is Changing with the Times" (remarks to the Saskatoon Regional Economic Development Authority, Saskatoon, Saskatchewan, September 18, 2017).

[xxiv] Specifically, the Comprehensive Economic and Trade Agreement (CETA) between Canada and the European Union, the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) between 11 Pacific nations including Canada, and the interprovincial Canadian Free Trade Agreement (CFTA).