

Staff Analytical Note/Note analytique du personnel 2016-4

# April 2016 Annual Reassessment of Potential Output in Canada



by Andrew Agopsowicz, Dany Brouillette, Shutao Cao, Natalia Kyui and  
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## **Acknowledgements**

We thank Mohanad Salameh for his excellent research assistance. We also thank Eric Santor, Rhys Mendes, Russell Barnett and Ben Tomlin for helpful comments. Finally, we would like to thank Maura Brown for her editorial assistance. All remaining errors are our responsibility.

## Abstract

This note summarizes the Bank of Canada's 2016 annual reassessment of potential output growth, which is projected to be 1.5 per cent over 2016–18 and 1.6 per cent in 2019–20. This projection is weaker than the one presented in the April 2015 *Monetary Policy Report*. Substantially softer business investment, largely due to much lower energy prices, causes the growth of trend labour productivity to be weaker. Weak business investment is the main negative shock to our projection. As investment picks up and the negative effects of the ongoing economic restructuring dissipate, we expect the growth of trend labour productivity to gradually increase toward its long-term average. Demographic developments are expected to contribute to gradually weaker trend labour input growth, however, which will act as a drag on the growth of potential output. A sensitivity analysis to various assumptions suggests a range for potential output that increases from about  $\pm 0.3$  percentage points in 2016 to  $\pm 0.6$  percentage points in 2018 and  $\pm 0.7$  in 2019 and 2020.

*Bank classification: Potential output; Productivity; Labour markets*

## Résumé

Cette note résume la réévaluation annuelle de la croissance de la production potentielle effectuée par la Banque en 2016. Le taux d'augmentation devrait s'établir à 1,5 % pour la période 2016-2018, et à 1,6 % pour la période 2019-2020. La croissance projetée sera plus faible que la prévision présentée dans le *Rapport sur la politique monétaire* d'avril 2015. Le recul très notable des investissements des entreprises, qui tient en grande partie à des baisses beaucoup plus fortes des prix de l'énergie, se traduit par une progression plus modérée de la productivité tendancielle du travail. La faiblesse de l'investissement des entreprises est le principal choc négatif de la projection. À mesure que les investissements se redresseront et que les effets négatifs du processus de restructuration économique en cours se dissiperont, la croissance de la productivité tendancielle du travail devrait peu à peu remonter vers sa moyenne à long terme. Les changements démographiques devraient concourir toutefois à une décélération graduelle de la croissance tendancielle du facteur travail, ce qui aura comme effet de ralentir la progression de la production potentielle. Une analyse de la sensibilité des résultats aux diverses hypothèses laisse entrevoir que la croissance de la production potentielle s'établira dans une fourchette de  $\pm 0,3$  point de pourcentage par rapport au scénario de référence pour 2016, passant à  $\pm 0,6$  point de pourcentage en 2018, et à  $\pm 0,7$  point de pourcentage en 2019 et 2020.

*Classification de la Banque : Production potentielle; Productivité; Marchés du travail*

## Summary

- This note summarizes the Bank of Canada annual reassessment of potential output growth conducted by Canadian Economic Analysis staff for the April 2016 *Monetary Policy Report* (MPR).
- We calculate potential output growth as the sum of trend labour input (TLI) growth—trend number of total hours worked in the economy—and trend labour productivity (TLP) growth—trend output per hour worked.
- We project potential output growth to be 1.5 per cent over 2016–18 and 1.6 per cent in 2019–20 (**Table 1**). These projected growth rates are weaker than was expected in the April 2015 MPR.
- We expect that the gradual slowdown of TLI growth will continue—from 0.7 per cent in 2016 to 0.4 per cent in 2020. This mainly stems from the slowdown in the growth of the working-age population, as projected by Statistics Canada, and a declining trend employment rate due to population aging.
- Slowing TLI means that potential output growth will be increasingly dependent on TLP. Indeed, TLP's contribution to potential output growth is expected to increase from 0.8 per cent in 2016 to 1.2 per cent by 2020.<sup>1</sup> However, this is weaker than was expected in the April 2015 MPR, since significant negative revisions to business investment lead to slower capital deepening. Starting in 2017, capital deepening is expected to gradually pick up, reaching its long-term average growth rate toward the end of the projection period (2020). In 2016, TLP growth is also affected by the negative effects of economic restructuring.
- Research and development investment, information and communication technologies investment, firm turnover and labour reallocation can also affect TLP growth through their effects on trend total factor productivity (TFP). Unfortunately, recent developments in these factors are not supportive of strong trend TFP growth. On the other hand, demographic developments could contribute to stronger productivity.
- A sensitivity analysis to various assumptions suggests a range for potential output growth that increases from about  $\pm 0.3$  percentage points in 2016 to  $\pm 0.6$  percentage points in 2018 and  $\pm 0.7$  in 2019 and 2020.

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<sup>1</sup> Labour productivity averaged 1.2 per cent in Canada over the 1982–2015 period.

- The uncertainty surrounding our TLP projection is particularly large. Investment and trend TFP are the main sources of uncertainty.

**Table 1: Potential output growth (%) has been revised down since the April 2015 Monetary Policy Report (MPR)**

	<b>April 2015 MPR</b>	<b>April 2016 MPR</b>		
	<b>Potential output</b>	<b>Potential output</b>	<b>Trend labour productivity</b>	<b>Trend labour input</b>
<b>2010–14</b>	2.0	2.0	1.0	1.0
<b>2015</b>	1.8	1.6	1.0	0.7
<b>2016</b>	1.8	1.5	0.8	0.7
<b>2017</b>	1.8	1.5	1.0	0.6
<b>2018</b>	—	1.5	1.1	0.5
<b>2019</b>	—	1.6	1.1	0.5
<b>2020</b>	—	1.6	1.2	0.4

Note: Numbers may not add up due to rounding.

## 1. Introduction

Each year, before the release of the *April Monetary Policy Report* (MPR), Bank of Canada staff reassess the level and growth rate of potential output in Canada.<sup>2</sup> This note provides an update on the staff projection for potential output growth. The analysis is based on the Bank's Integrated Framework that decomposes potential output into trend labour input (TLI) and trend labour productivity (TLP).<sup>3</sup> TLI is further decomposed into working-age population, trend employment rate and trend average hours worked. Section 2 discusses factors affecting TLI components. Section 3 describes the projection for TLP, which depends on capital deepening and trend total factor productivity (TFP). Section 4 briefly compares our projection with that of other economists. Section 5 provides a sensitivity analysis to various assumptions.

## 2. Trend labour input

We project that TLI growth will weaken from 0.7 per cent in 2015–16, to 0.6 per cent in 2017, 0.5 per cent in 2018–19, and 0.4 per cent in 2020 (April 2015 MPR reassessment: 0.6 per cent in 2015–16 and 0.4 per cent in 2017).<sup>4</sup> The projected slowdown in the growth of the working-age population and population aging are the main factors reducing TLI growth (**Chart 1**). In particular, population aging causes a decline in the trend employment rate and explains part of the decline of trend average hours worked. This is because the share of older workers in the total population is increasing, and these workers have lower trend employment rates and trend average hours worked than prime-age workers. This negative impact of demographic changes on TLI growth has been present for several years. According to our estimates, the changing population structure subtracted 0.5 percentage points from TLI annual growth from 2009–15. Moreover, without this change in the population structure from 2015 onward, the annual TLI growth rates would be around 0.4 percentage points higher over the projection period.

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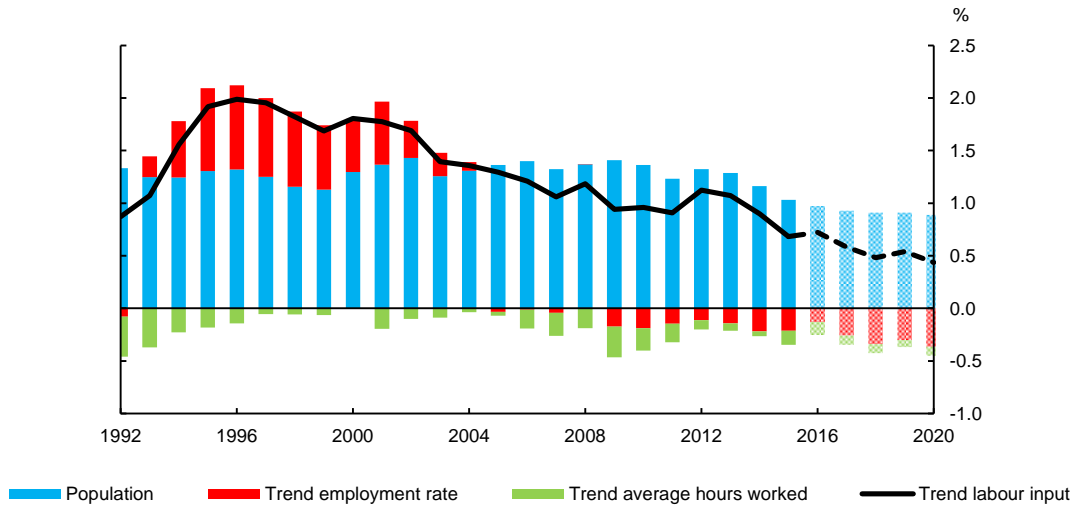
<sup>2</sup> Before 2015, the annual reassessment of potential output was conducted for the release of the October MPR.

<sup>3</sup> See Pichette et al. (2015) for details of this approach.

<sup>4</sup> Trend labour input growth is the sum of working-age population growth, trend employment rate growth and trend average hours worked growth.

**Chart 1: Trend labour input growth continues to decline**

Annual data



Source: Bank of Canada calculations

Last data plotted: 2020

### Working-age population

To project working-age population growth, we used Statistics Canada’s medium-growth scenario.<sup>5</sup> We verified that this scenario was consistent with the latest data on population growth from the Labour Force Survey. However, we adjusted TLI up slightly to account for the impact of stronger inflows of refugees in 2015–16 (e.g., Syrian refugees resettled in Canada), a factor not yet incorporated into Statistics Canada’s population scenarios. According to the medium-growth scenario, the growth of the working-age population is expected to slow from 1.0 per cent in 2016 to 0.9 per cent in 2020 (blue bars in **Chart 1**).

### Trend employment rate

The trend employment rate declines over the projection period, mainly driven by population aging. The proportion of older workers (55+) is projected to continuously increase from 2016

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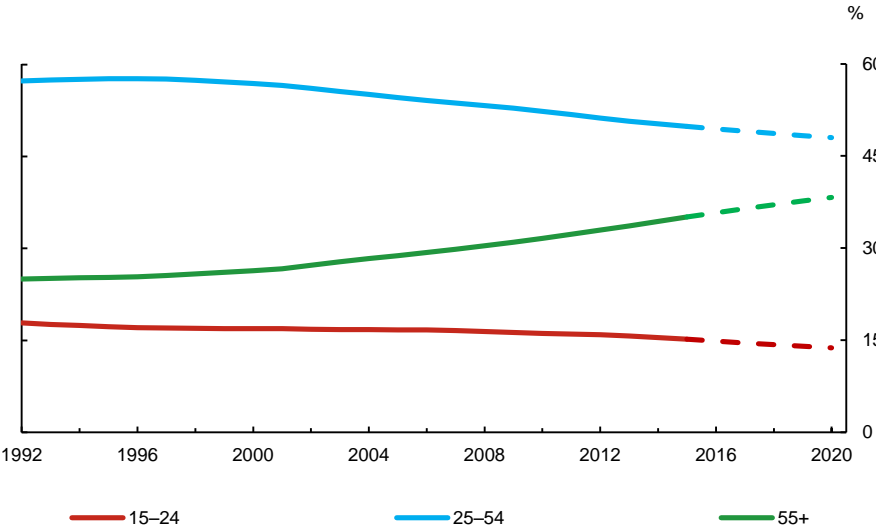
<sup>5</sup> For more details regarding the population projection conducted by Statistics Canada, please visit: <http://www.statcan.gc.ca/pub/91-520-x/91-520-x2014001-eng.htm>.



to 2020 (**Chart 2**), but older workers have lower trend employment rates than prime-age workers, despite their increasing labour market participation (**Chart 3**). For example, in 2015, the trend employment rate of older workers was around 35 per cent, while that of prime-age workers was slightly over 80 per cent. Therefore, an increasing proportion of older workers, who have lower trend employment rates, leads to a decline in the aggregate trend employment rate. The higher educational attainment of the Canadian population (more-educated workers tend to have higher employment rates) only partially compensates for the negative demographic trend.<sup>6</sup>

**Chart 2: The share of older workers is rising**

Fraction of total population, annual data



Sources: Statistics Canada and Bank of Canada calculations

Last data plotted: 2020

**Trend average weekly hours worked**

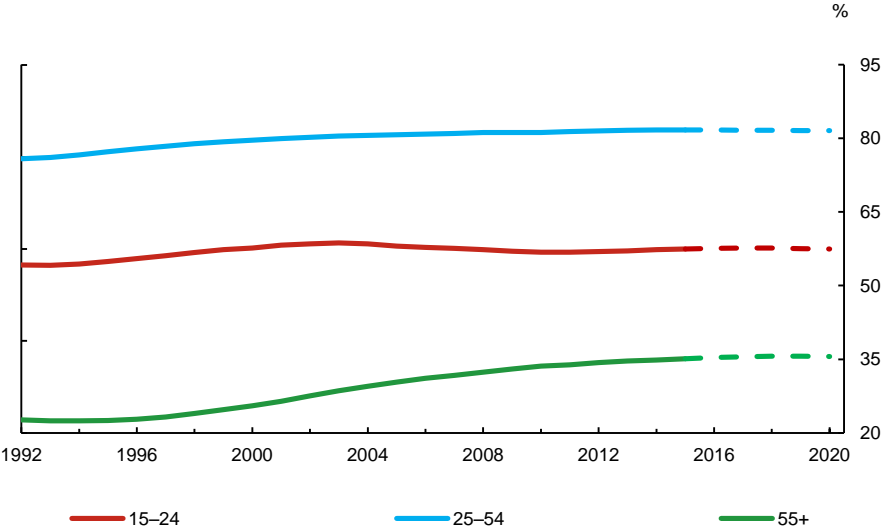
Trend average weekly hours worked are also declining. In fact, they have been trending down over our entire sample, as reflected in their negative contribution to TLI in **Chart 1**. Population aging and changes in the composition of employed workers are the main drivers of this

<sup>6</sup> The educational attainment of the Canadian population was recently added to the trend labour input model that is part of the Integrated Framework. The model also takes into account the increasing school enrolment of youth.

declining trend. The rising share of the service sector in the economy—where the number of weekly hours worked tends to be smaller—has also contributed to this decline.<sup>7</sup>

**Chart 3: Trend employment rate of older workers remains low**

Number of employed persons over population, annual data



Source: Bank of Canada calculations

Last data plotted: 2020

**Impact of lower energy prices on trend labour input**

The energy price shock is the main factor that leads us to revise down the projection of potential output growth for the coming years—mostly through TLP, as discussed in the next section. We do not expect, however, that the negative shock to energy prices will have a significant impact on aggregate TLI, for two reasons: (i) the historical correlation between aggregate TLI and oil prices is not significant; and (ii) employment in the energy extraction sector accounts for a small share of total employment. The negative shock to energy prices has nevertheless caused a decline in that sector’s TLI. In particular, using a simple regression model linking real energy prices with labour input, we project that the **share of hours worked in the oil and gas extraction sector** will fall below 0.4 per cent in 2018, from 0.7 per cent in 2014 (**Chart 4**).

<sup>7</sup> Average hours worked in 2015 was 31 hours in the service sector and 38 hours in the goods-producing sector.

**Chart 4: The share of the oil and gas sector in total employment is positively correlated with energy prices**



Source: Bank of Canada calculations

Last observation: 2016Q1

### 3. Trend labour productivity

We project that, after declining from 1.0 per cent in 2015 to 0.8 per cent in 2016, the growth of TLP will gradually accelerate to 1.2 per cent in 2020 (**Chart 5**), which is the long-term average for labour productivity. This is weaker than expected in the April 2015 MPR (1.2 per cent in 2015–16 and 1.4 per cent in 2017). Weaker capital deepening is the main factor explaining the lower profile.<sup>8</sup>

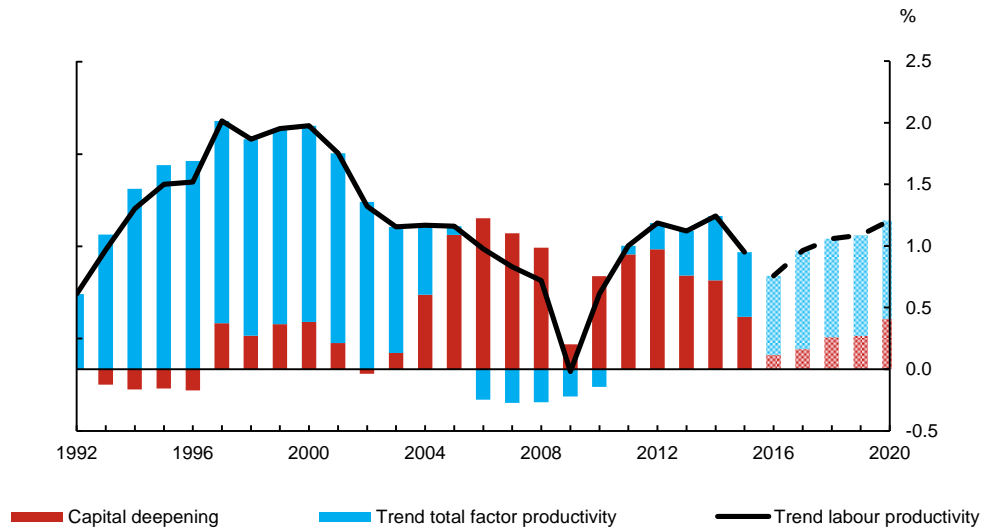
#### Capital deepening

The *Monetary Policy Report* projection for the level of business investment has been revised down considerably since April 2015 (**Chart 6**). There was a large revision to the outlook for business investment between April and October of last year, which led us to change our projection for potential output. Business investment has been revised down again since October 2015. As a result, **capital deepening** is now expected to be very weak in the near term and to only gradually accelerate toward the long-run average of 0.4 per cent by 2020.

<sup>8</sup> Trend labour productivity is made up of capital deepening and the growth of trend total factor productivity.

**Chart 5: Trend labour productivity growth will gradually accelerate**

Annual data

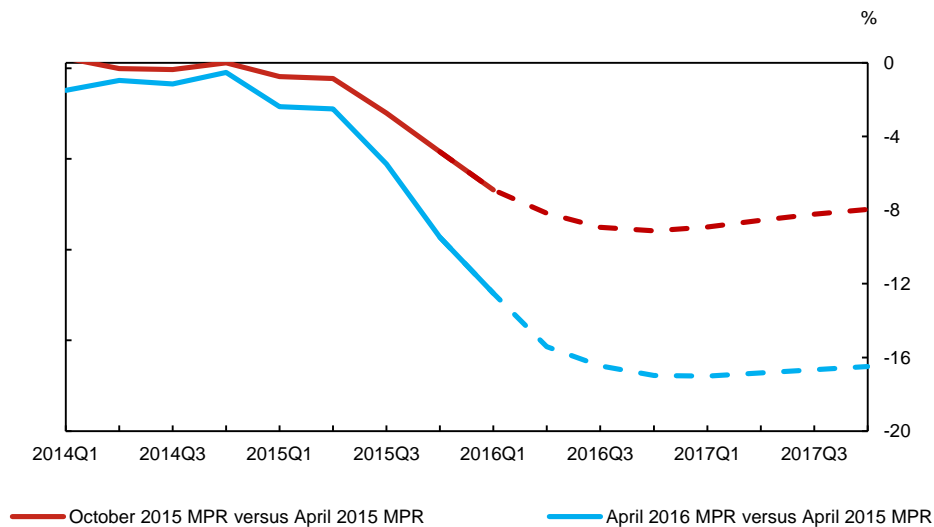


Source: Bank of Canada calculations

Last observation: 2020

**Chart 6: Large revisions to the MPR projection for the level of business investment since 2015**

Quarterly data



Source: Bank of Canada calculations

Last observation: 2017Q4

There is substantial uncertainty concerning the speed at which shocks to investment affect potential output growth. Unfortunately, it seems that the economic literature is largely silent on this subject. However, firms interviewed by Bank of Canada regional office staff in the

context of the *Business Outlook Survey* and regular energy sector consultations provide some evidence of a diffusion process that is broadly consistent with the one we are assuming, i.e., about 50 per cent of investment shocks affect capital deepening and potential output in the same year. The effects of the other 50 per cent are then spread over the following three years.

### Trend total factor productivity

In the Integrated Framework, trend TFP captures the influence of factors other than capital deepening that affect TLP. There is considerable uncertainty in projecting trend TFP, but some key variables have been identified in the economic literature; for example, information and communication technologies (ICT) investment and research and development (R&D) investment. These types of investment are thought to be more likely than others to generate higher TFP growth in addition to simply adding to the capital stock.<sup>9</sup> However, both types of investment have been weak in recent years. For example, as of 2014, the levels of investment in computer and electronic products and R&D had decreased by about 15 per cent relative to their pre-recession (2008) levels (**Chart 7**). It is interesting to note that a similar trend for R&D is not found in most other major countries belonging to the Organisation for Economic Co-operation and Development (OECD). The declines in these types of investment in Canada likely account for part of the slowdown of trend TFP since the early 2000s.<sup>10</sup>

A recent multi-country study (OECD, 2015) finds that the gap between the most productive firms and others has tended to increase in recent years in advanced countries. The authors argue that reduced **economic dynamism**, reflected in slower firm entry and exit rates and

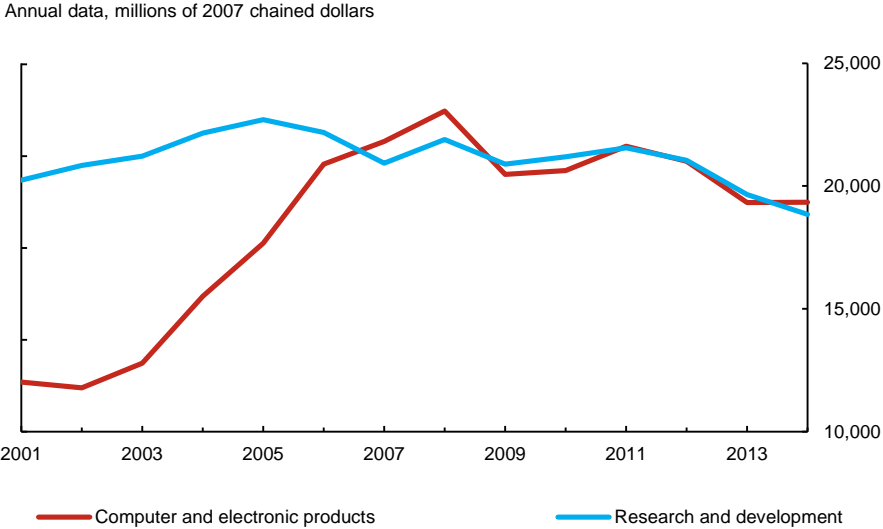
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<sup>9</sup> Hall, Lotti and Mairesse (2012) and Polder et al. (2010), for example, use micro data to document the importance of ICT and R&D investment for labour productivity growth. Using aggregated data, Guillec and van Pottelsberghe de la Potterie (2001) report that R&D has a positive impact on total factor productivity. See also Hall, Mairesse and Mohnen (2010) for a review of the literature on R&D spillovers and returns on R&D.

<sup>10</sup> Cette, Clerc and Bresson (2015) discuss the declining contribution of ICT to productivity growth in various countries, including Canada. Sharpe (2014) reviews the large gap in ICT investment between Canada and the United States.

slower labour reallocation, has contributed to this phenomenon.<sup>11</sup> Decreased economic dynamism and a continued weak performance of firms having a lower productivity level would contribute to slower aggregate productivity growth.

**Chart 7: The levels of investment in computer and electronic products and R&D have declined since 2008**



Source: Statistics Canada

Last observation: 2014

Impact of lower energy prices on TLP

So far, the discussion in this section would not support an optimistic view of Canada’s productivity prospects. Can weaker energy prices work in the other direction? Lower energy prices are contributing to weaker potential in the near term through their effects on capital deepening, but could they contribute to stronger productivity growth through other channels? Energy prices were relatively low in the late 1990s. Indeed, real oil prices reached their lowest level since the early 1970s. This may have facilitated strong productivity growth by reducing the costs of firms using energy as an input, therefore freeing some resources to

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<sup>11</sup> Macdonald (2014) and Cao et al. (2015) show that firm turnover is trending down in Canada. Haltiwanger (2012) discusses similar evidence for the United States. Cao et al. (2015) discuss some possible explanations for the trend decline in firm turnover (entry rate + exit rate) in Canada.

be spent on productivity-augmenting investments (R&D and ICT, for example). And in fact TFP boomed during those years. It is not impossible that something similar will happen in the coming years. The idea that lower energy prices can stimulate TFP is consistent with a simple exercise showing that the correlation between trend TFP and energy prices has been negative and significant in Canada since 2000. It is also supported by studies that find a negative relationship between energy prices and labour productivity in non-energy sectors (e.g., Jorgenson 1981).

Energy prices also have an impact on productivity through the changing weights of different sectors in the economy, i.e., **restructuring effects**. A new two-sector version of the Integrated Framework (oil and gas versus rest of the economy) can shed light on this issue.<sup>12</sup> The level of labour productivity in the oil and gas sector is higher than the average for the rest of the economy, so in the near term, a reduced weight of this sector in the economy is a drag on productivity growth.<sup>13</sup> However, the rest of the economy has tended to have a higher rate of trend TFP growth. We suppose that this will continue. Thus, in the longer run, restructuring may support productivity growth. Our projection for potential output includes some negative judgment for 2016 to reflect the fact that the short-run negative impact may not be entirely captured by the aggregate Integrated Framework. The possible longer-run positive effects enter as a positive judgment in our projection of trend TFP growth.

What about **demographic developments**? Some researchers (De Michelis, Estevao and Wilson 2013) have argued that the negative demographic trends, by causing the growth of labour supply to slow, provide firms with an incentive to invest more in physical and human capital. This could boost both capital deepening and trend TFP. However, there is not much evidence in recent data suggesting that this has been happening. Nevertheless, it remains a possibility for the future.

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<sup>12</sup> See also CSLS (2014) for an analysis of the impact of higher oil prices on productivity in the 2000s.

<sup>13</sup> Lower energy prices can have near-term positive effects on productivity in the oil and gas sector by forcing firms to become more productive and forcing the exit of less-productive firms.

## 4. Comparison with other projections

Our potential output projection for Canada is broadly consistent with that of other analysts. Some are less optimistic. For example, Capeluck and Drummond (2015) and McKinsey & Company (2015) assume constant labour productivity growth rates of, respectively, 1.0 and 1.1 per cent for their long-run projections. This gives them long-term growth rates of potential output of about 1.5 per cent. The OECD is also relatively pessimistic, seeing potential output growth at 1.4 per cent in 2016 and 1.3 per cent in 2017 (OECD 2016). The Parliamentary Budget Office (2015) is slightly more optimistic in projecting TLP growth at 0.9 per cent in 2016, 1.1 per cent in 2017 and 1.3 per cent, on average, from 2018 to 2020. This implies potential output growth rates accelerating from 1.6 per cent in 2016 to 1.7 per cent in 2018–20.

## 5. Sensitivity analysis

The purpose of this section is twofold. First, we put our projection in perspective by presenting two alternative scenarios with higher potential output growth, along with the necessary assumptions needed for them to materialize. Second, we present an update of the range for our projection of potential output growth. We take into consideration several factors affecting TLI (projection of working-age population growth and population aging, for example) and TLP (such as uncertainty about investment growth, future oil prices and trend TFP). For each of these factors, we establish a conservative (low) and an optimistic (high) scenario by changing our assumptions. Upper and lower bounds are then derived for potential output growth.

### Alternative scenarios

The first scenario presents the assumptions needed to produce the rates of potential output growth presented in the April 2015 MPR: 1.8 per cent for 2015, 2016 and 2017. Since the analysis is presented up to 2020, we further assume that potential output would grow at 1.8 per cent until 2020. The second scenario looks at the implication for potential output growth of the working-age population growing at a different rate—we assume the low- and high-growth scenarios from Statistics Canada.

- With no changes to our assumptions for TLI and trend TFP, the level of business investment needs to be, on average, 6 per cent higher between 2016 and 2020 to obtain the growth profile of the first scenario. A very strong pickup in exports that would trigger much higher levels of investment would be consistent with this scenario. If instead we assume that both TLI and capital investment are fixed, the



growth of trend TFP needs to be, on average, 0.2 percentage points higher. In the short run, cost savings from lower energy prices may induce productivity-enhancing investment, which would effectively boost trend TFP.

- If Statistics Canada's high-growth scenario for the working-age population materializes, then potential output growth (for a given investment profile and trend TFP) would be, on average, 0.1 percentage points higher between 2016 and 2020. In contrast, the low-growth scenario would remove almost 0.2 percentage points of the growth rate of potential output over the same period. Since demography only changes slowly, it is likely that much stronger or weaker immigration would account for any significant departure from our base case.

### Risks around potential output growth

This section details the high and low scenarios for the most significant risks and lists the other risks that were considered.

#### *Population growth*

Our base case uses Statistics Canada's medium-growth projection of the working-age population. Our current assessment is that this scenario is broadly in line with the actual population growth observed in 2015 based on the Labour Force Survey data. We use Statistics Canada's high- and low-growth projection of the working-age population to derive the bounds around our base case.

#### *Population aging*

The aging risk scenario reflects uncertainty about the behavioural changes of older workers in the labour market. The low-growth aging scenario assumes a less-optimistic profile for the trend employment rate of older workers and lower growth for trend average hours worked. The high-growth aging scenario uses more optimistic growth rates of trend average hours worked for older workers and for the trend employment rate of male workers over the projection horizon.

#### *Persistent excess supply in the labour market*

Certain labour market variables that deteriorated markedly during the 2008–09 crisis, for example, the rate of long-term unemployment and the participation rate of youth, have not

yet fully recovered. **Appendix A** discusses in more detail the implications of persistent labour market excess supply for potential output.

#### *Business investment*

Business investment paths for the high- and low-growth scenarios are based on an exercise comparing past projections with historical data. Based on forecasting errors in past projections, we obtain a plausible range for investment growth rates from 2016–18. In addition, to account for the uncertainty around the price of oil, we develop investment scenarios around the January 2016 MPR assumption of oil prices at \$37 per barrel (Brent). The low-growth scenario assumes oil prices at \$25 per barrel, while the high-growth scenario assumes oil prices at \$50 per barrel. We add the risk from the oil price scenario to the forecast-errors risk to get the lower and upper bounds of total business investment.

#### *Trend TFP*

The high-growth scenario assumes that trend TFP growth continues to increase and reaches 1.6 per cent—the historical average of the late 1990s—by 2020. This is optimistic, since trend TFP growth was exceptionally high in the 1990s. The low-growth scenario assumes that trend TFP growth will go down to the post-2009 historical average (2009–15) of 0.3 per cent by 2020. This period was characterized by much lower TFP growth than in the 1980s or the 1990s, with some episodes of negative TFP growth, something that was unseen before 2000.

#### *Other risks*

Other risks were considered, but their effects on the range are negligible. For TLI, we had high- and low-growth scenarios for the educational attainment of the Canadian workforce—which is affecting the trend employment rate—and for the share of employment in the service sector—which is affecting trend hours worked. For TLP, we also considered the uncertainty around firm turnover.

*Range*

**Table 2** summarizes our analysis.<sup>14</sup> For 2016, business investment forecasting errors, oil price scenarios, population aging and population growth are the main contributors to the range, accounting for about 85 per cent of it. However, by 2018, the weight shifts away from demographic factors toward business investment projection, oil price scenarios and trend TFP, which account for 75 per cent of the range.

Table 2: Uncertainty around projections for potential output growth (%)					
	2016	2017	2018	2019	2020
Range for potential output	1.2–1.8	1.0–2.0	0.9–2.1	0.9–2.3	0.9–2.3
Midpoint of the range	1.5	1.5	1.5	1.6	1.6

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<sup>14</sup> To obtain the upper bound for a given year between 2015 and 2018, we sum the impact of all risks and assume that this aggregate high- and low-growth scenario has a 0.25 probability of materializing. Assuming that these bounds capture about half of the uncertainty around potential output growth, we then apply an upward adjustment to obtain the figures presented in **Table 2**. However, some components are not available for 2019 and 2020. We therefore assume that the range increases at the same rate as in the previous two years.

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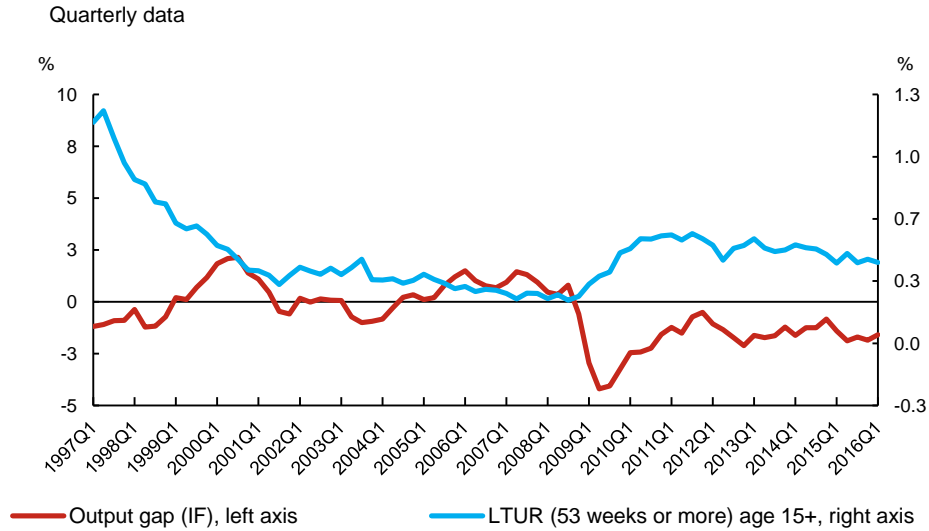
## Appendix A: Implications of persistent labour market excess supply on potential output

Persistent excess supply can have effects on potential output—a phenomenon often called hysteresis—as workers become detached from the labour market and their skills depreciate. A number of indicators can be used to assess the degree of these effects on the labour market. Long-term unemployment and the participation rates of young workers are examples of such indicators.

- **Long-term unemployment** (greater than 53 weeks) remains high relative to its pre-recession average (**Chart A1**). It is important to monitor this indicator because workers who remain unemployed for long periods may become discouraged and exit the labour force and may face declines in their skills.
- **Participation rates of young workers** fell sharply during the 2008–09 recession and have remained low since then (**Chart A2**). Only a small part of this decline can be attributed to an increase in school enrolment. Moreover, during the past year, the decline is particularly salient in the participation rate of males aged 20–24. This could partly reflect the complex adjustment following the oil price shock.

For example, if these indicators returned to their mid-2000s values, growth of trend labour input and, therefore, potential output growth, would be stronger than otherwise. The current projection for potential output growth takes the effects from persistent labour market excess supply into account.

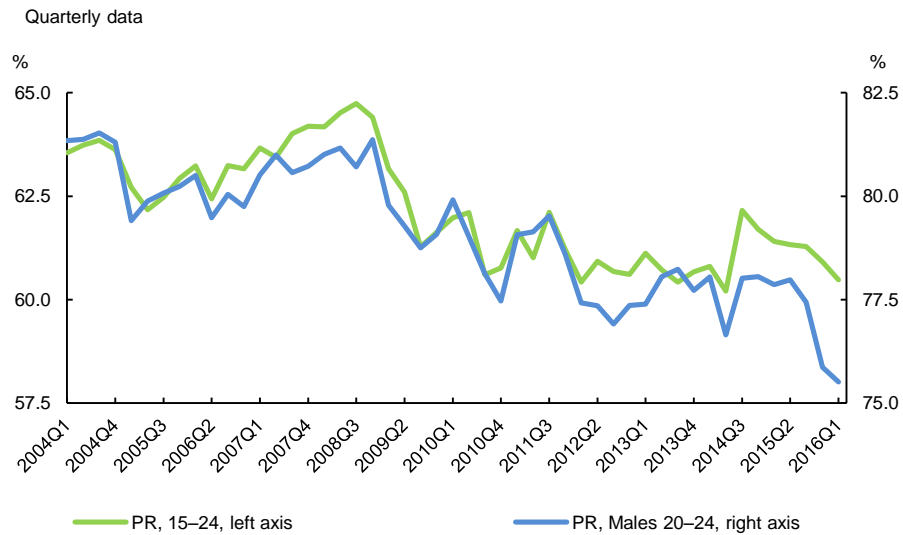
**Chart A1: Long-term unemployment rate (LTUR) remains above its pre-recession average**



Sources: Statistics Canada and Bank of Canada calculations

Last observation: 2016Q1

**Chart A2: Since the 2008–09 recession, the youth participation rate has declined**



Sources: Statistics Canada and Bank of Canada calculations

Last observation: 2016Q1