Canada's Potential Productivity and Output Growth: A Post-Crisis Assessment

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ABSTRACT

This study investigates the impact of the current financial crisis on Canada's potential GDP growth. Using a simple accounting framework to decompose trend GDP growth into changes in capital, labour services, and total factor productivity, we find a sizeable drop in Canadian potential growth rate in the short term. The estimated decline of about 1 percentage point originates from a sharply decelerating capital stock accumulation (as investment has dropped steeply). However, over the medium term, we expect Canada's potential GDP growth to gradually rise to around 2 per cent, below the pre-crisis growth rate, partly reflecting the effects of population aging.

RÉSUMÉ

L'étude examine l'impact de la crise financière actuelle sur la croissance du PIB potentiel du Canada. Au moyen d'un cadre comptable simple servant à décomposer la croissance du PIB à long terme selon les changements dans le capital, les services de main-d'œuvre et la productivité totale des facteurs, nous constatons une baisse appréciable du taux de croissance potentiel du Canada à court terme. La diminution estimée d'environ un point de pourcentage s'explique par la forte décélération de l'accumulation du capital-actions (étant donné que les investissements ont beaucoup chuté). Toutefois, à moyen terme, la croissance du PIB potentiel du Canada devrait s'élever progressivement à environ 2 %, en deçà du taux de croissance avant la crise, partiellement en raison des effets du vieillissement de la population.

POLICY MAKERS NEED ACCURATE ESTIMATES of the amount of economic slack, but this usually difficult exercise has become even harder during the ongoing financial crisis. The most common measure of slack is the output gap, i.e. the difference between actual production and a notional amount that could be produced using all available resources without strains on their price — the potential output of a country. With this measure at hand, monetary and fiscal authorities can evaluate inflationary and structural fiscal pressures. In particular, the timing of exit strategies from the unusual level of policy stimulus in developed economies depends closely on the size of this gap.

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However, potential output is not directly observable and economists need to take a stance on how its determinants will evolve, including future capital accumulation, equilibrium unemployment rates, and total factor productivity (TFP). In the current juncture, the uncertainty surrounding these estimates is especially large as it is hard to measure the impact of severe financial shocks on these variables. Other factors (e.g. sectoral reallocation) are also at play.

This article assesses the impact of the recent financial crisis on Canada's potential growth. For example, tighter credit conditions could have deterred efficient capital allocation and possibly slowed Canadian potential growth. The protracted recession and tighter financial conditions had already hurt total private fixed investment (down 18½ . per cent from peak to trough during the crisis and recently still 13 per cent below pre-crisis peak levels) and thus capital accumulation, while a higher unemployment rate has potentially affected equilibrium rates of unemployment — both lowering potential growth. While the cyclical impact of the financial crisis on TFP has so far been positive, the lukewarm past TFP performance in Canada does not point to encouraging performance moving forward.[2] Thus, bearing in mind the downward pressures on potential growth from trends in the working-age population (mostly from aging) and hours worked per worker (a secular trend), we estimate that potential GDP growth rate in Canada has declined significantly in 2009 and 2010 as a result of the crisis (by 1 percentage point), and will gradually rise to 2 per cent by 2015 (below the estimated 2.4 per cent potential growth for 2008). The potential GDP level would suffer a permanent decline of about 2 per cent vis-à-vis a no-crisis scenario, a modest loss compared to previous financial crises in industrialized countries (Cerra and Saxena, 2008, and IMF, 2010).

The article is structured as follows. The first section describes what theory predicts would be the impact of the crisis on potential GDP growth, while section two reviews recent empirical findings on this impact. The next two sections look at Canada's labour productivity and non-accelerating inflation rate of unemployment (NAIRU) performance over the years given their interlinkages with potential GDP growth rate, while section five describes a simple framework to decompose and project potential GDP growth rate. The results, compared and contrasted with other studies, are presented in section six, while section seven compares our findings with Canada's previous downturns. The final section concludes and offers some policy implications.

Some Theoretical Considerations

In the short term, a sizeable drop in Canadian potential growth could originate from the sharply decelerating capital stock accumulation (as investment has dropped steeply) and rising long-term unemployment, which would raise equilibrium unemployment rates.[3]

However, in general, theory does not predict a particular effect of the financial crisis on potential output:

- *The impact of the crisis on labour input is unclear.* On the one hand, a long and deep recession could cut the potential labour force by discouraging labour participation and migration flows (European Commission, 2009; Elmeskov and Pichelman, 1993). On the other hand, the huge depletion of savings following the stock market and housing decline could potentially encourage workers to extend

2 Estevão and Severo (2010) find a negative correlation between financial shocks and TFP growth for the United States and Canada.

3 Our analysis partly takes into account the indirect effects on potential output of stabilization policies in response to the crisis, given that we use actual data up to 2009 (when most of these policies were implemented). For a more detailed discussion of the indirect effects of stabilization policies on potential output in OECD countries, see Furceri and Mourougane (2009).

their working life past their originally planned retirement age or induce idled secondary earners to enter the labour market.[4] Debelle and Vickery (1998) show that the latter effect is particularly relevant to explain the labour force participation of female secondary-earners. We also expect a temporary increase in the non-accelerating inflation rate of unemployment (NAIRU, also referred to as structural unemployment in this article) from the crisis given possible hysteresis effects (Ball, 2009; Blanchard and Summers, 1989). The effect on the NAIRU and any changes in the participation rate are expected to be only temporary and not affect medium-term trends, given that labour markets are quite flexible in Canada.[5] Beyond the crisis, demographic forces will mitigate the positive contribution to potential growth from labour input.[6]

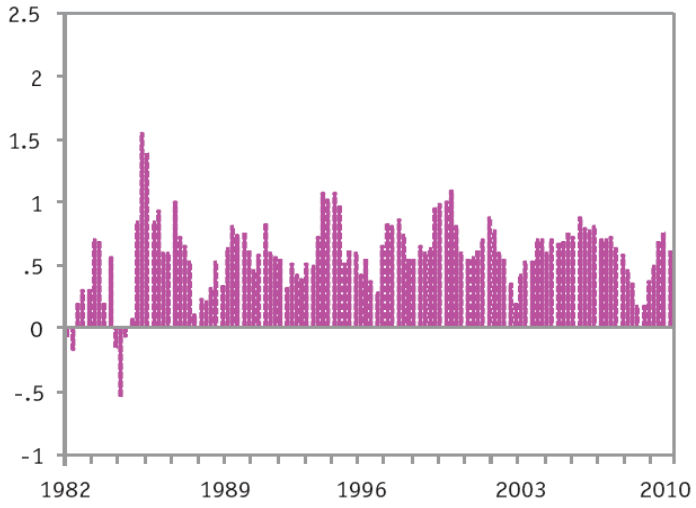
- *The impact of the crisis on capital accumulation could be significant.* Financial crises lower incentives to invest because of decreasing sales and raising uncertainty on investment returns and risk premia. In addition, credit supply is, in general, lower during a financial crisis, reflecting tighter lending standards for corporations (both in terms of price and non-price factors) as financial institutions work to fix their balance sheets. Canada has indeed experienced a large drop in investment since mid-2008, which has provoked much slower growth in the capital stock and, thus, lower potential growth. The longer-term effects on investment will depend on the persistence of high capital costs and on investors' attitudes towards risk.
- *The impact on TFP is uncertain a priori.* On the TFP front, Canada has lagged the United States in both level and growth rate terms, and the current crisis is not projected to ameliorate these gaps. In theory, TFP could be negatively affected by the crisis if economic uncertainty and higher capital costs deter private investment in R&D and innovation which, as indicated by the OECD (2006) is already low in Canada by international comparisons. On the other hand, firms might decide to undertake reforms and restructuring to improve efficiency given the crises, boosting TFP. The final effect on TFP growth could depend on industry characteristics. For instance, Estevão and Severo (2010) show that financial shocks affect TFP growth through their effect on factor allocation, which in turn depends on an industry's degree of reliance on external funding and whether the financial shock affects firms differently within each industry. The model presented shows that industry-level TFP growth would decline if banks' tightened lending standards affect the cost of raising capital differently across firms within an industry. Using data for 31 industries in the United States and Canada for the 1997-2007 period, they show that financial shocks indeed tended to lower TFP growth.

4 In the first quarter of 2009, household net worth was down C$52.3 billion in Canada from its peak in the third quarter of 2008 and over $16.8 trillion in the United States from its peak in the third quarter of 2007. The fall in household net worth in Canada represented 3.4 per cent of nominal Canadian GDP at market prices in 2009, while the drop in the United States represented 119.0 per cent of nominal U.S. GDP in 2009.

5 Balakrishnan (2008) finds that Canada's labour market is as efficient as that in the United States. Labour market flexibility is reflected in the significant and immediate impact of the Canadian downturn on the unemployment rate, which increased from 6.2 per cent in September 2008 to 8.7 per cent in August 2009.

6 Statistics Canada's baseline projections (see Appendix for more details) indicate that between 2006 and 2011, working-age population will rise by a cumulative 4.4 per cent compared to a 13 per cent increase in the elderly population. This discrepancy increases over time; by 2031, the elderly population more than doubles (compared to 2006) while the size of the working-age population (aged 15-64) only increases 8 per cent.

Chart 1
Contribution of Finance, Insurance, and Real Estate to GDP Growth in Canada, 1982-2010
(percentage points)



Sources: Haver Analytics and authors' estimates.

Impact of Past Financial Crises on Potential Output

Past research suggests that financial crises could permanently affect potential growth. Furceri and Mourougane (2009), using a univariate autoregressive growth equation for 30 OECD countries for the period 1960–2007, find that financial crises negatively and permanently affect potential GDP; they show that a financial crisis typically lowers potential GDP level permanently by 1.5–2.4 per cent in a crisis-hit OECD country, with some countries having their potential output level declining by as much as 4 per cent.[7] They also find that the magnitude of the effect increases with the severity of the crisis. This is in contrast to Haugh *et al.* (2009) who find mixed effects from crises on potential output, based on an events-study approach. Looking at a sample of EU and OECD countries over the period 1970–2007, a recent European Commission analysis (European Commission, 2009) finds that each year of a banking crisis (which lasts, on average, 3.9 years) is associated with about 0.5 percentage-point lower potential GDP per capita growth, with partial restoration of growth rates during the recovery years. Thus, there is a permanent loss in potential GDP level (also found in IMF (2009a,b).[8] Cerra and Saxena (2008) estimate a permanent output loss of 4 to 16 per cent following financial crises in developed and less-developed countries.

Financial crises result in large output losses with protracted recoveries. Reinhart and Rogoff (2009) reviewed several recent financial crises and found that they are accompanied by recessions with large losses in output and employment that last longer than "typical" episodes by an average of one year. Haugh *et al.* (2009) also find that during financial crises output losses are typically two to three times greater than during "normal recessions," again with a more protracted recovery. Cerra and Saxena (2008) find that for 14 OECD countries, economic contractions are not typically followed by fast recoveries, with crises leading to lower long-term growth.

Past crises had severe and long lasting effects on Canadian output. For example, during the 1980s recession (which was accompanied by a severe housing downturn) the contribution of finance, insurance, and real estate (FIRE) to Canadian GDP growth was negative, while in the milder 1991 recession, FIRE output growth slowed from an average of 3.8 per cent over 1990–91 to 2.5 per cent in 1992.[9] At the onset of the current crisis, FIRE's growth rate decelerated significantly but did not turn negative, averaging around 1 per cent in late 2008 and early 2009, before rebounding

7 Their sample includes the recent crises in the United States and the euro area, as well as crises in Spain (1977), Norway (1987), Finland (1991), Sweden (1991), Japan (1992), Australia (1989), Canada (1983), Denmark (1987), France (1994), Germany (1977), Greece (1991), Iceland (1985), Italy (1990), New Zealand (1987), United Kingdom (1974,1991,1995) and United States (1984).

8 For a more extensive discussion on recent literature analyzing the effects of financial crises on GDP and potential GDP growth, see European Commission (2009) and IMF (2009a, b).

strongly, possibly relating to the underlying strength of the FIRE sector in Canada (Chart 1).

Productivity Developments in the Canadian Business Sector[10]

Labour productivity growth has slowed significantly in the Canadian business sector in the last decade. Baldwin and Gu (2009) analyzed labour productivity growth in the business sectors of Canada and the United States between 1961 and 2008. They found that over the past 50 years, labour productivity in Canada has increased by around 2 per cent per year, compared with 2.3 per cent in the United States. However, in recent years, the gap in productivity growth rates between the two countries has widened steadily. From 2000 to 2008, labour productivity in Canada's business sector increased at an annual average rate of 0.7 per cent versus 2.6 per cent in the United States. This is in sharp contrast with the Canadian performance prior to the mid-1980s, when Canadian productivity grew faster than in the United States. Between 1961 and 1980, labour productivity in Canada increased 2.9 per cent a year on average, faster than the rate of 2.5 per cent in the United States. More recently, between 1997 and 2000, Canadian labour productivity grew by 3.2 per cent per year before decelerating significantly to a mere 1.1 per cent in 2001 and declining by 1 per cent in 2008.

Using a production function approach, past research finds that the recent slowdown in Canadian labour productivity growth is linked to a slowdown in TFP growth. Baldwin and Gu (2009) find that the recent labour productivity slowdown is explained by slower TFP growth while earlier declines were mostly driven by lower contribution from capital deepening, as defined by the growth in the capital-labour ratio. They find that Canadian TFP has actually declined in recent years; from growing by an annual average of 0.3 per cent between 1980 and 2000 to declining by 0.6 per cent per year in the 2000-08 period (with the Canada-U.S. labour productivity growth gap 1.9 percentage points per year in the 2000–08 period).[11] Statistics Canada (2007a) finds that TFP growth was an important driving force behind U.S. labour productivity growth in recent years: at 1.5 per cent a year during 1996–2006 labour productivity growth was more than double the Canadian figure (0.6 per cent). Rao *et al.* (2008) also find that most of the widening gap between Canadian and U.S. labour productivity is explained by TFP performance.

Turning to a sectoral view of productivity developments, past research has found mixed evidence on the source for the performance gap between the two countries. Cardarelli and Kose (2004) find that the widening labour productivity gap between the United States and Canada over the 1990s is a reflection of different evolution of industrial structures: the United States has benefited from dramatic labour productivity acceleration in the service sector, magnified by the larger share of services in U.S. production. Cardarelli (2004) finds that two key service sectors account for most of the gap, namely trade, and finance, insurance and real estate (FIRE). On the other hand, Baldwin and Gu (2009) claim that the recent Canadian labour productivity growth slowdown is primarily explained by a weaker performance in mining, oil and gas extraction as well as in manufacturing, possibly related to an appreciating Canadian dollar.[12] The former accounts for 0.6 percentage point of the post-2000 deceleration in labour productivity growth while manufacturing accounts for 0.5 percentage point. They claim that the slowdown in

9 The 1980s crisis was not characterized by a credit crunch, while the recent crisis included a credit crunch, and is thus often referred to as a financial crisis.

10 While this section and the productivity discussion, in general, focus on the business sector, our overall analysis is for the total economy, which includes the non-business sector.

11 Baldwin and Gu (2009) estimate that the average annual growth rate of TFP in the United States over the period 1961-2008 was 0.9 percentage points higher than in Canada.

FIRE is only responsible for 0.2 percentage point of the deceleration in labour productivity growth.

In contrast, Sharpe (2010) finds that Canada's weak post-2000 productivity performance is not attributable to a reallocation of labour toward mining, oil and gas, a sector with low productivity growth. Rather, it was the fall in labour productivity growth in manufacturing that accounted for all of the slowdown in business sector productivity growth after 2000. Thus, Ontario has contributed disproportionately more to the slowdown (Sharpe and Thomson, 2010a,b). On the other hand, Rao *et al.* (2005) assert that it is hard to isolate the factors explaining the slower Canadian productivity growth in recent years given numerous factors at play at the same time including a productivity collapse in ICT-producing industries, cyclical factors, rapid increase in commodity prices, and the appreciation of the Canadian dollar.

Labour productivity rebounded in 2009 and 2010, after declining in 2008 by 0.9 per cent (for the business sector). The decline in business labour productivity in 2008 originated mostly from the goods-producing sector, in particular construction and manufacturing. The decline in manufacturing labour productivity has also continued in early 2009, while there has been a sharp reversal in recent quarters (rising by over 7 per cent in the first half of 2010). Labour productivity in the construction sector had initially rebounded in early 2009 (reflecting the strong recovery in the housing market) but has since retrenched considerably.[13] Labour productivity growth in the services sector held better during the crisis, although there have been large declines in wholesale trade and FIRE. Under this sectoral approach, subdued activity in the FIRE sector must have affected potential growth via two channels: a direct effect through lower growth in the output of FIRE (which contributed about a fourth of aggregate output growth in the last decade); and an indirect effect through reduced activity elsewhere in the economy, as credit tightening raised capital costs.

Canada's NAIRU

Analysts have a range of estimates for the NAIRU in Canada, but there is a consensus that it had been declining up to the beginning of the current crisis.[14] Richardson *et al.* (2000) find that the NAIRU has been declining steadily in Canada. Rose (1988) estimates that the NAIRU was about 8 per cent at the end of 1987 in Canada, but notes factors working to reduce it over the medium term. Sharpe and Sargent (2000), after summarizing the work of various authors, indicate a strong consensus that structural unemployment has fallen in the 1990s. Estimates of the Canadian NAIRU range from a high of 9.5 per cent to a low of 6.5 per cent with the average estimate being 7.7 per cent (OECD 1996) in the mid-1990s.[15] Fortin (2000) finds that during the 1990s, the lowest sustainable rate of unemployment (LSRU) in Canada declined

12 The importance of the mining sector in explaining the slowdown in Canadian TFP is also consistent with Statistics Canada's findings (cited in Sharpe and Arsenault, 2009) that Alberta's annual labour productivity growth was the slowest in Canada during 1997-2007 (at 1.0 per cent), closely followed by British Columbia at 1.2 per cent. Ontario and Quebec were at the middle of the sample, with an average annual labour productivity growth rate of around 1.7 per cent, while Newfoundland was leading with almost 5 per cent annual growth. In terms of TFP performance, Alberta's TFP declined by an annual average of 1.6 per cent, while again Newfoundland was leading with annual TFP growth of over 4 per cent during the same period. Quebec and Ontario's TFP growth was around 0.9 per cent per annum while British Columbia's TFP has been growing by around 0.5 per cent per year, one-tenth of a percentage point above the national average. For the latest estimates of the levels and growth rates of labour, capital and multifactor productivity for the Canadian provinces by industry for the 1997-2007 period, see Sharpe and Thomson (2010a).

13 Tsounta (2010) provides a discussion of recent developments in the Canadian housing market.

14 Estimates of the NAIRU in general are very sensitive to methodological choices (Setterfield *et al.*, 1992; Staiger *et al.*, 1997) and therefore should be interpreted with considerable caution. Finance Canada defines that "structural unemployment occurs when workers are unable to fill available jobs because they lack the skills, do not live where jobs are available, or are unwilling to work at the wage rate offered in the market." Jackson (2005) discusses studies estimating the NAIRU in Canada.

15 The large range of estimates indicates the degree of uncertainty in estimating this unobservable series.

from the 7.5 to 8 per cent range to around 6 per cent by 2000.[16] Sharpe (1996) estimates that a reasonable estimate of the NAIRU in 1994 was around 7.5 per cent in Canada and around 6 per cent in the United States. To explain the structural differences, the author examines unemployment insurance in both countries. In Canada, the unemployment insurance system is more generous than in the United States, offering a higher benefit replacement rate and more extensive coverage as well as requiring less prior work than the typical program in the United States. Research indicates that the greater generosity of the Canadian system lowers labour force participation and increases the duration of unemployment in Canada relative to the United States (Sharpe, 2001; Fortin and Fortin, 1999).[17]

Several reasons have been cited for the decline in the NAIRU in the 1990s. Those include (i) a drop in the relative size of the youth labour force — a group experiencing above-average unemployment rates; (ii) higher average education level of the labour force; (iii) deregulation in the domestic economy, together with increased globalization in the world economy, which has sharpened labour and product competitiveness; and (iv) a decline in unemployment insurance generosity both in terms of lower benefits and stiffer eligibility criteria (Fortin, 2000). Other factors that could potentially explain a lower NAIRU include increased female labour force participation rate since the mid-1990s; Tsounta (2006) finds that reforms in the tax and benefit system increased labour force participation for secondary earners in a household and thus could be important in explaining the decline in the NAIRU since the mid-1990s.

The NAIRU is estimated to have declined further in the 2000s but the current crisis has probably raised it somewhat again, at least temporarily. Sharpe and Sargent (2000) point out that the decline in the unemployment rate in the 2000s below previous NAIRU estimates coupled with low inflation rates indicate that the structural rate of unemployment has fallen in the 2000s. However, with unemployment rates now hovering around an 11-year high, and given the protracted economic recovery, we conjecture that there has been a marginal temporary increase in structural unemployment of around one-tenth of 1 per cent (given human capital depletion) which should return to its pre-crisis levels over the medium term, given Canada's flexible labour markets.[18]

A Simple Framework to Decompose and Project Potential GDP Growth

Aggregate data and trends show that potential growth has been decelerating since 1999. Following Barrera *et al.* (2009), we decompose potential GDP growth into changes in (i) capital stock, (ii) equilibrium capital utilization; (iii) trend hours of work per worker;[19] (iv) the equilibrium rate of unemployment (or NAIRU); trend labour force participation rate; (vi) working-age population (aged 15-64); and (vii) trend TFP.[20] The decomposition begins by first calculating the logarithm of the TFP level according to:

16 Within the old-fashioned vertical long-term Phillips curve framework, the LSRU concept (proposed by Modigliani and Papademos, 1975) is the same as that of the NAIRU. But the LSRU is a broader concept than the NAIRU since it can also apply to the non-vertical, long-term Phillips curves arising from theories such as proposed by Eckstein and Brinner (1972); Tobin (1972); Akerlof, Dickens and Perry (2000).

17 Betcherman (2000) looks at evidence of the importance of labour market policies and institutions for structural unemployment and finds that the generosity of the unemployment insurance system has been systemically associated with higher levels of unemployment across OECD countries.

18 Canada's labour market performance remains impressive during the crisis compared to the United States; in the latter, unemployment rate is hovering around a 27-year high. The U.S. NAIRU is estimated to have increased by around 1½ percentage points (Dowling, Estevão and Tsounta, 2010).

19 In our analysis, workers include all persons working (i.e., including the self-employed). See appendix for more details.

20 Details on data used and the methodology are provided in the Appendix.

$$tfp = y - \alpha\, ks - \alpha\, ku - (1-\alpha)\, l \quad (1)$$

Where y is the logarithm of output, ks is the logarithm of capital stock, ku is capital utilization (proxied by a measure of capacity utilization in industry estimated by Statistics Canada), l is the logarithm of total labour hours, tfp is the logarithm of TFP, and α is the average share of capital compensation in value added (discussed in more detail below). Once the logarithm of the TFP level is obtained, the potential output level is calculated as:

$$y^* = \alpha\, ks + \alpha\, ku^* + (1-\alpha)\, h^* + (1-\alpha)\,(1-u^*) + (1-\alpha)\, lfp^* + (1-\alpha)\, wap + tfp^* \quad (2)$$

Where h is average hours of work, u is the unemployment rate, lfp is the labour force participation rate, and wap is working-age population. Variables with a * are trend values obtained using an HP filter for all series (to avoid end-of sample biases, we filter a longer series including projections for each variable according to the IMF World Economic Outlook) assuming a smoothness parameter, ë, of 100—the traditional value for annual-frequency data. [21] We use the actual capital and working-age population series in the calculation for potential output, as these variables cannot deviate from notional "equilibrium" values in the short term (unlike the unemployment rate and labour force participation), i.e., they are "sunk" variables. Results are qualitatively unchanged if we use smoother versions of capital and working-age population growth. All variables refer to the total Canadian economy, and growth rates are computed from the estimated level of potential GDP. The average share of labour compensation in value added used in the calculation as a proxy for (1- α) is equal to 0.62; according to Sharpe and Arsenault (2009), the labour share in Canada hovers around 0.6 with the capital share around 0.4 (see also Sharpe *et al.* (2008) for more details). [22] Data on capital are taken from the OECD Economic Outlook database and labour data are based on Statistics Canada's Labour Force Survey.

Past data illustrate, in particular, ongoing demographic shifts and broad TFP trends. The data show clearly that, even before the crisis, growth in working-age population and hours worked per worker had been declining, while the NAIRU was falling and participation rate was rising (given the reforms of the 1990s in employment insurance and tax and benefit systems analyzed earlier). On net, trend labour input growth declined in the last years of the sample while filtered TFP growth rate does not show large variations.

We find that the crisis has slowed down potential growth mostly due to slower capital accumulation and to a much lesser extent due to reduced labour services growth. Moving forward, we project that capital accumulation would return to more normal growth levels, although the contribution of labour services to potential GDP growth would remain moderate given the aging of the population. The exact path for each variable should be seen as illustrative, but it is consistent with the experience of past crises as indicated in the next section and broadly in line with the earlier discussion of theoretical issues and the available research on the topic. Notice that in the absence of a final verdict on TFP growth given the different factors discussed before, we opted to keep it relatively unchanged throughout the crisis and subsequent period. Key factors determining future potential growth are discussed below.

- We forecast a 5.1 per cent increase in gross private fixed investment in 2010 (after falling

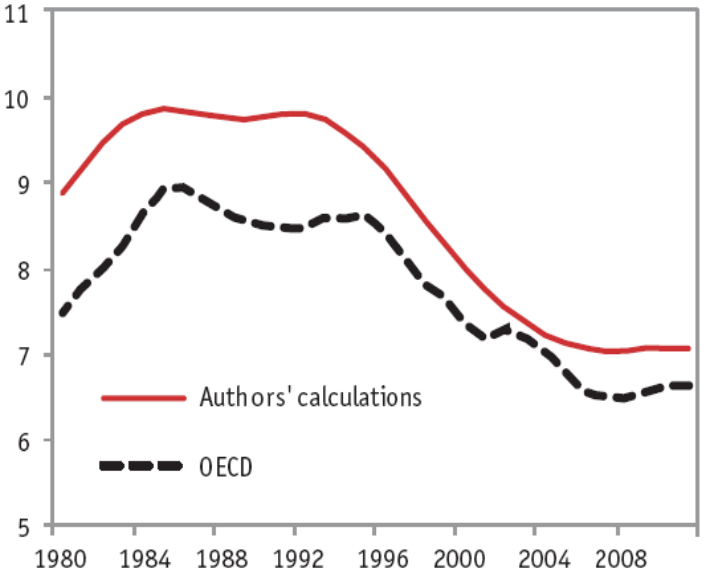
21 For a discussion of the advantages and disadvantages of using statistical filters to estimate potential output, see Cotis *et al.* (2005). Possible extensions of the study could include using different filtering techniques, for instance a lower smoothness parameter as suggested by Ravn and Uhlig (2002). Estevão and Tsounta (2010) projected the trend variables instead of filtering the longer series and came up with similar results to those presented here.

22 Robidoux and Wong (2003) indicate that the TFP gap between the United States and Canada might be smaller when using time-varying capital and labour income shares. Throughout the analysis we choose to keep the income shares constant so as to isolate the impact of income share changes to potential GDP growth changes.

by 16 per cent in 2009), [23] mimicking the subdued recovery experienced after the 1982 recession and consistent with ongoing global economic uncertainties, low levels of capacity utilization, and still-tight lending conditions. Following these sharp declines, the investment/output ratio is set to return slowly to near pre-crisis levels at the end of the forecast horizon (about 18 per cent).[24] Using a perpetual inventory method based on a historical rate of depreciation of around 8 per cent a year, we obtain a forecast path for the growth in the capital stock.[25] The weak investment dynamics are key to future potential growth, as our forecast is predicated on (i) protracted tight financial conditions internationally, which is important for Canadian firms that rely on U.S. sources for raising around 25 per cent of their capital (IMF, 2008) and (ii) recovery in foreign demand given the global and, particularly, the U.S. economic outlook. These assumptions are in line with those of the European Commission (2009), which finds that for past EU crises the contribution of capital accumulation to potential growth does not slow down significantly over the long-term, though there is a short to medium-run deceleration in capital accumulation in the aftermath of the crisis.

- By fitting an HP filter to actual Canadian unemployment rates (and correcting for end-of sample bias by filtering the historical and projected series), we estimate a measure of the NAIRU (Chart 2). This procedure has the advantage of being simple and appears to be consistent with other estimates in the literature. For instance, we observe the widely documented declining trend in NAIRU over the 1990s and 2000s. Consistent with the experience during past downturns, we forecast a path that mirrors historical relationships between filtered series and the actual unemployment rate, though we take into account the declining trend in working age population over the medium term.
- Given the sharp increase in labour force participation in the last decade, we are assuming

Chart 2
Estimated NAIRU for Canada, 1980-2012
(per cent)



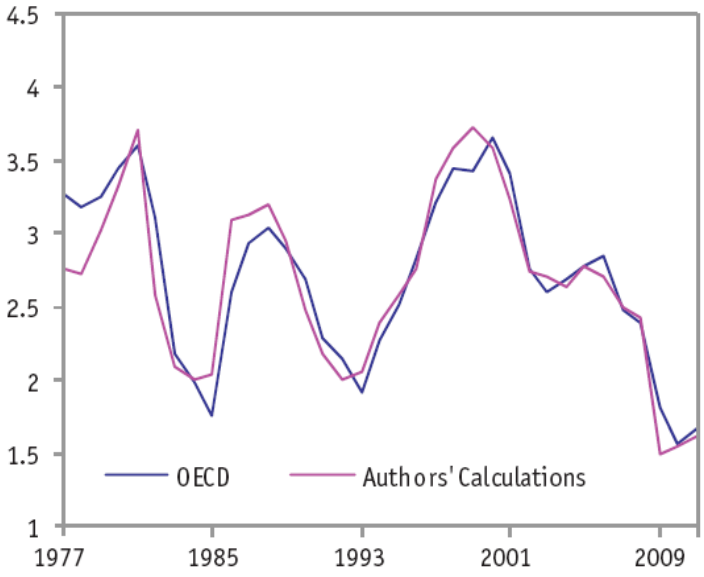
Sources: OECD and authors' calculations.

23 The sharp slowdown in capital accumulation reflected distressed banking systems worldwide and the global financial instability which has led to considerable uncertainty and misallocation of resources.

24 The projections take into account the positive impact on private investment from the planned cuts in corporate income tax (CIT) rate (to 15 per cent by 2012). While in the past, such cuts had a pronounced impact on investment spending (e.g. from 2001 to 2004 the CIT rate declined by 5 percentage points accompanied by an increase in the investment share (in per cent of GDP) from 20 to 23 per cent, these effects are projected to be less muted at present given the uncertainties over the economic recovery.

25 Statistics Canada (2007b) indicates that Canada's depreciation rate is greater than the rates observed in the United States due to higher depreciation in building and engineering construction. While both countries have similar depreciation rates for machinery and equipment asset classes (18 per cent on average in the United States and 20 per cent in Canada), there is a considerable difference between Canadian and U.S. depreciation rates for buildings and engineering construction (U.S. rate is 3 per cent versus an 8 per cent Canadian average). On the issue of depreciation rates in Canada and the United States, see Tang, Rao and Li (2010).

Chart 3
Potential Output Growth Rate Estimates for Canada, 1977-2011



Sources: OECD and authors' calculations.

Table 1
Comparing Potential GDP Growth Estimates for Canada

	2002-03	2007
Bank of Canada	3.0	2.6
Authors' Calculations	2.7	2.5

Sources: Bank of Canada and authors' calculations.

that labour participation would remain essentially unchanged over the medium term (falling by only a negligible amount due to population aging, as more older individuals choose to remain longer in the labour force to rebuild lost savings and more secondary earners choose to enter the labour market).

- Growth in working-age population (individuals aged 15–64 years) is set to decline slowly in the next few years, according to projections from Statistics Canada (baseline scenario, see appendix for details).
- Average hours of work are assumed to continue their long-term downward trend in the coming years.
- Equilibrium capacity utilization in Canadian non-farm goods-producing industries (a proxy for total economy capital utilization) has been on a declining trend since the early 2000s, after rising during the 1990s. For the remaining forecast period, we assume it would remain essentially constant.
- Trend aggregate TFP growth is relatively smooth, rising by around 0.4 per cent per year in the last decade, after falling in the 1990s. Following the experience from past crises in Canada, we do not expect TFP changes to be the driving force behind long-run potential growth; a minor decline in TFP growth is assumed over the medium term given resource reallocations within industries, and between industries and provinces, which may affect productivity in the near term. However, the immediate impact from the crisis on TFP appears tame so far.[26]

Results

Our historical estimates of potential growth rates are broadly consistent with those of the Bank of Canada (Table 1) and the OECD (Chart 3). For example, Bank of Canada (2008) estimates that Canada's 2007 potential growth rate was 2.6 per cent, in line with our estimate of 2.5 per cent, while in its 2002 Monetary Policy Report (Bank of Canada, 2002), it had estimated an average annual potential growth rate at 3 per cent for the period 2002-03 (against our 2.7 per cent). Bank of Canada (2005) also indicates the declining trend in potential GDP growth from around 4 per cent in 1999 (our estimate is 3.8 per cent) to about 2.5 per cent (our estimate is 2.7 per cent) in 2002. For 2008, however, the Bank of Canada estimates that the potential GDP growth rate was only 1.7 per cent (down from 2.6 per cent in 2007) while our estimate is

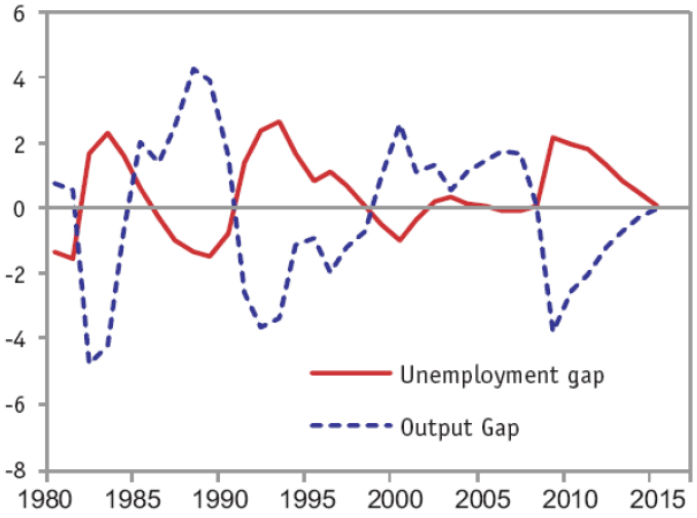
26 For a discussion of trend TFP for industrial countries during financial crises, see Haugh *et al.* (2009).

at 2.4 per cent (slightly lower than our 2007 estimate at 2.5 per cent). Estimates of potential GDP growth by the OECD and Bishop and Burleton (2009) are also in line with our estimates.

Our productivity series is consistent with findings from Statistics Canada for the period 1997–2007, though its data refer to the business sector and the decomposition methodology is somewhat different than ours, requiring caution when comparing the two statistics directly. [27] We also find that TFP growth has increased by an average of 0.4 per cent per year. However, unlike Statistics Canada we find that TFP growth hovers around a 0.4 per cent rate from 1997 to 2007; instead Statistics Canada finds that for the business sector in the period 1997–2000 TFP was growing more strongly at 2 per cent per year, while since 2000 TFP declined by about 0.2 per cent a year. Looking at more historical data, similar to Robidoux and Wong (2003) and Armstrong *et al.* (2002) we find that TFP stalled in the 1980s (contracting at an annual average of rate 0.1 per cent in the period 1977–1988).

Estimated potential output growth lies between 1.5 and 2 per cent during the next five years (Charts 4-5 and Table 2). After being hit severely by the capital growth dynamics and the projected temporary increase in the NAIRU, potential growth converges slowly towards 2 per cent in 2014 – below its pre-crisis average — but consistent with estimates of potential growth in the absence of the crisis. Before the crisis, we had projected that potential growth would fall towards 2 per cent as a result of population aging, stabilizing female labour force participation following a persistently rising trend since the mid-1990s, and the ongoing restructuring of the Canadian industrial structure. The average potential growth rate for 2009–15 is estimated to be 1¾ per cent — around 0.3 percentage point below our estimates for potential growth in the absence of the crisis.

Chart 4
Output and Unemployment Rate Gaps in Canada, 1980-2015



Sources: Haver Analytics and authors' estimates.

1 Unemployment gap is the difference between unemployment rate and the non-accelerating inflation rate of unemployment (NAIRU).

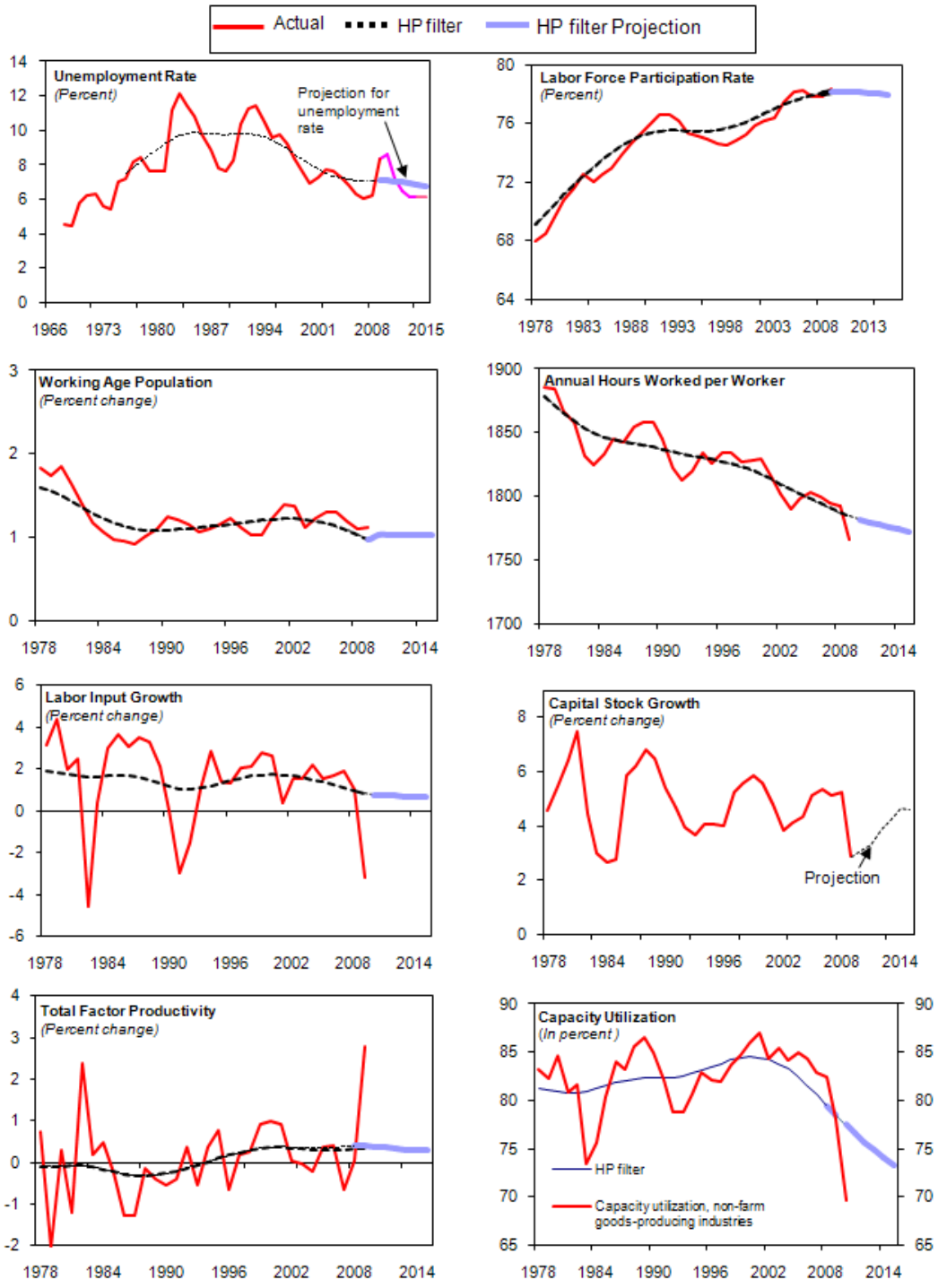
2 Output gap is the difference between actual output and potential output as

The resulting paths for the output gap and the unemployment gap (defined as the difference between actual unemployment rates and the NAIRU) are shown in Chart 4, and closely mimic the performance in the 1980s crisis. The output gap reaches its widest point in 2009 at about similar levels as in the 1982 recession, while the unemployment gap peaks in 2010 (given the usual lags in unemployment dynamics).

Ultimate losses in potential output are in the same range of previous research. As shown in Chart 6, by 2015, potential output is expected to be about 2 per cent (C$31.5 billion) below the counterfactual level produced by assuming a no recession scenario and a gradual decline in potential GDP growth rate from 2.4 per cent in 2008 to 2.0 per cent by 2015 solely driven by demographics (as assumed by the IMF WEO

27 Statistics Canada considers capital services intensity—capital services per hour worked—instead of capital services used in our decomposition.

Chart 5
Potential Output Growth and Components in Canada



Sources: Haver Analytics, WEO, OECD, and authors' calculations.

Table 2

Path for Potential Output Growth Components in Canada[1]

	2005-2008[2]	2008	2009	2010	2011	2012	2013	2014	2015
Potential Growth, per cent change	2.6	2.4	1.5	1.6	1.6	1.8	1.9	2.0	2.0
Capital Services, per cent change	4.0	3.8	1.5	1.8	2.1	2.7	3.1	3.5	3.4
Labour Services, per cent change	1.1	0.9	0.8	0.8	0.7	0.7	0.7	0.7	0.7
NAIRU, percentage points[3]	7.1	7.0	7.1	7.1	7.1	7.0	7.0	6.9	6.8
Labour Force Participation Rate	0.2	0.1	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1
Labour Force Participation Rate, percentage points[4]	78.0	78.1	78.2	78.2	78.1	78.1	78.0	77.9	77.8
Annual Hours Worked per Worker, per cent change[5]	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Working Percentage Population, per cent change[6]	1.1	1.0	1.0	0.9	0.9	0.8	0.8	0.8	0.8
Total Factor Productivity, per cent change	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3
Contributions to Potential Output Growth[1] (percentage points)									
Potential Growth	2.6	2.4	1.5	1.6	1.6	1.8	1.9	2.0	2.0
Capital Services[7]	1.5	1.5	0.6	0.7	0.8	1.0	1.2	1.3	1.3
Labour Services	0.7	0.6	0.5	0.5	0.4	0.4	0.4	0.4	0.4
NAIRU[3]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Labour Force Participation Rate[4]	0.1	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1
Annual Hours Worked per Worker[5]	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Working Age Population[6]	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5
Total Factor Productivity	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3

Sources: Haver Analytics, IMF, OECD, and staff estimates.

1 Output-labour elasticity assumed to be 0.6 and output-capital elasticity assumed to be 0.4, see Sharpe, Arsenault and Harrison (2008).

2 The estimates are the average annual rate of change, not the total per cent change.

3 Non-accelerating inflation rate of unemployment. HP filter of civilian unemployment rate, 15-64 years (seasonally adjusted).

4 Trend labour force participation rate calculated by applying the HP filter of the ratio between labour force and working age population.

5 Trend changes in annual hours work per worker is calculated by applying the HP filter of annual hours worked per worker in the total economy.

6 Working-age population refers to Canadian population 15-64 years of age . Projections as published by Statistics Canada.

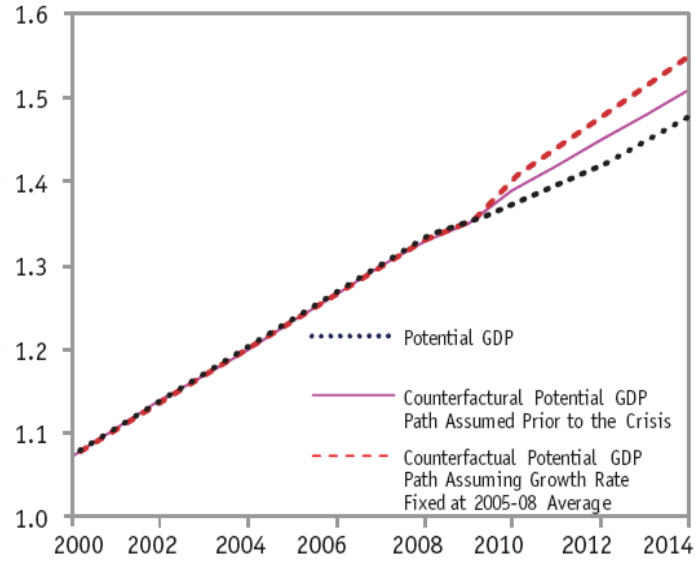
7 Trend capacity utilization is calculated using data from Statistics Canada (detrended by HP-filter).

projections before the crisis erupted).[28] This gap is in line with the ones observed after previous financial crises as documented in Furceri and Mourougane (2009), but a bit lower than the interval estimated by Cerra and Saxena (2008) of 4 to 16 per cent permanent output loss following financial crises in developed and less developed countries.

Canada's potential growth path closely mimics the U.S. performance (Chart 7). European Commission (2009) finds that potential growth rates in the United States and the EU-12 countries (a proxy for the euro area) have generally been trending downwards since the late 1980s, with a pause in the United States in the mid-1990s driven by the ICT-related upsurge, which only lasted until 2000 (Barrera *et al.*, 2009). We

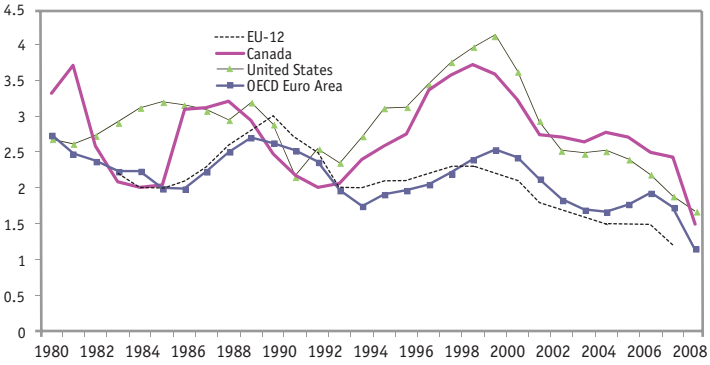
28 The loss in potential output in 2015 would have been around 5 per cent assuming potential output grew from 2009 to 2014 at the same average rate observed in 2005-08.

Chart 6
Potential GDP in Canada, 2000-2014
(Trillions of chained 2002 Canadian dollars)



Source: Authors' calculations.

Chart 7
Potential GDP Growth Rates in Selected Countries/ Regions, 1980-2009
(per cent)



Source: Authors' calculations.

find that Canada's potential growth rate closely mimics the U.S. performance possibly reflecting the close real and financial ties between the two countries.[29] Using European Commission estimates for the United States and the EU-12 countries, we find that potential growth rates in 2008 in the EU-12 area, United States and Canada were substantially lower compared with the year 2000 (1 percentage point lower in the EU-12 countries, 1.4 percentage points lower in the United States, and around 1.2 percentage points lower in Canada). Thus, the current crisis is only exacerbating the last decade's downward trend in potential growth rates. Interestingly, while in the past U.S. potential growth was somewhat above Canada's from 1982 until end-1990s, we find that the situation reversed in the 2000s, and should continue over the medium-term, given the larger negative implications of the recent crisis for the U.S. economy.

Our projections on potential GDP growth are broadly in line with estimates from other researchers (Table 3). Despite some minor differences in our NAIRU forecasts compared to the OECD, the shape of potential growth estimates are essentially the same for 2009 and 2010. Similarly, the Bank of Canada's (2010) estimate of potential growth is only 0.3 percentage points lower than our estimate for 2009 and it is the same for 2010 (the main difference lies in estimates for potential output in 2008). Over the medium term, we have the same potential growth outlook as the Bank of Canada (at around 2 per cent), though we have a more gradual recovery in growth rates than expected by the Bank. Given our higher rate of potential GDP growth for 2008, we have a much higher output gap for 2009 (at around 3¾ per cent of potential) versus 3 per cent by the Bank of Canada. Similarly, our projections are broadly in line with those released by Bishop and Burleton (2009).

A Look at Past Canadian Recessions

The current recession closely mimics those experienced in the 1980s and 1990s in terms of its severity and composition (Tables 4 and 5). In the 1980s and 1990s recessions, capital services were

29 For a discussion of the methodology used to construct the U.S. potential growth series, see Barrera *et al.* (2009). Our estimates of U.S. potential growth differ slightly from theirs, as we incorporate recent revisions in GDP data which occurred after the publication of their study.

Table 3
Estimates of Potential GDP Growth Rate for Canada, 2007-2014
(per cent)

	2007	2008	2009	2010	2011	2012	2013	2014
Authors' calculation	2.5	2.4	1.5	1.6	1.6	1.8	1.9	2.0
Department of Finance Canada	2.8	1.8	1.8	1.4	1.5	1.7	1.9	2.0
Bank of Canada	1.8	1.7	1.2	1.6	1.8	2.0	2.1	…
PBO	2.1	2.1	1.9	2.0	2.0	1.9	1.8	1.7
OECD	2.5	2.4	1.8	1.6	1.7	…	…	…
Bishop and Burleton[1]	…	…	1.2	1.3	1.8	…	…	…

Sources: Parliamentary Budget Officer, Bank of Canada, Finance Canada, OECD, Bishop and Burleton (2009), and authors' calculations.

1 Average for 2012-15 is projected at 2.3 per cent.

the main force behind reductions in potential GDP. In the 1982 recession, private investment fell by 13.7 per cent; an even larger decline happened in 2009 (Table 4). As indicated in Table 5, a large decline in potential GDP growth resulted from this deceleration in capital stock accumulation in 1982, removing more than 1 percentage point from Canada's estimated potential growth. In contrast, labour services and TFP contributions were essentially unchanged during the 1980s and 1990s recessions, as has been the experience during the recent crisis. Moving forward, we expect the recovery in potential GDP to closely mimic past crises. Similar to the 1982 and 1991 recessions, potential growth rate over the medium term does not return to its pre-crisis levels, reflecting the declining trend since the 2000s and demographic developments.

Table 4
Trends in the Growth Rate of GDP and Expenditure Categories in Canada During Recent Recessions
(per cent)

	1982	1983	1991	1992	2009	2010 Proj.
GDP	-2.9	2.7	-2.1	0.9	-2.5	3.0
Consumption	-2.5	2.6	-1.6	1.5	0.4	3.3
Private Investment	-13.7	-0.5	-7.1	-3.0	-16.0	5.1
Government Spending	2.5	1.1	3.1	0.7	5.1	4.4
Exports	-1.6	5.9	1.8	7.2	-14.2	6.8
Imports	-16.1	10.0	2.5	4.7	-13.9	13.4

Sources: Haver Analytics and authors' projections.

Conclusion

This article estimates the impact of the recent financial crisis on potential GDP growth in Canada. According to our estimates, the economic crisis has led to a sharp downward revision in potential growth rate for Canada in 2009 and 2010, making potential growth rate another victim of the Great Recession. Bearing in mind the considerable technical and economic uncertainties (also highlighted among others, in Koopman and Székely, 2009) we find that the immediate impact of the crisis on potential GDP growth rate has been severe — with a fall of around 1 percentage point in 2009. The effects over the medium term are less clear: we expect Canadian potential growth to gradually rise to 2.0 per cent by 2015— a bit lower than its 2008 rate, with the decline partly reflecting the effects of population aging.

What do our estimates imply for policymakers? To start with, data suggest that Canada's output gap is still considerably large, implying that the current accommodating stance for monetary and fiscal policies should stay in place. Moving forward, the crisis would have a permanent impact on Canada's potential GDP level, implying that policies to raise potential growth are essential. These could include promoting private R&D investment (which is low in Canada from an international perspective), facilitating internal trade, reducing for-

Table 5

Path for Potential Output Growth Components During Recent Canadian Downturns[1]

	1981	1982	1983	1984 -87[2]	1990	1991	1992	1993-1996[2]	2008	2009	2010
Potential Growth, per cent change	3.7	2.6	2.1	2.6	2.5	2.2	2.0	2.5	2.4	1.5	1.6
Capital Services, per cent change	7.4	4.4	3.2	4.8	5.4	4.7	4.1	4.3	3.8	1.5	1.8
Labour Services, per cent change	1.7	1.6	1.6	1.6	1.1	1.0	1.0	1.2	0.9	0.8	0.8
NAIRU, percentage points[3]	9.2	9.5	9.7	9.8	9.8	9.8	9.8	9.5	7.0	7.1	7.1
Labour Force Participation Rate, percentage points[4]	71.8	72.4	73.0	74.2	75.5	75.5	75.5	75.5	78.1	78.2	78.2
Annual Hours Worked per Worker, per cent change[5]	-0.3	-0.3	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.1
Working Percentage Population, per cent change[6]	1.4	1.4	1.3	1.2	1.1	1.1	1.1	1.1	1.0	1.0	0.9
Total Factor Productivity, per cent change	-0.1	-0.1	-0.1	-0.2	-0.3	-0.2	-0.1	0.1	0.4	0.4	0.4
Contributions to Potential Output Growth[1]											
Potential Growth	3.7	2.6	2.1	2.6	2.5	2.2	2.0	2.5	2.4	1.5	1.6
Capital Services[7]	2.8	1.7	1.2	1.8	2.1	1.8	1.5	1.6	1.5	0.6	0.7
Stock of Capital	2.9	1.7	1.1	1.7	2.1	1.8	1.5	1.5	2.0	1.1	1.2
Capacity Utilization	-0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.1	-0.5	-0.5	-0.5
Labour Services	1.0	1.0	1.0	1.0	0.7	0.6	0.6	0.8	0.6	0.5	0.5
NAIRU[3]	-0.2	-0.2	-0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Labour Force Participation Rate[4]	0.6	0.5	0.5	0.4	0.1	0.0	0.0	0.0	0.1	0.0	0.0
Annual Hours Worked per Worker[5]	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	-0.1	-0.1	-0.1
Working Age Population[6]	0.9	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.6
Total Factor Productivity	-0.1	-0.1	-0.1	-0.2	-0.3	-0.2	-0.1	0.1	0.4	0.4	0.4

Sources: Haver Analytics; IMF; OECD; and staff estimates.

1 Output-labour elasticity assumed to be 0.6 and output-capital elasticity assumed to be 0.4, see Sharpe, Arsenault and Harrison (2008).

2 The estimates are the average annual rate of change, not the total percent change.

3 Non-accelerating inflation rate of unemployment. HP filter of civilian unemployment rate, 15-64 years (seasonally adjusted).

4 Trend labour force participation rate calculated by applying the HP filter of the ratio between labour force and working age population.

5 Trend changes in annual hours work per worker is calculated by applying the HP filter of annual hours worked per worker in the total economy

6 Working-age population refers to Canadian population 15-64 years of age . Projections as published by Stats Canada.

7 Trend capacity utilization is calculated using data from Statistics Canada (detrended by HP-filter).

eign ownership barriers where possible (including telecommunications, airlines and broadcasting), removing obstacles that hinder elderly labour force participation (aged 65+), and ensuring that incentives do not hinder firms from growing larger.[30]

That said, Canada's outlook for potential growth appears favorable by international comparison. The strong macroeconomic and financial stability frameworks in place have enabled Canada to weather the crisis better than most countries, and would be pivotal in supporting its

recovery in the next few years. The authorities are considering or are already implementing many of the recommendations noted above as highlighted in *Advantage Canada* (Finance Canada, 2006) — the government's economic plan to increase Canada's competitiveness. These include lowering corporate income taxation (at the provincial and federal level) and eliminating capital taxes while they are considering the recommendations of the Competition Policy Review Panel (2008) to enhance competition and productivity.

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30 Pilat (2005) finds that Canada lags many OECD countries in innovative performance and may have some scope for further catch-up. However, he notes that Canadian investment in R&D is unlikely to catch up with the R&D intensity recorded in a number of OECD countries, as it is limited by the structural composition of the economy -i.e. with a relatively small high-tech industry- and a relatively small average firm size. For a more extensive discussion of possible structural reforms that could raise productivity in Canada, see OECD (2004 and 2006) and Bishop and Burleton (2009).

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Appendix: Data Sources

This appendix describes data used in the growth accounting decomposition as given by equations (1) and (2), where output (Y_t) is defined as the total-economy real Fisher chained GDP from Statistics Canada. All trend series have been obtained by smoothing the raw series using the Hodrick-Prescott filter.

Capital Services

Capital services are obtained by multiplying trend capital stock by trend capacity utilization. Trend capital stock is a smoothed version of the net capital stock for the total non-residential economy (volume) available from OECD Economic Outlook No 87 (annual data).[31] The trend capital growth is the growth in the capital stock before the adjustment for capacity utilization rate. Data on capacity utilization in the industrial sector (NAICS: Total industry) are available from Statistics Canada starting in 1988. In order to obtain a longer capacity utilization series, the pre-1988 data are estimated using the growth rates of capacity utilization for Non-farm Goods-Producing Industries.

Labour Services

Labour Services are obtained by multiplying (1-NAIRU) by trend labour force participation rate, trend average annual hours worked per worker and trend working-age population. All data are available from Statistics Canada's Labour Force Survey, where NAIRU is the trend unemployment rate (both sexes, 15 to 64 years); labour force participation rate is the ratio of labour force (both sexes, 15 to 64 years) divided by working- age population (both sexes, aged 15 to 64 years); and average annual hours worked per worker are constructed by multiplying actual hours worked per week (all sectors) by 52 and dividing it by total employment (both sexes, 15 years and over, including self employed). Projections for working-age population are based on the medium-growth scenario Population Estimates and Projections of Statistics Canada, available at: http://www40.statcan.ca/l01/cst01/demo23a-eng.htm.

Trend TFP

Trend TFP level is estimated by applying an HP filter to raw TFP level as estimated in equation (1).

31 The OECD's estimates are based on historical series from the OECD Stocks and Flows of Fixed Capital updated with a perpetual inventory method, using recent investment series and a constant 'scrapping rate'. For more details see Schreyer and Webb (2006).