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A Simulation Model of Federal, Provincial and Territorial Government Accounts for the Analysis of Fiscal-Consolidation Strategies in Canada

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A SIMULATION MODEL OF FEDERAL, PROVINCIAL AND TERRITORIAL GOVERNMENT ACCOUNTS FOR THE ANALYSIS OF FISCAL-CONSOLIDATION STRATEGIES IN CANADA

ECONOMICS DEPARTMENT WORKING PAPER No. 800

By Yvan Guillemette

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ABSTRACT/RESUME

A Simulation Model of Federal, Provincial and Territorial Government Accounts for the Analysis of Fiscal-Consolidation Strategies in Canada

This paper presents a simulation model of the main budget aggregates of federal, provincial and territorial governments in Canada. The general approach is to use a cyclical indicator (output gap), estimate the sensitivity of government revenue and expenditure to this cyclical indicator using historical data, and use projections of the cyclical indicator to simulate budgetary outcomes under various economic scenarios. Provincial/territorial annual output gaps are estimated going back to 1984. These are used to jointly estimate for all governments the historical sensitivities of the main revenue and expenditure categories to provincial/territorial economic cycles using Seemingly Unrelated Regressions. Projections of potential output by province and territory are then made to 2020 and a multitude of paths for the evolution of provincial/territorial output gaps are generated to 2020. These output gap paths serve as bases for simulating medium-term fiscal outcomes under a variety of possible economic scenarios, allowing the construction of probability densities for fiscal outcomes. The paper also contains an analysis of the cyclicality of Canadian governments' fiscal policies between 1984 and 2007. Several jurisdictions are found to have had pro-cyclical fiscal policies over this period.

JEL classification codes: E37; E61; E62; H68
Keywords: Canada; budget; deficit; debt; fiscal policy; consolidation; model; simulation

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Un modèle de simulation des comptes gouvernementaux fédéraux, provinciaux et territoriaux pour l'analyse des stratégies de consolidation fiscale au Canada

Ce document de travail présente un modèle de simulation des principaux agrégats budgétaires des gouvernements fédéral, provinciaux et territoriaux du Canada. L'approche générale consiste à utiliser un indicateur cyclique (écart de production), estimer la sensibilité des revenues et dépenses d'un gouvernement à cet indicateur cyclique en utilisant des données historiques, et utiliser des projections de l'indicateur cyclique pour simuler les résultats budgétaires sous différents scénarios économiques. Des écarts de production annuels sont estimés pour chaque province/territoire depuis 1984. Ceux-ci sont utilisés pour estimer conjointement pour tous les gouvernements la sensibilité historique des principaux postes de revenue et de dépense aux cycles économiques provinciaux/territoriaux en utilisant la méthode des Régressions Apparemment Non-Reliées. Des projections de la production potentielle des provinces et territoires jusqu'en 2020 sont ensuite réalisées et une multitude de trajectoires pour l'évolution des écarts de production sont générées jusqu'en 2020. Ces trajectoires servent à simuler les budgets gouvernementaux à moyen terme sous un grand nombre de conditions économiques plausibles, permettant ainsi l'obtention de densités de probabilités pour les résultats budgétaires. Le document de travail contient aussi une analyse de la cyclicalité budgétaire des différents gouvernements Canadiens entre 1984 et 2007. Plusieurs juridictions semblent avoir opéré une politique fiscale pro-cyclique durant cette période.

Classification JEL : E37; E61; E62; H68
Mots clefs : Canada ; budget ; déficit ; dette ; politique fiscale ; consolidation ; modèle ; simulation

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A Simulation Model of Federal, Provincial and Territorial Government Accounts for the Analysis of Fiscal-Consolidation Strategies in Canada

By Yvan Guillemette[1]

"When the time is right – when our Economic Action Plan has been implemented, our recovery is entrenched, and the private sector forecasts become more certain – we will determine the amount of restraint in the growth of programme spending that will be required to eliminate the deficit". – Federal Minister of Finance Jim Flaherty, 10 September 2009.

Introduction

This paper documents the fiscal projection model used in the 2010 *OECD Economic Survey of Canada* to examine, among other things, the issue identified in the above quote: how much spending restraint will be necessary to eliminate federal and provincial government deficits in Canada. The development of a new tool for fiscal policy analysis beyond those used in the regular *OECD Economic Outlook* (hereafter *Outlook*) is desirable, for two main reasons.

First, it is desirable to have a model which disaggregates the various Canadian jurisdictions. As with the general macroeconomic projections, all fiscal projections for Canada in the *Outlook* are at the general government level, which includes the federal government, provincial and territorial governments, municipal governments as well as the Canada and Quebec Pension Plans (CPP/QPP). In order to consider the fiscal positions and strategies of individual governments more carefully, and analyse tradeoffs and problems related to fiscal federalism, it is helpful to split and perform separate analyses on the federal government and the provincial and territorial governments. It is also useful to abstract from the municipal sector, and to strip out the CPP/QPP as these are operated at arms' length from governments.[2] The model developed here consists of several sub-models: one economic projection model and one fiscal model for each of the provinces and territories, as well as a fiscal model for the federal government. These are used to simulate government revenue and expenditures under a range of possible economic scenarios over the next 10 years. They are also used to analyse the cyclicality of fiscal policy historically. An effort is made to reconcile the main results of the model with Canada-wide results from *Outlook* 87 (May 2010).

1. Economist in the OECD Economics Department. This paper reports on background work for the 2010 *OECD Economic Survey of Canada*, published under the responsibility of the Economic and Development Review Committee. The author is grateful for the valuable comments received on earlier drafts from Christophe André, Alexandra Bibbee, Peter Jarrett and Dave Turner as well as for comments from, and discussions with, officials from Canadian governments. Special thanks go to Françoise Correia for statistical assistance and to Mee-Lan Frank for editorial support.

2. Though not fully funded, according to the latest actuarial reports for these plans, they are expected to be able to meet their commitments without exhausting their reserves for another 40 years (for the QPP) or more (for the CPP), so they are not a source of concern for public finance sustainability in the short to medium term. See Régie des Rentes du Québec (2007) and Office of the Superintendent of Financial Institutions Canada (2007).

Second, while the *Outlook* usually presents only a mechanistic medium-term baseline as an extension of the short-term projections, the model developed in this paper allows simulations of government revenue and expenditure over the medium term (to 2020) under a variety of economic and fiscal assumptions, in either deterministic or stochastic frameworks. The deterministic framework allows the production of point estimates for important fiscal outcomes under chosen economic growth assumptions. But the large uncertainty around economic and fiscal projections over the medium term calls for its explicitly consideration. The stochastic version of the model does this by generating probability distributions for fiscal outcomes given assumptions about fiscal policies and randomly generated GDP growth rates.[3] Such information tells policy makers the likelihood of achieving a particular fiscal outcome – as determined for instance by a fiscal rule or objective – and can thus be useful in the fiscal planning process.

The structure of the paper is as follows: section 1 explains the estimation of historical output gaps by province/territory; section 2 describes the estimation of budget elasticities with respect to these output gaps, the calculation of historical cyclically adjusted budget balances and provides a simple analysis of historical fiscal stances; section 3 develops supply-side projections; section 4 develops demand-side projections; and section 5 describes the baseline assumptions and results from the model. A final section offers concluding remarks. It must be emphasised from the start that because of the poor timeliness of some of the necessary data and because of modelling constraints, the model is unable to give accurate fiscal projections for any one year. Instead, its purpose and usefulness is in tracing out likely paths for important fiscal variables under different economic and policy assumptions to derive policy recommendations on the required degree and the timing of fiscal consolidation.

1. Estimation of historical potential output

As in the *Outlook*, output gaps are used as cyclical indicators in the analysis of budget stances and for fiscal projections. To calculate output gaps, potential output is estimated over the period 1981 to 2008 for each province and territory, 1981 being the earliest year for which Provincial Economic Accounts data are available. Because of the short existence of separate Northwest Territories and Nunavut, the two territories are combined to obtain time series long enough for analysis.

Two well-known approaches are used to estimate potential output over history, the production-function approach (structural) and the Hodrick-Prescott (HP) filter approach (non-structural). The production-function approach is broadly similar to the method used in the *Outlook* and described in Beffy *et al.* (2006), the main distinction being that simple capital stock estimates by province are used instead of capital services estimates. The final historical estimate of potential output used is the average of the two methods. Because potential output is unobservable and estimates of it are necessarily imprecise, combining two estimates should smooth out idiosyncrasies in either method and produce a more reliable measure. For the territories, however, because not all of the data necessary for the production-function approach exist, only the HP-filtering method is used. An effort is made, as described below, to ensure that once aggregated for the country as a whole, historical potential output corresponds closely to the latest *Outlook* estimate.

1.1. The production-function approach

The production-function approach uses a simple, two-factor, constant-returns-to-scale, Cobb-Douglas production function with capital and labour inputs and Harrod-neutral labour-augmenting technical

3. For earlier applications of stochastic methods to the study of fiscal planning under uncertainty, see Hermanutz and Matier (2000), Hostland (2001), Robson (2006) and Robbins, Torgunrud and Matier (2007).

progress. The function describes total-economy production, and not only the business sector. Using usual *Outlook* mnemonics where applicable, real GDP is defined as:

$$GDPV = (ELEFF \cdot ET \cdot HRS)^{\alpha}(K)^{1-\alpha} \quad [1]$$

where ET denotes total employment (the Labour Force Survey measure), K represents the provincial capital stock, and HRS is the annual number of hours worked per employee. $ELEFF$ represents multi-factor productivity (or labour efficiency), which is not directly observable and is therefore computed as a residual. Finally, α is the average wage share over the sample period. It is calculated as total compensation of employees divided by GDP net of taxes on production and imports.

The employment term can be further broken down as follows. The participation rate ($LFPR$) is defined as the labour force (LF, the sum of total employment and the number of unemployed persons, $ET + UN$) divided by the working-age population ($POPT$, population aged 15 to 64), both from the Labour Force Survey. Introducing also the unemployment rate (UNR) as the number of unemployed people divided by the labour force, [1] becomes:

$$GDPV = (ELEFF \cdot POPT \cdot LFPR \cdot (1 - UNR) \cdot HRS)^{\alpha}(K)^{1-\alpha} \quad [2]$$

The unemployment rate is assumed to have both a permanent (or trend) component and a transitory component. The trend component, the non-accelerating inflationary rate of unemployment (*NAIRU*), is estimated in two steps. First, a structural rate of unemployment ($UNRS$) is estimated using the method described in Elmeskov and MacFarlan (1993), whereby

$$UNRS = UNR - (\Delta UNR / \Delta^3 logW)\,\Delta^2 logW \quad [3]$$

Where Δ is the first-difference operator and W is total compensation per hour worked. Because a third difference is used, the first $UNRS$ estimate is for 1984. This series is then smoothed using a HP filter (with a smoothing parameter of 100, see the subsection below for more on the HP-filter technique) to produce the *NAIRU* estimate. To reduce the end-point problem associated with the record-low unemployment rates observed in a number of provinces in 2007 and 2008, the *UNRS* series is extended over the entire projection period (to 2020) by assuming that it goes back to its level of a few years ago (when the output gap was close to zero) within a few years and then stays constant. The HP filter is then applied over the entire period 1984-2020, which produces a projection (to be used later) as well as historical estimates. Note that because the first $UNRS$ estimate is for 1984, the production function approach only yields estimates of potential beginning in 1984.

The computation of historical potential output is based on the following steps and assumptions:

- $ELEFF$ is obtained from solving out [1];
- $ELEFF$ and HRS are then de-trended using a HP filter with a smoothing parameter equal to 100;
- $LFPR$ is de-trended in the same way over both the historical and projection periods (see section 3.1 for projections of $LFPR$).
- K is adjusted to make it correspond more closely to the capital services estimates used for Canada in the *Outlook*. This admittedly *ad hoc* adjustment is necessary only for recent years (2004 to 2008), until 2004 the two series line up well. The main reason why the two capital series would otherwise differ after 2004 is related to the recent large capital investments in the resource sector, particularly in the province of Alberta where oil sands are being developed. Although the

capital stock has increased significantly, not all recent additions to it are yet capable of yielding productive capital services. For instance, it can take several years of capital investment in oil sands before oil can actually be extracted and sold. Because *K* is not smoothed, without this adjustment, all additions to it in recent years translate directly into higher potential output, making potential too high relative to *Outlook* estimates.[4] The two are reconciled by adjusting capital stock estimates downward by a factor no greater than 3% cumulatively over 2004-2008.

- Finally, the level of potential (*GDPVTR*) is given by [2] using the filtered and adjusted variables, apart from *POPT*, as inputs in the production function:

$$GDPVTR = (ELEFFT \cdot POPT \cdot LFPRT \cdot (1 - NAIRU) \cdot HRST)^{\alpha} (KA)^{1-\alpha} \quad [4]$$

where *ELEFFT*, *LFPRT* and *HRST* are, respectively, the trended counterparts of *ELEFF*, *LFPR* and *HRS*, and *KA* is the adjusted capital stock. Thus [4] relates the evolution of potential output to trends in total factor productivity (*ELEFFT*), the quantity of labour (or potential employment $ETPT = POPT \cdot LFPRT \cdot (1 - NAIRU)$), the number of hours worked per employee (*HRST*) and the quantity of capital used in the production process.

1.2. The Hodrick-Prescott filtering approach

In order to reduce the importance of any large errors made in the estimation of potential output using the production function approach, a second, simpler approach is used to produce another estimate. Results from the two approaches can then be compared. If they are similar, one can be reasonably certain that true, though unobservable, potential lies not too far from these estimates. If the two estimates diverge substantially over some period of history, then averaging the results of the two methods should, unless both are biased in the same direction, produce a more precise estimate.

This second method, the only one used for the territories, is the Hodrick-Prescott (HP) filtering approach. The HP filter is a smoothing method that is widely used among macroeconomists to obtain a smooth estimate of the long-term trend component of a series. Technically, the HP filter is a two-sided linear filter that computes a smoothed version of the original series by minimising the variance of the original series around the smoothed one, subject to a penalty that constrains the second difference of the smoothed series. The smoothing parameter determines this penalty and thus determines the smoothness of the series. The most-often used smoothing parameter for annual data is 100, and this is the value used here, the same that is used to de-trend variables in the production function approach. Indeed, because several of the inputs in the production function approach are HP filtered, this second method does not differ greatly from the first one. The difference is that while the HP filter is applied to some of the inputs of the production function, here it is applied directly to historical real GDP estimates from the Provincial Economic Accounts. This method produces estimates of potential output for the entire 1981-to-2008 period. The main advantage of the production-function method over the direct HP-filtering method is that the first one provides a better basis for projecting potential output in the future, as will be done below.

1.3. Output-gap estimates

Equipped with potential output estimates, historical output-gap estimates are calculated as:

4. Another way around this problem would simply be to smooth *K*, but doing so would somewhat bias historical estimates of potential output. As the Congressional Budget Office (2001) argues, "unlike the labour input, the capital input does not need to be cyclically adjusted to create a 'potential' level – the unadjusted capital input already represents its potential contribution to output".

$$GAP = \frac{GDPV}{GDPVTR} - 1 \qquad [5]$$

For each province, Figure 1 shows historical output gaps according to the two methods just outlined and the average of the two, which is used as the final output-gap estimate. Because the production-function approach yields estimates only starting in 1984, this final average estimate is likewise available only from 1984. For the territories, the figure shows only the HP-filter estimates, which start in 1981 and are used as the final estimates. The figure also shows the aggregate output gap for the country as a whole compared to *Outlook* 87 (EO87). The two are very similar.

2. Estimation of budget sensitivities to the economic cycle and of cyclically adjusted budget balances

Historical output-gap estimates can be used to estimate the sensitivity of budget balances to cyclical fluctuations around trend output growth. These sensitivity estimates can then be used to calculate what part of a government's actual budget balance reflects the influence of permanent factors (structural budget balance) and what part reflects temporary cyclical factors. Knowing how variations in economic activity affect fiscal positions is important to formulate short- and medium-term fiscal policies. For instance, mistakenly ascribing a cyclical increase in revenue to structural changes could encourage a government to introduce a costly permanent programme, producing a long-lasting policy error and a structural deficit. This section explains the estimation of revenue and spending elasticities in the model and then uses this information to estimate historical cyclically adjusted budget balances and to assess the historical fiscal stances of Canadian governments. The methodology broadly follows the one used in the *Outlook* and explained in Girouard and André (2005), but with a number of differences. Where relevant, the results obtained here are compared to those used in the *Outlook*. Unlike in the *Outlook*, however, most of the analyses below show fiscal outcomes separately for the federal government and for each provincial/territorial government, not including the municipal sector. When results for the total government are shown, the municipal sector is added back in but without any cyclical adjustments, that is, municipal-sector revenue and expenditure are assumed to be non-cyclical. Also, unlike in the *Outlook*'s general-government sector, the CPP and QPP are left out of the total government.

2.1. Government accounts data

The budget-accounting framework used is that of the national accounts. Estimates of provincial-government-sector revenue and expenditure are taken from Statistics Canada's Provincial Economic Accounts (PEA). These accounts contain estimates of government revenue and expenditure separately for the federal government broken down by source/destination province, for provincial/territorial governments and for local governments. These accounts are chosen because they provide a consistent accounting framework across jurisdictions, because they are consistent with the estimates of government assets and liabilities which also enter the model, and because they correspond to the accounting framework used in the *Outlook*. One major downside, however, is that government accounts data in the PEA are currently available only for years until 2007.

Figure 1. **Historical output gap estimates**

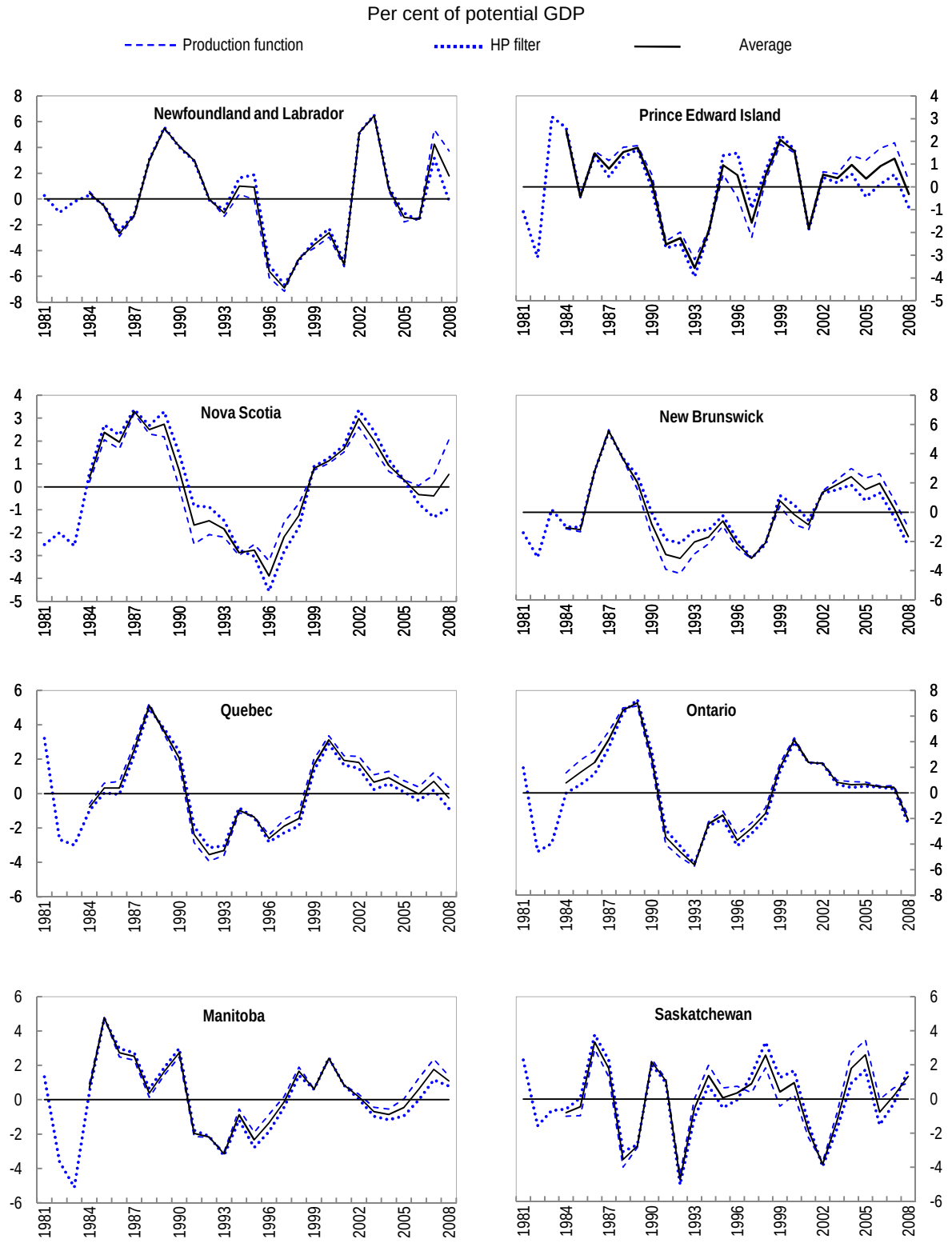
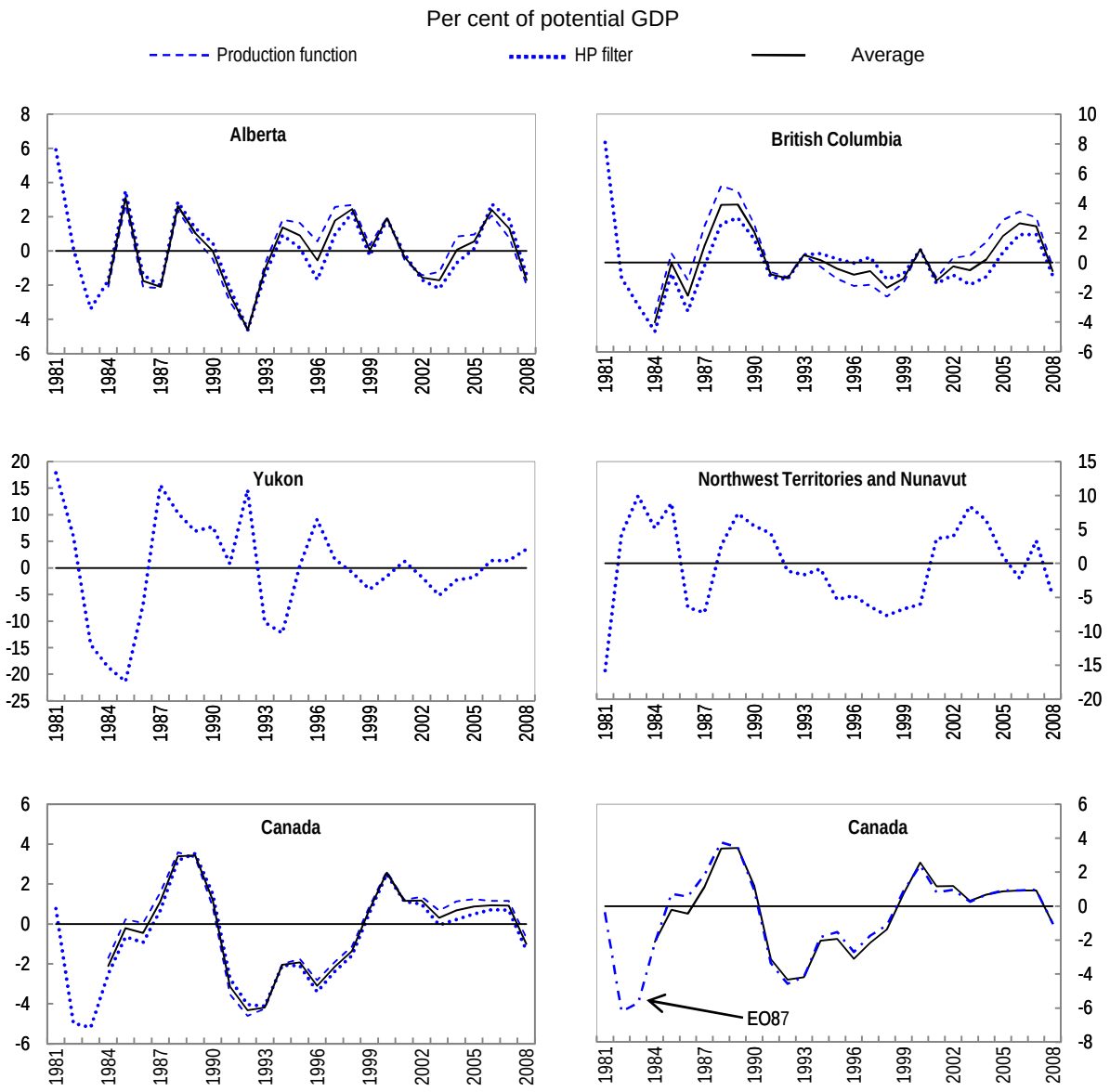


Figure 1. **Historical output gap estimates** (*continued*)



In order to compute cyclically adjusted budget balances for 2008, and provide a sounder basis for eventual fiscal projections beyond that, an effort is made to extend PEA figures to 2008 using other sources of data on government finances. Quarterly data on federal-government revenue and expenditure are made available in the income and expenditure sub-sector accounts as part of regular national-accounts releases. These releases are used to update the federal-government figures in the PEA up to 2009. Because historical figures in the income and expenditure sub-sector accounts do not correspond exactly to those of the PEA, however, only growth rates for 2008 and 2009 are used and applied to actual PEA figures.

The task is more complicated for provincial-government revenue and expenditure, however, because provincial figures in the quarterly national-accounts releases are not disaggregated by province. Instead, when possible, Statistics Canada's Federal, Provincial and Territorial Government Revenue and Expenditure statistics on a Financial Management System (FMS) basis are used. These statistics have the advantage of being more up-to-date than the PEA, with data available up to fiscal year 2008/09. They are

also based on a consistent accounting framework across provinces, though different from the national-accounts framework. When FMS figures are unavailable or do not correspond well to PEA concepts, official historical figures from public accounts or budget documents are used. The main disadvantage of budget documents is that accounting frameworks vary between provinces, and they are different from the national-accounts framework.[5] Budget documents sometimes present fiscal projections only on a cash basis, under which transactions are recorded when cash is received or spent. In the PEA, transactions are recorded on an accrual basis. For instance, under the accrual basis, the expenditures related to the construction of infrastructure would be allocated over the years when the infrastructure is built, regardless of when the cheques are cashed by the construction firm. Another difference is that in both the FMS and in budgets figures are presented on a fiscal-year basis, as opposed to a calendar-year basis as in the PEA. Given comparability problems between the PEA and sources of more recent fiscal results, only 2008 growth rates are used and applied to actual 2007 levels in the PEA. Also, no fiscal-to-calendar-year adjustments are made. The main updates are:

- The growth rates of 'net current expenditure on goods and services' and 'current transfers to businesses' are assumed to be equal to the growth rates of 'programme expenditure' or 'direct programme spending' (so as to exclude interest payments) as reported in budget documents.

- The growth rates of 'investment in fixed capital and inventories' are assumed to be equal to the growth rates of 'capital expenditure' or 'acquisition of tangible capital assets' as reported in budget documents, usually as part of non-budgetary transactions in statements of change in net debt.

- The growth rates of 'direct taxes from persons', 'direct taxes from corporations and government business enterprises', 'contributions to social insurance plans', 'taxes on production and imports', 'investment income other than royalties', 'royalties',[6] 'current transfers from federal government' and 'interest on the public debt' are calculated from FMS figures.

- Other revenue and expenditure components are projected as explained below in section 4. The significant items are provincial 'current transfers to local governments', which are assumed to grow at their average 1997-2007 growth rates, and 'current transfers to persons', which are projected according to the methodology described in section 4 using the elasticities computed in section 2.3 below.

Table 1 shows the growth rates derived from the foregoing methods and used to extend provincial figures in the PEA to 2008. Because of the caveats outlined above, these figures can by no means be considered precise estimates of what the PEA will eventually show when they are released. For this reason, the elasticities computed in the following subsections are estimated using only actual PEA figures up to the end of 2007.

5 . For more on the differences between the national accounts and the public accounts accounting frameworks, see Government of Canada (2005).

6. Note that in both the PEA and FMS, royalties do not include offshore royalties for the provinces of Newfoundland and Labrador (except royalties from the Hibernia project) and Nova Scotia. Offshore royalties are collected by the federal government and then transferred back to these provinces. They are thus recorded as federal transfer payments. This accounting feature has implications for the cyclicality estimates and projections below.

Table 1. **Assumptions to update Provincial Economic Accounts for 2008**

Per cent growth rates

Growth rate of…	NL	PE	NS	NB	QC	ON	MB	SK	AB	BC	YT	NT&NU
Updates from provincial budget documents												
… net current expenditure on goods and services and transfers to businesses	2.5	4.3	6.6	7.6	6.8	0.8	4.9	22.1	10.4	4.0	9.8	9.0
Updates from FMS statistics												
… direct taxes from persons	5.8	1.7	2.3	5.3	-1.4	0.5	6.5	-1.9	4.1	-10.6	13.3	21.5
… direct taxes from corporations and government business enterprises	1.5	0.0	-9.5	-54.9	-8.2	-39.4	3.5	-11.7	-19.6	-7.7	0.0	-33.0
… contributions from social insurance plans	1.4	3.2	-4.4	-8.7	2.5	3.5	5.3	4.3	2.1	2.0	4.0	81.0
… taxes on production and imports	1.3	3.1	2.7	18.5	3.4	1.7	6.6	9.2	1.6	3.5	15.4	-2.6
… investment income other than royalties	-17.7	0.0	2.8	-1.4	1.2	8.7	-13.9	75.2	-38.6	-11.7	-13.8	-2.2
… royalties	-9.4	n/a	2.8	28.8	27.2	1.0	-8.1	58.6	11.4	3.0	0.0	n/a
… current transfers from federal	38.2	5.7	-1.3	1.6	3.6	-4.4	4.4	7.0	34.8	2.7	4.4	1.9
… debt service	-5.8	-4.8	-2.9	2.9	1.0	-1.0	6.9	-1.8	-3.0	-4.4	0.0	11.1
Other updates												
… current transfers to local governments	2.8	5.2	2.9	1.0	4.4	5.8	1.7	5.3	8.0	2.0	-0.4	6.1
… current transfers to persons	9.7	12.0	3.4	3.4	1.6	6.5	5.1	23.5	24.2	6.4	6.4	21.0

2.2. Revenue elasticities

Revenue elasticities are estimated for four broad categories of revenue found in the Provincial Economic Accounts: direct taxes from persons, direct taxes from businesses and government business enterprises, contributions to social insurance plans and taxes on production and imports. The elasticity of a revenue category with respect to the output gap is usually separated into two components:

$$\varepsilon_{R,GAP} = \varepsilon_{R,B} \cdot \varepsilon_{B,GAP} \qquad [6]$$

where $\varepsilon_{R,B}$ is the elasticity of revenue with respect to the relevant base, and $\varepsilon_{B,GAP}$ is the elasticity of this base with respect to a cyclical indicator, here the output-gap estimates computed in section 1. This approach leaves out other sources of cyclicality in government revenue, such as asset-price cycles, unless these are perfectly correlated with the production cycle captured by the output gap. To the extent they are not, using only the output gap as a cyclical indicator will tend to underestimate the true cyclicality of total government revenue.

2.2.1. Elasticity of direct taxes from persons

For personal income taxes, the relevant tax base is taken to be total personal income, which includes employment income, business income, investment income, income from government transfers and all other sources of income. On personal income tax returns, it corresponds to total income assessed before deductions. The data on personal income and tax payable by province come from the Canada Revenue Agency's (CRA) final sample file for individual tax returns for the 2006 tax year (Canada Revenue Agency, 2009).[7] For provincial tax payable in Quebec, the only province operating a separate tax collection system, the data are from Government of Quebec (2009). First, the elasticity of tax payable (*TAX*) relative to total personal income (*TPI*) is calculated as:

$$\varepsilon_{TAX,TPI} = \frac{\sum_k \gamma_k MA_k}{\sum_k \gamma_k AV_k} \qquad [7]$$

7. These data present detailed profiles of Canadian taxfilers based on a stratified random sample of individual tax returns. The report for the 2006 tax year was produced using a sample of 493 492 returns and represents the 24 141 699 returns that were filed in 2007 for the 2006 tax year.

where γ_k is the weight of total-income-bracket k in total income assessed. MA_k is the marginal income tax rate and AV_k is the average income tax rate in that bracket. Eighteen income brackets are used. The 2006 marginal income tax rates by income bracket, tax system (federal or provincial/territorial), type of income (dividends, capital gains and all other income) and jurisdiction are taken from the website *taxtips.ca*. For each income bracket, a weighted average of personal marginal income tax rates on different types of income is used with the weights calculated as the share of each type of income in total income.[8] Average tax rates are computed directly from the CRA data as provincial or federal tax payable divided by total taxable income. Table 2 shows the resulting elasticities of federal and provincial tax with respect to total personal income for each province and for the federal government.

Table 2. **Elasticities for cyclical government revenue and expenditure**[1]

Elasticity of…	NL	PE	NS	NB	QC	ON	MB	SK	AB	BC	YT	NT &NU	Fe-deral
Direct taxes from persons													
… provincial personal income tax with respect to total personal income (1)	2.0	2.1	2.0	2.1	2.1	1.8	2.1	1.9	1.7	1.9	2.1	2.3	n.a.
… federal personal income tax with respect to total personal income (2)	2.2	2.2	2.1	2.2	2.0	1.9	2.1	2.0	1.7	1.9	2.1	2.0	n.a.
… total personal income with respect to the output gap (3)	0.5	0.4	0.7	0.2	0.2	0.4	0.7	0.8	0.5	0.3	0.1	0.5	n.a.
… provincial personal income tax with respect to the output gap (1) X (3)	0.9	0.8	1.4	0.4	0.4	0.7	1.4	1.4	0.8	0.7	0.2	1.0	n.a.
… federal personal income tax with respect to the output gap (2) X (3)	1.0	0.9	1.4	0.4	0.4	0.7	1.3	1.5	0.8	0.6	0.2	0.9	0.6
Direct taxes from corporations and government business enterprises													
… corporate income tax with respect to the output gap	1.6	1.1	1.1	2.2	1.8	1.8	1.9	1.5	1.5	1.9	2.0	1.6	1.5
Contributions to social insurance plans (scaling factor 2.7)													
… contributions to social insurance plans with respect to earnings (4)	0.5	0.5	0.5	0.5	0.6	0.4	0.5	0.5	0.4	0.4	0.4	0.3	n.a.
… earnings with respect to the output gap (5)	0.4	0.8	1.1	0.3	0.6	0.6	0.4	0.4	0.5	0.4	0.4	0.6	n.a.
… contributions to social insurance plans with respect to the output gap scaled (4) X (5) X scale factor	0.6	1.2	1.4	0.4	0.9	0.6	0.5	0.5	0.6	0.5	0.4	0.5	0.6
Taxes on production and imports													
… federal taxes on production and imports with respect to personal expenditure on goods and services (6)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	n/a
… personal expenditure on goods and services with respect to the output gap (7)	0.6	0.4	0.6	0.0	0.3	0.4	0.4	0.4	0.3	0.4	0.0	0.2	n.a.
… federal taxes on production and imports with respect to the output gap (6) X (7)	0.6	0.4	0.6	0.0	0.3	0.4	0.4	0.4	0.3	0.4	0.0	0.2	0.3
… provincial taxes on production and imports with respect to the output gap	0.6	0.7	1.5	1.1	0.3	0.7	0.7	0.0	1.3	0.4	0.0	0.0	n.a.
Investment income due to royalties from natural resources													
… investment income with respect to non-energy commodity prices	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
… investment income with respect to energy commodity prices	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.5	0.0	0.0	0.0	0.0
Current transfers to persons													
… transfers to persons with respect to the output gap	0.0	-4.5	0.0	0.0	0.0	-1.3	0.0	0.0	-2.1	0.0	-0.5	0.0	-1.5
… transfers to persons with respect to the previous year's output gap	0.0	0.0	-3.9	0.0	-1.5	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0

1. See the Appendix for detailed estimation results.

Second, the elasticities of total personal income with respect to output gaps are estimated using time series regressions. The following equations (with time subscripts and error terms omitted) are estimated:

8. One complication is that marginal tax rates are given for taxable income only, and not for total income. After verifying that in many cases average taxable income falls within the total income bracket (but not always, in which case it always falls within the next lowest bracket), and verifying that using the marginal income tax rate of the next lowest tax bracket does not materially affect the results, the simplifying assumption that marginal tax rates for taxable income can be applied to total income is made.

$$\Delta \log \frac{TPI_i}{GDP^*_i} = \beta_{0_i} + \beta_{1_i} \Delta log \frac{GDP_i}{GDP^*_i} \quad \text{for province/territory } i = 1 \text{ to } 12 \quad [8]$$

$$\Delta \log \frac{\sum_i TPI_i}{\sum_i GDP^*_i} = \beta_2 + \sum_i \left(\frac{GDP_i}{\sum_i GDP_i} \beta_{1_i} \right) \Delta log \frac{\sum_i GDP_i}{\sum_i GDP^*_i}$$

where GDP_i is actual nominal GDP and GDP^*_i is nominal potential GDP obtained from applying actual GDP deflators to the average of the two estimates of real potential output from section 1. The β_{0_i} and β_2 are constants and the β_{1_i} are the elasticities of interest. The subscript i indexes provinces and territories, so [8] is a system of 13 equations, one for each of the 12 provinces and territories and one "aggregate" equation. The last equation does not estimate any new parameter of interest, but it helps to obtain more precise estimates from the 12 other equations. It simply relates the aggregate variation in total personal income as a share of potential GDP for the country as a whole to the Canada-wide output gap using a weighted average of the elasticity coefficients estimated for the 12 individual jurisdictions. The weights used are the GDP shares of the different jurisdictions. The system of 13 equations is estimated using the Seemingly Unrelated Regression (SUR) method. The elasticities thus estimated appear in Table 2 (detailed estimation results are in Table A1 in Appendix). The SUR method, also known as the multivariate regression, or Zellner's, method, estimates the parameters of the system accounting for heteroskedasticity and contemporaneous correlation in the errors across equations. Contemporaneous correlation can be expected because economic cycles tend to coincide across provinces. Because potential output estimates start in 1984, and the time series regressions are in first-difference, the sample size only runs from 1985 to 2008, so there are only 24 data points per regression. The small sample size makes it hard to obtain precise estimates, another reason to use a full-information systems method such as SUR to make use of all available information.

As a third step, the elasticity of direct taxes on persons is calculated by multiplying the result of [7] with that of [8] for each province and territory. For federal personal income tax, the federal income tax elasticities by province from [7] are used with the provincial total compensation elasticities from [8] to obtain per-province federal income tax elasticities. The estimated elasticities appear in Table 2. Overall, for the federal government, a 1% increase in the output gap leads to a 0.7% increase in federal personal income tax revenue. This elasticity is lower than the 1.1 personal income tax elasticity used in *Outlook* calculations for Canada, which is the result of an elasticity of personal income tax revenue with respect to personal earnings of 1.6 and an elasticity of earnings with respect to the output gap of 0.7. Besides differences due to imprecision in estimation, the main conceptual difference is that the methodology here uses total personal income as opposed to only earnings. Because of government transfers and other sources of income, it is not surprising that the estimated elasticities of personal income with respect to output gaps – which average around 0.4 – are lower than that of only earnings. Personal income tax systems in Canada tax most sources of income in addition to earnings, so it makes more sense to use an elasticity that applies to all sources of income. The elasticities of personal income tax revenue with respect to personal income – which average approximately 2 – are closer to the 1.6 used in the *Outlook*. One would not expect a big difference here since a dollar of earnings is a dollar of income. Part of the difference probably comes from the use of different base years. The currently used *Outlook* estimate was derived from the 2003 federal tax code, whereas the estimate for the current model was derived from 2006 tax data. Changes to personal income tax systems between these two years have probably increased the elasticity somewhat – for example, through increases in basic personal amounts. The rest of the difference may be due to the use of different levels of aggregation and to imprecision in estimation. Note that, ideally, to take into account changes in tax systems through time, different elasticities corresponding to different tax years would be used for historical cyclical adjustments, and the latest estimate would be used for fiscal projections on a business-as-usual basis. However, for simplicity, and because the data used above are not available for all historical tax years, only the 2006 estimates will be used below for both historical adjustments and projections, just as only the 2003 elasticity is used in the *Outlook*.

2.2.2. Elasticity of direct taxes from businesses and government business enterprises

Under the assumption that the corporate tax base can be approximated by the profit share of GDP (or one minus the labour share of GDP, denoted in section 1.1 by α) and the assumption of proportionality between the corporate tax base and corporate tax proceeds (so that the first right-hand-side term in [6] is one), the elasticity of direct taxes from businesses with respect to the output gap for each province and territory can be estimated with a system of 13 equations identical to [8] where total personal income (TPI_i) is replaced by profits $(1-\alpha_i)GDP_i$. The estimated elasticities (β_{1_i}) appear in Table 2 (detailed regression results are in Table A1 in Appendix). Though in reality there are small differences in the corporate tax regimes of provinces versus that of the federal government, here the elasticity of federal business taxes collected in a given province is assumed equal to the elasticity of provincial business taxes collected in that province. Hence, consistent with the "aggregate" equation in [8], the elasticity of federal corporate tax revenue is a weighted average of provincial elasticities. This average comes out to 1.5, very close to the 1.6 estimate used in *Outlook* calculations for Canada.

2.2.3. Elasticity of contributions to social insurance plans

Here the relevant contribution base is taken to be earnings, defined from tax return data as employment income, commissions from employment and other employment income. The data again come from the CRA's final sample file for individual tax returns for the 2006 tax year. The elasticity of all contributions to social insurance plans with respect to earnings for provinces and the federal government is assumed to be equal to the elasticity of Employment Insurance (EI) contributions to earnings, because like EI contributions, other social-insurance contributions are usually levied on earnings at a flat rate up to a ceiling. First, the elasticity of EI contributions with respect to earnings is calculated for each province using a formula identical to [7] except that EI contributions replace tax payable and earnings replace total personal income. The γ_k weights become the weights of earnings-bracket k in total earnings, MA_k is the marginal EI contribution rate and AV_k is the average EI contribution rate. The same 18 income brackets that were used in [7] are used. The marginal EI contribution rate is set at the 2006 employee rate of 1.87% up to total income of CAD 40 000. Average EI contribution rates are computed directly from the CRA data as employee EI contributions divided by total earnings. The resulting elasticities of contributions to earnings average about 0.5, somewhat lower than the 0.8 estimate used in *Outlook* calculations for Canada, which is based on 2003 data.

Second, the elasticities of total compensation with respect to output gaps are estimated for all provinces/territories using time series regressions. A system of equations identical to [8] is estimated by SUR except that total personal income (TPI_i) is replaced by wages, salaries and supplementary labour income from the Provincial Economic Accounts. The estimated elasticities for both steps appear in Table 2 (detailed regression results are in Table A1 in Appendix). These elasticities, which average about 0.5, are also somewhat lower than the 0.66 elasticity of the wage bill with respect to the output gap used in the *Outlook* for Canada. The source of the difference is hard to establish, however. Without any adjustment, the elasticity for the federal government, which stems from aggregating provincial elasticities, would be 0.2, three times lower than the corresponding *Outlook* elasticity of 0.6, the result of both sub-component elasticities being lower. Because this overall elasticity appears too low, overall provincial elasticities are scaled up by a factor of 2.7 so that the national aggregate elasticity corresponds to the *Outlook* estimate. This adjustment preserves the inter-provincial proportional differences in elasticities.

2.2.4. Elasticity of taxes on production and imports

For the federal government, the federal goods and services tax (GST), a value-added tax, is responsible for almost all revenue from taxes on production and imports, so the consumption tax base is approximated by personal expenditures on goods and services from the Provincial Economic Accounts,

and proportionality between this base and federal consumption tax proceeds is assumed (so that the first right-hand-side term in [6] is one).[9] The elasticity of federal taxes on production and imports with respect to the output gap for each province and territory can then be estimated with a system of 13 equations identical to [8] except that total personal income (TPI_i) is replaced by personal expenditures on goods and services. The estimated elasticities (β_{1_i}) appear in Table 2 (detailed regression results are in Table A1 in Appendix). Only those statistically significant at the 10% level are kept, so for the Yukon it is set to zero, meaning that personal expenditure on goods and services do not vary systematically with the cycle. The elasticity of federal consumption tax revenue is thus a weighted average of provincial elasticities. At 0.3, it is more than three times lower than the corresponding elasticity used in *Outlook* calculations for Canada as a whole, which is set to 1 by assumption. An elasticity significantly less than 1 makes sense for the federal government, because among aggregate demand components, personal expenditure on goods and services is typically relatively resilient to the economic cycle, as exemplified for instance by the last downturn.

The elasticity of provincial consumption tax proceeds cannot be assumed equal to the elasticity of federal consumption tax proceeds in that province, however, for two reasons. First, while some provinces have a value-added tax harmonised with the federal GST, not all provinces do. For those with a retail sales tax, this assumption would bias the elasticity of provincial taxes on production and imports downward, because retail sales taxes also apply to business purchases of intermediate inputs, which tend to be more sensitive to the cycle than personal expenditure. Second, at the provincial level, taxes on production and imports include levies other than indirect sales taxes. For instance, although Alberta does not have a sales tax, it still collected about 18% of its 2008 total revenue in the form of taxes on production and imports. Therefore, the elasticities of provincial taxes on production and imports with respect to the output gap are estimated using a system of 12 equations similar to [8] but without the 13th, aggregate, equation and with total personal income (TPI_i) replaced by provincial taxes on production and imports. The estimated elasticities (β_{1_i}) appear in Table 2 (detailed regression results are in Table A1 in Appendix). For provinces where the estimated elasticities are not statistically significant at the 10% level, then if they have either their own value-added tax (Quebec) or one harmonised with the federal GST (*e.g.* Newfoundland and Labrador), the elasticity is set equal to that estimated above for federal taxes on production and imports. In the case of British Columbia, the estimated elasticity is also not statistically significant, but because the province harmonised its provincial sales tax with the federal GST effective 1 July 2010, it is helpful for projection purposes to likewise set its elasticity equal to the federal one.[10] Elasticities for Saskatchewan, the Yukon and the Northwest Territories remain at zero. For the two territories, this outcome is not so surprising since they do not have a sales tax. The simple average of the resulting non-zero provincial elasticities is 0.8, in line with common estimates of consumption tax elasticities.

2.2.5. Elasticity of natural-resource royalties to commodity prices

For provinces that receive a significant share of revenue in the form of natural-resource royalties, it is useful to identify transitory components of the fiscal balance that are related to fluctuations in commodity prices. The approach here considers only the influence of fluctuations in commodity prices on such royalties. It does not consider many other sources of government revenue indirectly affected by the price of resources. For instance, exceptionally strong commodity prices are likely to lead to higher tax revenue, most immediately from the companies directly involved in extracting or producing the commodities, but also less directly if the consequent rise in the terms of trade increases real incomes more broadly as the

9. Regressions not reported here confirm that the elasticity of federal taxes on production and imports with respect to personal expenditure on goods and services since the GST was introduced is very close to one.

10. Note that Ontario also harmonised its retail sales tax with the federal GST on the same date.

rents are shared with workers.[11] One conceptual problem is that, though resource prices are cyclical, and though the resource price cycle broadly corresponds to the worldwide business cycle – as exemplified by the trend increase in commodity prices during the long boom that preceded the recent financial crisis and their reversal during the crisis – the two cycles do not correspond perfectly. So the cyclical indicator used to adjust other government revenue items, namely the output gap, cannot be used as the cyclical indicator for resource prices. One or more indicators of cyclicality for commodity prices are needed. To better differentiate between provinces, such as Alberta, that produce mainly energy commodities and other provinces, the approach taken here is to use two cyclical indicators: one based on energy commodity prices and the other on all other commodity prices. The price indices used as bases for these indicators are sub-components of the new Bank of Canada Commodity Price Index.[12] One is the annual energy sub-index and the other is the annual total index excluding energy.

A key assumption needed to identify an "equilibrium" level of government revenue from natural-resource royalties is the equilibrium level of commodity prices. Estimating such a level being beyond the scope of the current exercise, a highly-simplified approach is used instead. First, because the indices are based on the US dollar (USD), they are deflated by the US GDP deflator and then converted into CAD to compute real commodity price indices in local currency. Then, 10-year moving averages including the current year are taken over the period 1981 to 2008, which requires data going back to 1972, the earliest year for which the commodity price indices are available. These averages are interpreted as the equilibrium levels of real energy and non-energy commodity prices, in the same sense that potential output is the equilibrium level of output. Commodity-price gaps ($COMPGAP$) can then be computed in a manner similar to output gaps. In equation form:

$$COMPGAP_{j,t} = \frac{COMP_{j,t}}{\sum_{t=0}^{-9}\frac{COMP_{j,t}}{10}} - 1 \qquad \text{for } j = \text{energy, non-energy} \qquad [9]$$

where $COMP_{j,t}$ is the real commodity price index in CAD for commodity j. The estimated non-energy and energy commodity-price gaps are shown in Figure 2.

The next step is to estimate the sensitivity of natural-resource royalties to changes in these commodity-price gaps. For provinces where such revenue is not trivial, the elasticities of royalties with respect to the commodity-price gaps just calculated are estimated using the following regression (omitting time subscripts and the error term):

$$\Delta\, log\frac{ROYALTIES}{GDP^*} = \theta + \varepsilon_{energy}\Delta logCOMPGAP_{energy} + \varepsilon_{non-energy}\Delta logCOMPGAP_{non-energy} \qquad [10]$$

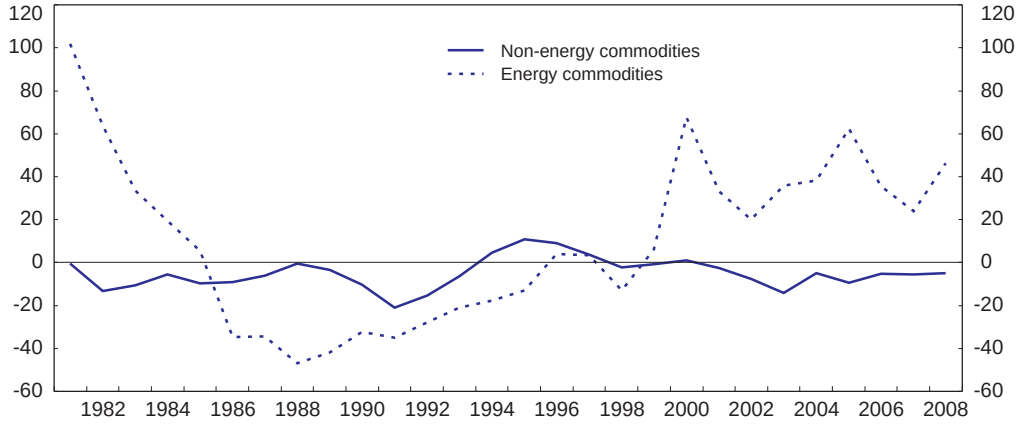
where $ROYALTIES$ is provincial revenue from natural-resource royalties, θ is a constant, the ε coefficients are the elasticities of interest and other variables were defined previously. Only elasticities significant at the 10% level are kept. Others, and those for jurisdictions for which no equation is estimated, are set to zero. The results appear in Table 2 (detailed regression results are in Table A1 in Appendix). Note that in reality, revenue from royalties depends on the volume of natural resources extracted and not just on prices.

11. For a discussion of the issues involved in estimating the influence of all terms-of-trade effects on the fiscal balance with an application to Australia, see Turner (2006).

12. The new Bank of Canada commodity price index is a chain Fisher price index of the spot or transaction US dollar prices of 24 commodities produced in Canada and sold in world markets, with weights updated on an annual basis. The index is also updated using recent commodity production data.

Figure 2. **Historical commodity price gaps**

Per cent deviation from equilibrium level



To a certain extent, the commodity-price gaps used here do capture some volume effects. Canada being a price taker on global commodity markets, production volumes tend to fluctuate in the same direction as prices. The elasticities just estimated could nevertheless be refined to better capture volume effects.

2.3. Government-expenditure elasticities

Among expenditure categories, only transfers to persons are assumed to be affected by the business cycle. Often, the elasticity of government transfers to persons is estimated in two parts, as in [6], the first being the elasticity of transfers to persons with respect to the unemployment rate and the second being the elasticity of the unemployment rate with respect to the output gap (inverse Okun's coefficient[13]). While a large part of federal direct transfers to persons consists of Employment Insurance payments, which are closely linked to the level of unemployment, provincial transfers to persons are not necessarily closely tied to unemployment. Rather, they consist mostly of various types of welfare payments, which are related to the level of unemployment but only loosely and with a cumulative lagged effect, because often people have to exhaust their Employment Insurance entitlements before being entitled to welfare payments. Hence, the elasticities of transfers to persons (TP) from provinces and territories as well as from the federal government are estimated all at once using the system of equations (with error terms omitted):

$$\Delta \log \frac{TP_{i,t}}{GDP^*_{i,t}} = \beta_{0_i} + \beta_{1_i} \Delta log \frac{GDP_{i,t}}{GDP^*_{i,t}} + \beta_{2_i} \Delta log \frac{GDP_{i,t-1}}{GDP^*_{i,t-1}} \qquad \text{for province/territory } i = 1 \text{ to } 12 \qquad [11]$$

$$\Delta \log \frac{TP_{fed,t}}{\sum_i GDP^*_{i,t}} = \beta_2 + \beta_{1_{fed}} \Delta log \frac{\sum_i GDP_{i,t}}{\sum_i GDP^*_{i,t}}$$

where as in [8] the first 12 equations estimate province-specific elasticities but the 13th equation estimates the elasticity of federal transfers to persons with respect to the country-wide output gap. Also, unlike in [8], first-period lagged values of the provincial output gaps are included to capture the lagged effects of the economic cycle on provincial transfer payments to persons. This estimation model is an instance where government expenditure statistics from the Provincial Economic Accounts are needed, so the sample size for each provincial equation goes only from 1986 (because of the lagged independent variable) to 2007 (21 data points per province), making it difficult to obtain precise estimates. Many of the provincial elasticities obtained are indeed not statistically significantly different from zero. This finding can also

13. Okun's law describes an inverse relationship between the change in the rate of unemployment and the output gap.

indicate that transfers to persons are not closely associated with the economic cycle. For instance, in the case of Saskatchewan, both the elasticities on the current and the lagged output gaps are positive and statistically significantly different from zero, which suggests either a badly designed social safety net or pro-cyclicality in policy decisions on transfers to persons. Again, only the estimates that are significantly different from zero at the 10% significance level are kept. The others are set to zero. The elasticities used in the model appear in Table 2 (detailed regression results are in Table A1 in Appendix). These elasticities do not have a comparator in *Outlook* methodology, in which the estimated elasticity for unemployment benefits is scaled down and applied to total current primary expenditure.

2.4. Cyclically adjusted budget balances

The potential output series and elasticities estimated above allow the calculation of cyclically adjusted budget balances for the 13 provincial/territorial jurisdictions and the federal government comparable to those calculated for Canada and other OECD countries and published in the *Outlook*. Cyclically adjusted budget balances (CABB) show the levels that government expenditure and revenue would be at if the economy were operating at its potential level. They make it possible to gauge the underlying budgetary position by stripping out the temporary components due to cyclical fluctuations. They also allow an assessment of budgetary changes over time, disentangling improvements due to policy measures from those due to the underlying strength of the economy. They can also be used to assess whether the stance of fiscal policy is contractionary or expansionary (see the next subsection). Growth rates of cyclically adjusted revenue and expenditure correspond to the trend growth path of the economy. From a fiscal policy point of view, they correspond to "neutral" programme settings. A cyclically adjusted budget deficit suggests that either taxes have to be raised or expenditures cut for the budget to be balanced over a typical economic cycle.

While useful, the CABB also has drawbacks. It is only as precise as the elasticity estimates of cyclically sensitive budget components, and it also depends on the reliability of potential output estimates. In addition, real-time estimates of CABB involve projections about current economic and budget conditions and will be subject to revisions. The actual cyclical position at a given point in time is only revealed *ex post* and even then has to be estimated as some of the components cannot be observed (such as potential output). Still, the current indicator is often used to inform policy action on a forward-looking basis. Furthermore, as pointed out above, the CABB is calculated here by considering the production cycle and the commodity price cycle, but there may be other cycles affecting government revenue and expenditure, for instance an asset price cycle (*e.g.* house prices), etc. To the extent the cycles left out are not perfectly correlated with those taken into account, the CABB underestimates the cyclical component of the budget balance. Two other drawbacks of the present approach should be mentioned. First, the methodology does not correct for simultaneity issues in the determination of output gaps and cyclical revenue and expenditure. Second, only certain tax bases and expenditure categories are assumed cyclical, whereas in reality others may also be at least partially cyclical. These caveats should be borne in mind when interpreting the results. Together, they likely lead to a significant underestimation of the cyclicality of the overall budget balance.

2.4.1. Estimating cyclically adjusted budget balances

Conceptually, the cyclically adjusted budget balance (CABB) is given by:

$$CABB = BB - CC = BB - \eta \cdot GAP \qquad [12]$$

where BB stands for budget balance and CC for cyclical component. The cyclical component is given by the product of the cyclical sensitivity of the budget balance (η) times the output gap (GAP). Output gaps were estimated in section 1.3. For natural-resource revenue included as part of investment income, the gaps

used are of course the commodity-price gaps estimated in subsection 2.2.5. The share of investment income that is cyclically adjusted is equal to the proportion of investment income attributable to resource revenue in a given province, which appears in Table 2. Although it is possible to calculate the sensitivity of the overall budget balance for use in [12], which involves computing weighed averages of revenue and spending elasticities according to the weights of different revenue and expenditure categories in output and taking their difference, the equivalent approach used here for practical reasons is to adjust each cyclical component of the budget separately. That is to say, each cyclical revenue and expenditure category is adjusted individually using an equation similar in spirit to [12] where η is based on the elasticities estimated in subsections 2.2 and 2.3 so that overall revenue and expenditure elasticities vary over time according to the relative weights of budget items. Cyclical budget components are then re-aggregated with non-cyclical ones into a CABB. The exercise is done separately for each province/territory and for the federal government. Cyclically adjusted primary balances (CAPB) are also computed, where the primary balance is defined as the overall balance plus interest payments minus investment income. Subtracting total investment income underestimates the primary balance, because investment income includes things other than interest income that should normally be part of the primary balance, notably natural-resource royalties. Unfortunately, the data to disaggregate investment income into its components over the entire historical period do not exist.

2.4.2. Adjusting cyclically adjusted revenue components for recent policy changes

In the light of recent policy changes at the federal level, two important adjustments are made to the cyclically adjusted revenue estimates computed for 2007 and 2008. These adjustments are necessary because cyclically adjusted federal revenue estimates are computed by aggregating provincial-level estimates, but while actual revenue figures at the federal level are available up to 2009, and thus include the effects of policy changes that occurred in 2008 and 2009, the breakdown of these revenue by source province is available only until 2007. Therefore, the cyclically adjusted figures would not be comparable to the actual figures without adjusting provincial-level data for recent policy changes. First, on 1 January 2008, there was a reduction of one percentage point in the rate of the federal Goods and Service Tax (GST) from 6% to 5%. Consequently, the 2008 province-level estimates of federal taxes on production and imports, which almost entirely consists of revenue from the GST, are reduced by applying a factor of 0.83 (5/6). Second, in 2008, the employee and employer Employment Insurance (EI) contribution rates were reduced from 1.8% to 1.73% and from 2.52% to 2.422%, respectively. Accordingly, the 2008 provincial-level estimates of federal contributions to social insurance plans, which almost entirely consists of EI contributions, were reduced by applying a factor of 0.96 (the ratio of the combined employee-employer contribution rates in 2008 *versus* 2007).

2.4.3. Total government

Aggregating federal, provincial/territorial and municipal fiscal aggregates yields results for the total-government sector. Fiscal data for the municipal sector are from the Provincial Economic Accounts and are not cyclically adjusted. Also, as explained previously, this total-government sector is not directly comparable to the general-government sector as defined in the *Outlook*. First, Canada and Quebec Pension Plan revenue (contributions and investment income) and expenditure (mainly transfers to persons) are excluded. Because both plans currently receive more contributions than they have outlays, their removal from total government subtracts from the overall net lending figure.[14] Second, in the Provincial Economic Accounts, on which the model's accounting framework is based, government current expenditure on goods and services is recorded on a net basis, that is, after deducting revenue from the sale of goods and services. In the *Outlook*, which follows conventions in the government sector accounts of the National Income and

14. In 2008, combined net saving by the Canada and Quebec Pension Plans amounted to CAD 10.7 billion (about 0.7% of GDP).

Expenditure Accounts, sales of goods and services by government to other sectors are shown separately as part of revenue, and current expenditure on goods and services is shown on a gross basis. While this accounting difference changes both expenditure and revenue aggregates, it leaves saving (and net lending) unchanged.[15]

2.4.4. Results

Figure 3 plots the historical actual and cyclically adjusted budget balances as a percentage of, respectively, actual and potential GDP, for the provinces and territories, for the federal government and for the total government from 1981 or 1984 to 2008 (recall from section 2.1 that years up to 2007 are based on actual Provincial Economic Accounts data, while 2008 provincial government revenue and expenditure have been estimated using other sources). Figure 4 does the same for the actual and cyclically adjusted primary balances. Both also show the estimates from the latest *Outlook* for the general government. For reasons just mentioned in the previous subsection, and because of the use of somewhat different concepts for cyclical revenue and expenditure, the total government concept used in this paper is not directly comparable to the *Outlook*'s general-government sector, but the *Outlook* estimates are nevertheless shown for information purposes.

2.5. Fiscal stance over the cycle

Abstracting from permanent policy changes made for structural reasons, optimal fiscal policy should in theory be characterised by tax rates and discretionary government spending as a share of GDP that remain constant over the business cycle. If governments respected these prescriptions, fiscal policy would exhibit a counter-cyclical pattern. During a boom, first, total government spending as a share of GDP would go down because of automatic stabilisers. Second, with constant tax rates and some degree of progressivity, government revenue as share of GDP would go up. As a result, the budget balance as a share of GDP would increase. The opposite would occur in recessions. If this pattern is not respected, fiscal policy is said to be pro-cyclical, in which case it tends to add to macroeconomic instability, amplifying booms and recessions alike when they occur.

Two different methods can shed light on whether the fiscal policies of the federal government and of provincial/territorial governments have leaned toward pro- or counter-cyclicality in recent years. The first is based on the cyclically adjusted primary balances (CAPB) calculated in the previous subsection. The second is based on simple time-series regressions.

2.5.1. Fiscal stance according to cyclically adjusted primary balances

Changes in the CABB or CAPB are the most commonly used indicators of whether government is actively taking expansionary or contractionary fiscal measures. Nevertheless, they are imperfect measures, as they do not correspond exactly to the effect of fiscal policy on aggregate demand, for three main reasons. First, these measures do not allow for the fact that tax changes will generally have a different impact on demand than expenditure changes of equal magnitude, not to mention that different taxes affect economic activity in different ways. Second, multiplier, or "leakage", effects are not considered. That being said, there is no agreement in the economics profession on the size of fiscal multipliers, with recent estimates ranging from zero to as much as three.[16] And third, when potential GDP is used as a denominator, any change in the growth rate of non-cyclical revenue or expenditure relative to that of

15. In 2008, revenue from the sales of goods and services by all governments in Canada amounted to approximately CAD 50 billion (about 3% of GDP).

16. Auerbach and Gale (2009) review the literature on the size of fiscal multipliers.

Figure 3. **Historical actual and cyclically-adjusted budget balances**

Per cent of GDP or potential GDP

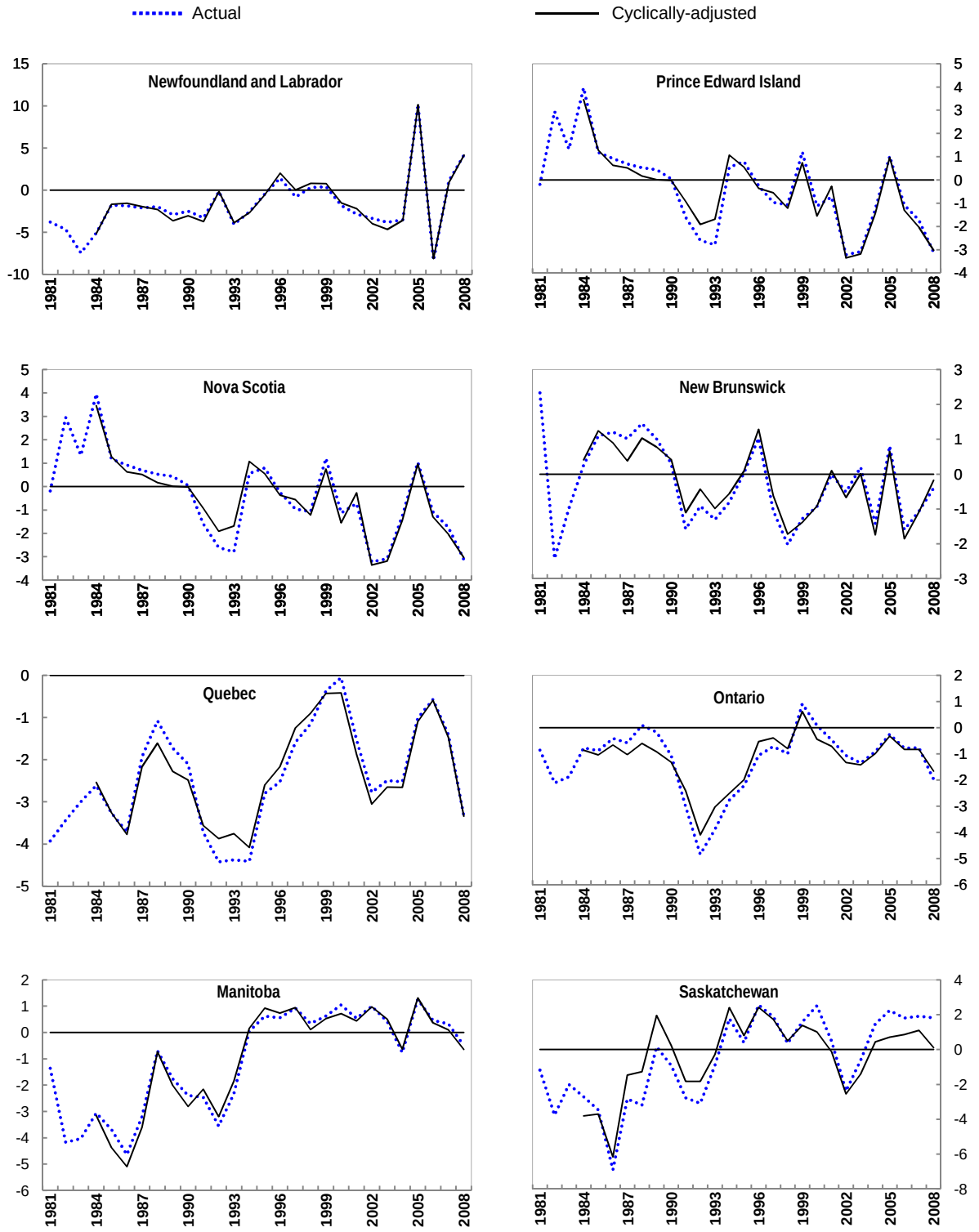
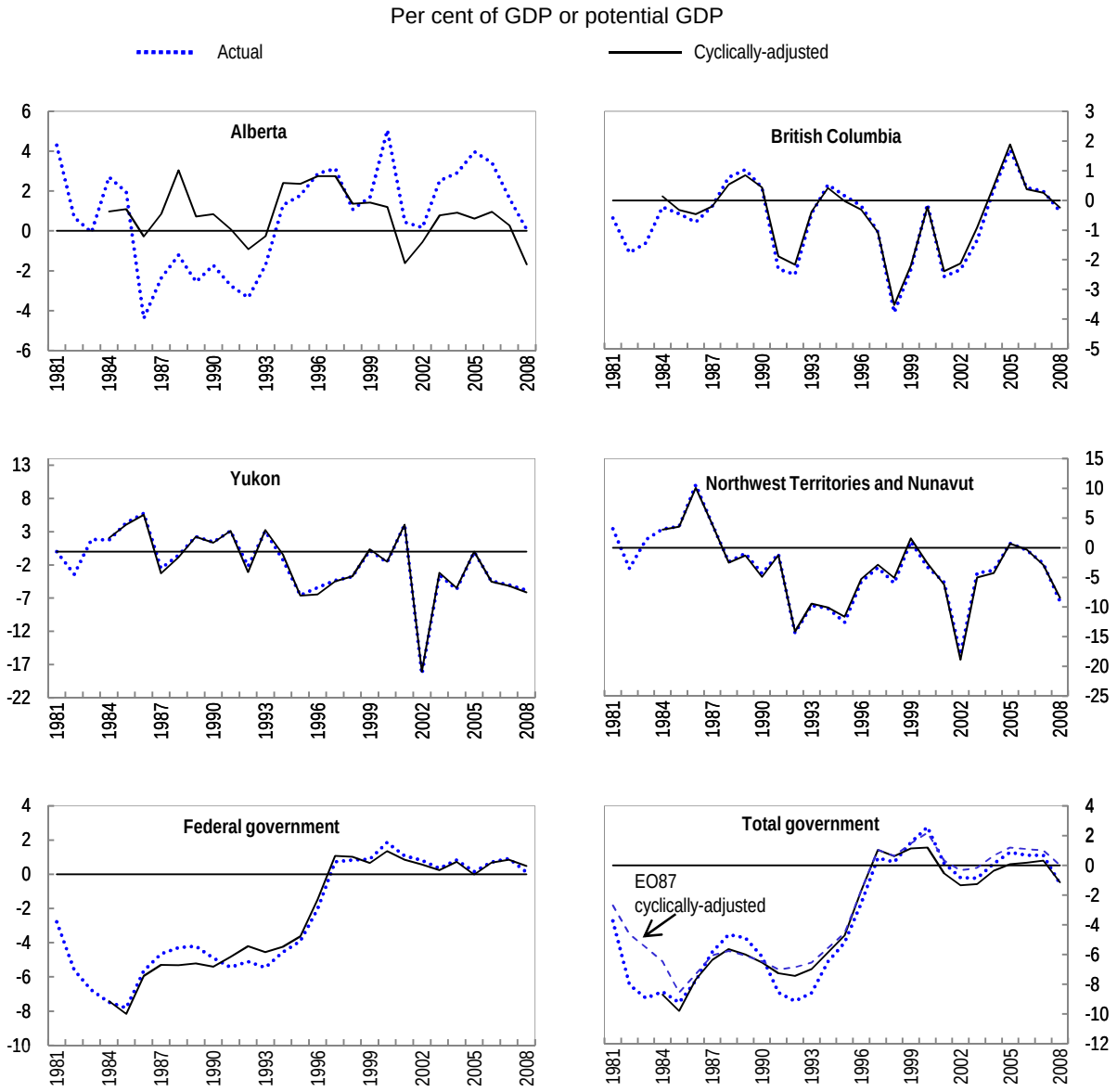


Figure 3. **Historical actual and cyclically-adjusted budget balances** (*continued*)



potential GDP is by definition the result of government intervention. In fact, many revenue or expenditure categories may be more likely to grow in line with population and sector-specific inflation (*e.g.* the cost of technological advancement in the health sector) than with potential output. Therefore, the change in the CABB or CAPB does not necessarily identify the *intent* of government policy, though it is still a useful measure of its effects.

Keeping these drawbacks in mind, Figure 5 shows graphic representations of the fiscal stances (approximated by the annual change in the CAPB in percentage points of potential GDP on the x-axis) and cyclical conditions (approximated by the size of the output gap also in percentage points of potential GDP on the y-axis) of Canadian governments from 1985 to 2008. Each panel is divided into four quadrants according to fiscal orientation and cyclical position. If the combination of fiscal stance and cyclical position falls in the first or third quadrant, then fiscal policy is expansionary when output falls below

Figure 4. **Historical actual and cyclically-adjusted primary balances**

Per cent of GDP or potential GDP

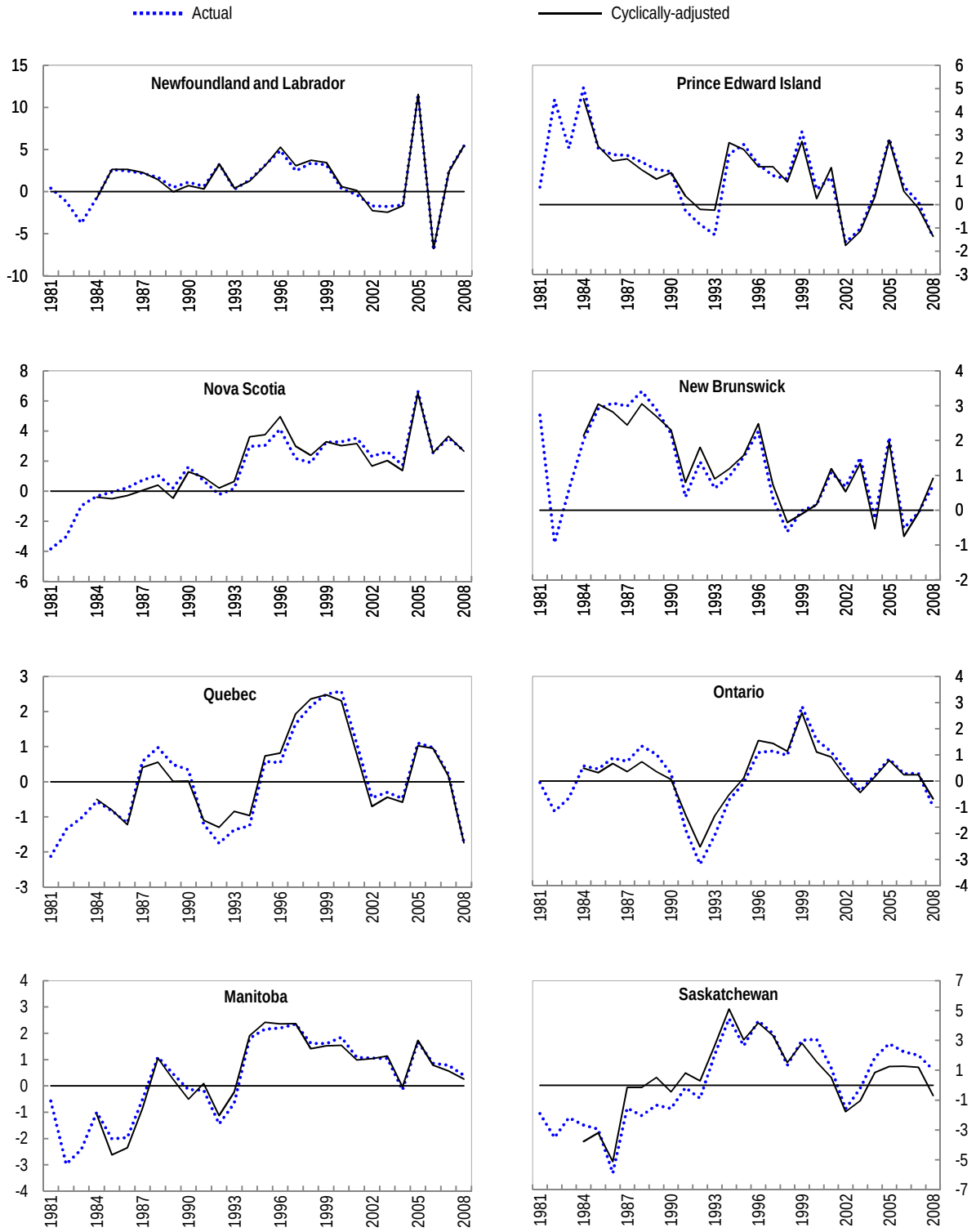
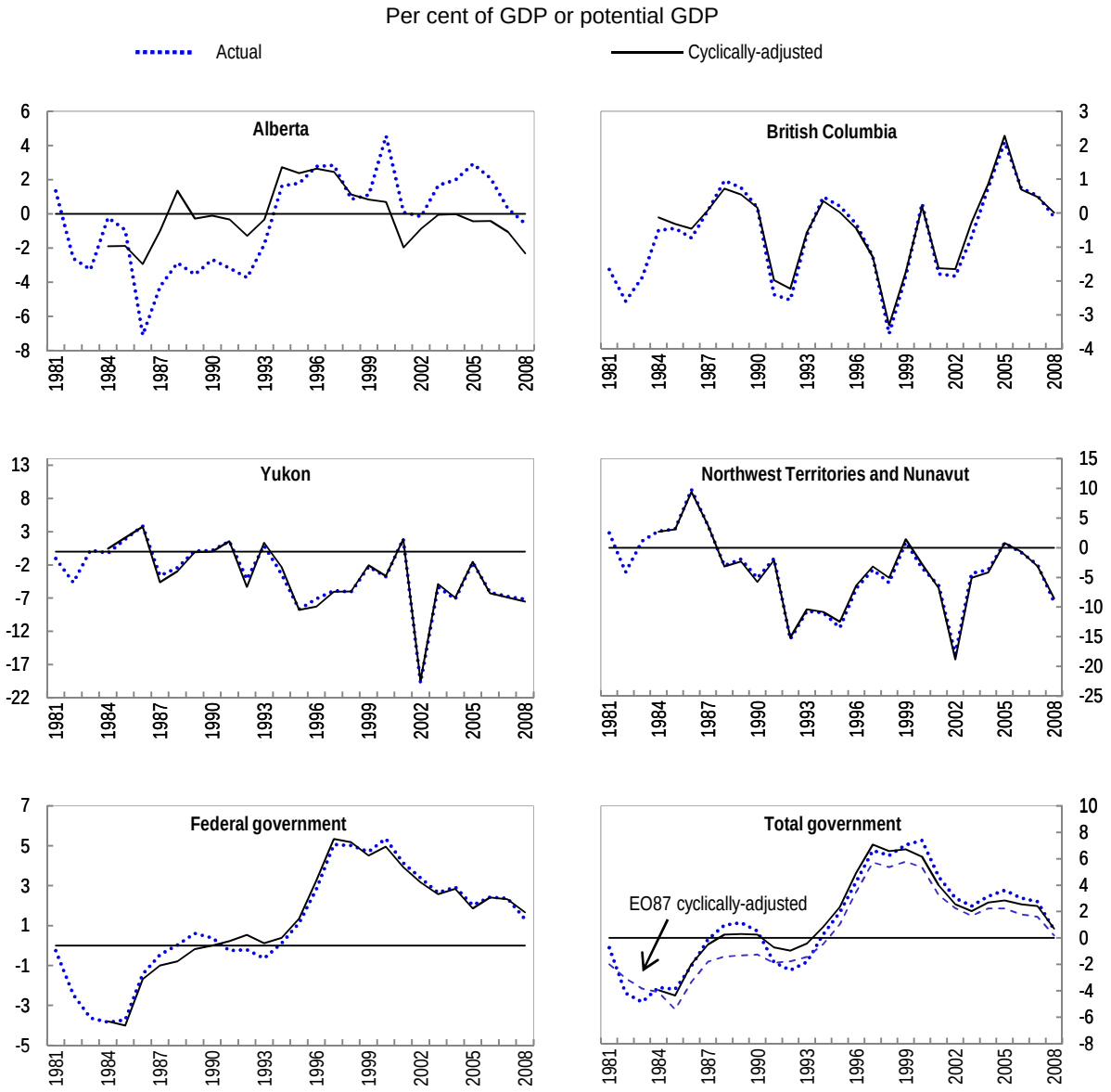


Figure 4. **Historical actual and cyclically-adjusted primary balances** (*continued*)



potential or restrictive when output is above potential, suggesting that fiscal policy is counter-cyclical. Conversely, the combination of both parameters in the second or fourth quadrant suggests a pro-cyclical fiscal stance. According to the results from 1985 to 2007 (to consider only the period based on actual government-account statistics), Prince Edward Island, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, the Yukon and the federal government all had pro-cyclical fiscal stances in most of the 23 years (Table 3). Fiscal policies in some jurisdictions, notably Quebec and the federal government, also appear to have become more pro-cyclical over time, as represented by the higher proportion of pro-cyclical years in the second sub-sample (from 1997 to 2007) than the first (1985 to 1996). In the last 10 years considered here, Quebec, Alberta and the federal government have had pro-cyclical fiscal stances particularly often.

Figure 5. **Primary balances and output gaps**

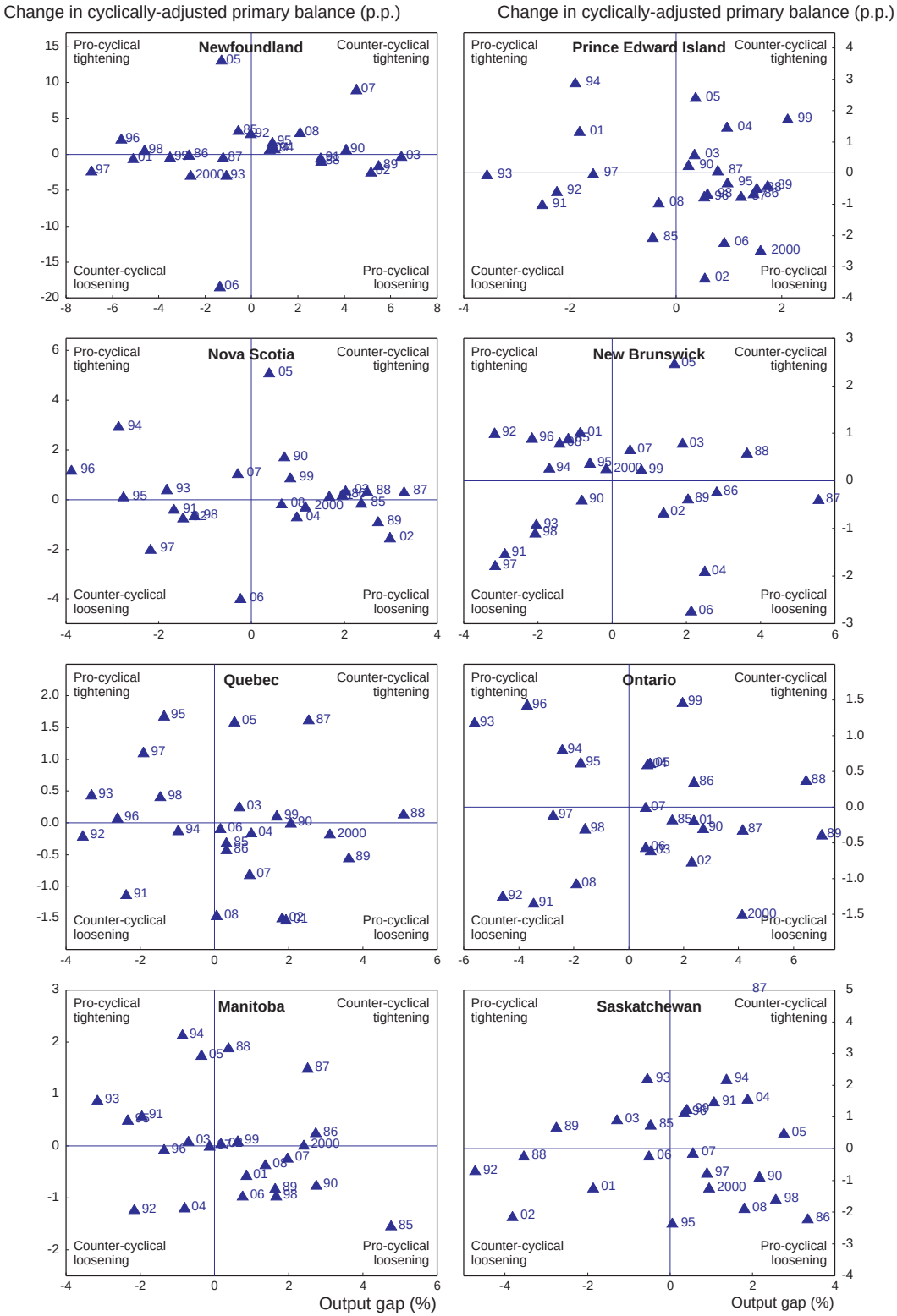


Figure 5. **Primary balances and output gaps** (*continued*)

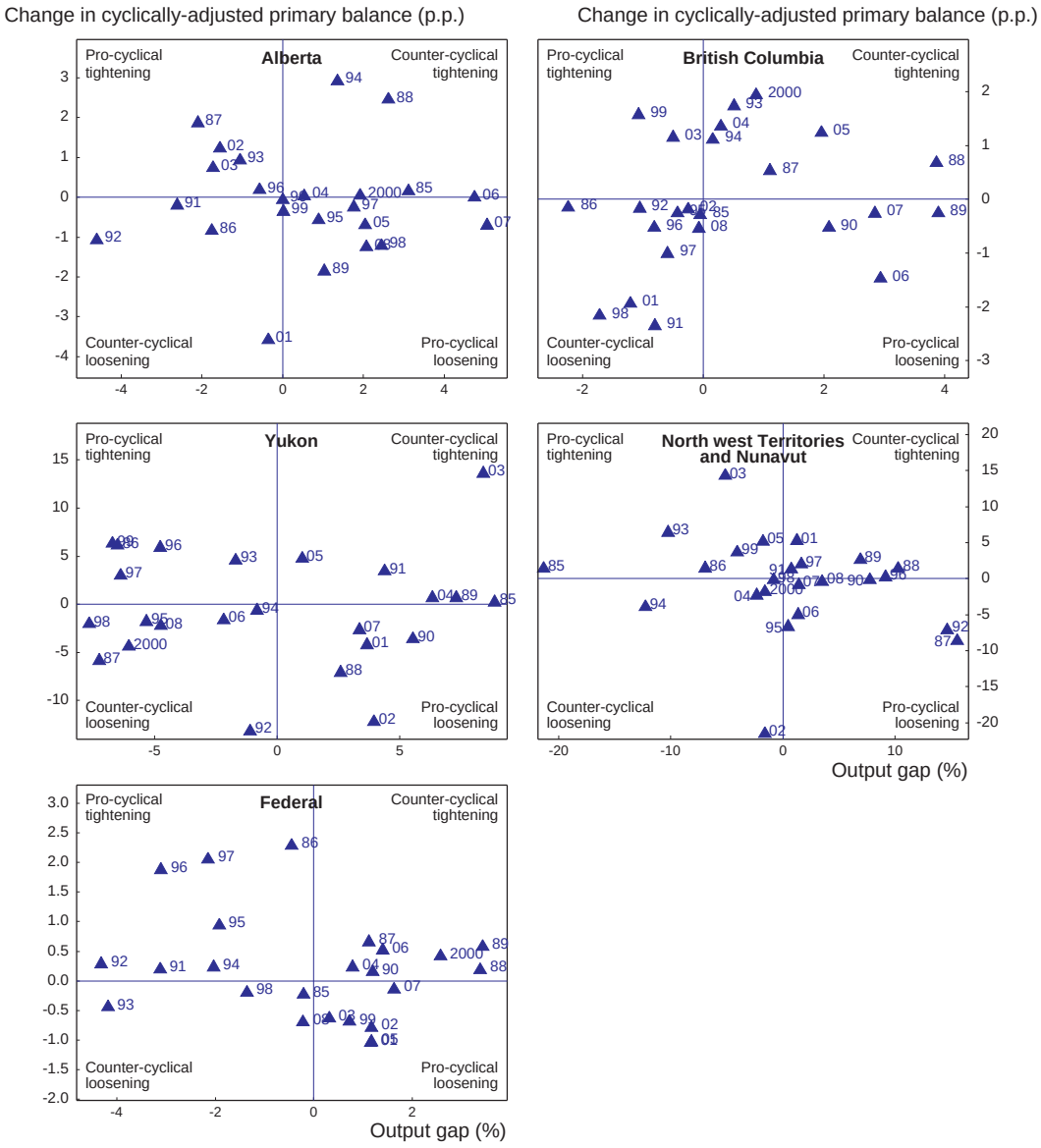


Table 3. **Indicators of cyclicality in fiscal policy**

	NL	PE	NS	NB	QC	ON	MB	SK	AB	BC	YT	NT &NU	Fe-deral
Number of pro-cyclical years from 1985 to 1996 (out of 12)	6	6	6	8	6	8	7	6	6	2	6	5	6
Number of pro-cyclical years from 1997 to 2007 (out of 11)	4	6	5	6	7	5	8	7	8	4	7	5	7
Number of pro-cyclical years from 1985 to 2007 (out of 23)	10	12	11	14	13	13	15	13	14	6	13	10	13
Regression coefficient if statistically significant						0.42	0.42		0.67	0.51			

2.5.2. Fiscal stance according to regression analysis

To check the robustness of this finding, a second method based on times-series regressions is used. The dependent variable is taken to be government primary spending (*G*). This method has the advantage of using a policy instrument as an input rather than a fiscal outcome (such as the primary balance as a percentage of GDP) which is endogenous to factors not necessarily under direct government control. On the other hand, it has the disadvantage of considering only the spending side of the ledger, even though it is possible for governments to adopt pro-cyclical fiscal stances using tax policy, for instance by cutting taxes during booms. The assessment of fiscal stances is based on the following regression (with error terms omitted):

$$\Delta log G_{i,t} = \alpha_i + \beta_i \Delta log GDP_{i,t-1} \qquad \text{for province/territory } i = 1 \text{ to } 12 \qquad [13]$$

$$\Delta log G_{fed,t} = \alpha_{fed} + \beta_{fed} \Delta log \sum_i GDP_{i,t-1}$$

where t indexes years and the β coefficients measure the elasticity of government primary spending with respect to GDP for each province/territory and for the federal government. A positive value indicates pro-cyclicality whereas a negative value implies counter-cyclical behaviour. A value greater than one further indicates that government primary spending rises (falls) more than proportionally in response to a positive (negative) change in output. The one-period lagged change in output is used under the assumption that it takes one year of strong (weak) output growth for governments to react and increase (lower) spending. This system of equations is once again estimated using SUR for the period 1983-2008 (data up to 2007 for the provinces/territories). Cyclicality coefficients are shown in Table 3 if they are statistically significant at the 5% level (detailed estimation results are in Table A1 in Appendix).

The results support the finding of pro-cyclical fiscal behaviour in several provinces. Ontario, Manitoba, Alberta and British Columbia all exhibit a positive and statistically significant elasticity of primary government expenditure with respect to output. Combining these results with those of the previous method, one can be reasonably confident in asserting that Alberta, Ontario and Manitoba, a list which includes two of the four most populous provinces, have tended to run pro-cyclical fiscal policies over the past quarter century. The results also suggest that, to the extent the other provinces identified through the previous method and the federal government have tended to run pro-cyclical fiscal policies, they have done so mainly through tax as opposed to spending adjustments.

3. Economic projections

The budget elasticity estimates of section 2 can be used to make projections of cyclical government revenue and expenditure under various economic scenarios. Combined with assumptions on the evolution of non-cyclical revenue and expenditure, budget balances, cyclically adjusted budget balances and other fiscal outcomes can be constructed for the different scenarios. To do this, both supply-side and demand-side projections are needed to obtain output gap projections to which the budget elasticities can be applied. The approach used here is to construct supply-side estimates for each province/territory in a manner similar to the *Outlook* medium-term baseline,[17] and then generate various aggregate demand scenarios to study the evolution of government budget balances under different economic conditions and fiscal strategies. One important simplifying assumption inherent in the modelling approach is that government decisions on spending and/or tax changes do not affect aggregate demand. Rather, aggregate demand is entirely exogenous, and the question under study is how different fiscal rules/strategies would

17. For the methodology behind the *Outlook* medium-term baseline, see Appendix 1.1 of OECD (2009); and for the assumptions behind the medium-term baseline of *Outlook* 87 shown in some of the charts in this paper, see Chapter 4 of OECD (2010).

affect budget outcomes over the projection period. This section explains, in turn, the construction of supply-side (potential) estimates, short-term demand-side economic projections, medium-term demand-side economic projections in both deterministic and stochastic frameworks, and fiscal projections.

3.1. Projections of potential output

The potential output estimates derived above are extended to the period 2009 to 2020 using the production function approach, which requires making projections for each of the right-hand-side variables in [4]:

- *ELEFFT* is assumed to keep growing at its 1981-2008 average growth rate.

- *POPT*, total population aged 15 to 64, is projected using Statistics Canada's latest population projections, scenario 2. This scenario features medium natural-population growth and recent migration trends, with a base population derived from the official postcensal population estimates for provinces and territories as of 1 July 2005. Scenario 2 is defined by the following assumptions: a Canadian total fertility rate constant at 1.5 births per woman; a Canadian life expectancy that reaches 81.9 years for males and 86.0 years for females in 2031; a national immigration rate of 0.7% and interprovincial migration patterns based on the trends observed between 2000 and 2003. However, because the projections for this scenario, which start in 2006, do not match perfectly the postcensal population estimates for the past few years, instead of using projected population levels directly, growth rates are applied to the latest (2009) population estimates from the Labour Force Survey to produce population projections to 2020.

- *LFPR* is projected mechanically from 2010 onward by assuming that sex- and age-specific participation rates stay constant at their 2005-2009 averages ($\overline{LFPR}_{2005-2009,sex,age}$) and weighting them using population projections by age and sex ($POPT_{sex,age,t}$) from Statistics Canada's scenario 2. Omitting the province subscript,

$$LFPR_t = \sum_{sex,age} \overline{LFPR}_{2005-2009,sex,age} \frac{POPT_{sex,age,t}}{POPT_t} \quad [14]$$

Ten different age categories are used for each sex. *LFPRT* is then estimated by applying the HP filter to *LFPR* over the historical and projection period at the same time. Taking five-year averages and applying the HP filter over both history and projections help to reduce any end-point bias that would otherwise result from the HP-filtering technique. Using age- and sex-specific participation rates and population projections takes into account the effect of population ageing on the overall participation rate and therefore on the growth rate of potential output. To be sure, labour shortages associated with the coming retirement wave and the destruction of retirement and other wealth during the recent financial and economic crisis may push some older workers to remain in the labour force longer than has been the case recently. This possibility is not taken into account, however.

- Projections for the *NAIRU* are obtained *via* the methodology used to estimate its historical values as described section 1.1, namely by assuming that the estimated structural rate of unemployment (*UNRS*) goes back to its level of a few years ago by 2012 and stays there for the rest of the projection period, and applying a HP filter to *UNRS* over both the historical and projection periods at the same time.

- *HRST* is assumed to keep growing at its 1981-2009 average growth rate. The trend number of hours worked per employee shows a mild downward trend over the historical period in all provinces. This trend is assumed to continue over the projection period.

- Official capital stock estimates are available for 2009. From 2010 onward, they are obtained from the usual identity:

$$KA_t = ITV_t + (1 - rscrb) \cdot KA_{t-1} \quad [15]$$

where ITV represents whole-economy investment and $rscrb$ the scrapping rate. The effects of the recession on capital obsolescence are implicit in the official 2009 capital stock estimates, but consistent with *Outlook* methodology, 2009 scrapping rates have not changed much from previous years. From 2010 onward, scrapping rates are assumed equal to their 2004-2008 averages. Likewise, the drop in investment during the recession is reflected in official capital stock estimates for 2009. Capital accumulation rates from 2010 onward are assumed equal to their 1997-to-2008 averages. The capital stock dynamic assumptions are chosen so that the overall country-wide potential output profile over the projection period matches that of *Outlook* 87's medium-term baseline (MTB87). They are summarised in Table 4.

- Finally, α is simply kept at the same average used in the computation of historical potential output in section 1.1.

Table 4. **Capital accumulation[1] and scrapping[2] rates, history and 2010-2020 assumptions**

Per cent growth rates

		NL	PE	NS	NB	QC	ON	MB	SK	AB	BC	YT	NT &NU
Capital accumulation rate	Avg 1981-2008	9.7	10.7	10.3	9.3	9.5	10.8	9.3	11.0	13.0	10.1		
	2007	10.3	15.8	12.2	14.9	13.9	15.3	13.5	14.8	17.4	14.9		
	2008	10.0	14.8	12.0	14.1	14.5	14.7	14.9	16.5	16.8	15.3		
	2009	11.1	11.6	13.2	11.6	13.9	13.6	13.5	15.6	13.1	13.1		
	2010-2020	10.7	11.8	11.8	11.2	11.2	12.7	11.1	12.3	15.7	11.8		
Scrapping rate	Avg 1981-2008	11.1	10.9	11.5	10.7	11.5	12.5	10.9	11.2	11.5	11.0	n.a.	n.a.
	2007	11.4	11.3	12.1	11.2	11.9	12.9	11.2	11.5	11.8	11.4		
	2008	11.7	11.4	12.3	11.2	12.2	13.2	11.4	11.8	12.2	11.6		
	2009	12.0	11.4	12.5	11.2	12.2	13.3	11.4	11.8	12.3	11.6		
	2010-2020	11.1	10.9	11.5	10.7	11.5	12.5	10.9	11.2	11.5	11.0		

1. Defined as investment over the previous year's end-year net stock of assets.
2. Defined as straight-line depreciation over the previous year's end-year net stock of assets.

The production-function approach can no more be used for projecting potential output in the territories than it could be used to estimate it historically. Potential output is simply assumed to grow at 3% per year for the Yukon (where the 1981-2008 average growth rate of potential output from the HP filter was a little over 3%) and at 4% for the Northwest Territories and Nunavut (where the historical growth rate was 4.3%). Because of their younger population, ageing is not expected to be as much of a drag on the territories' potential growth rates as in the provinces. Figure 6 shows actual and potential real GDP over the historical period as well as future potential as projected according to the methodology just outlined. It also shows aggregate potential output for the country as a whole compared to *Outlook* 87 (EO87) and its medium-term baseline (MTB87).

Figure 6. **Potential GDP estimates and projections**

Indices (CAD billion)

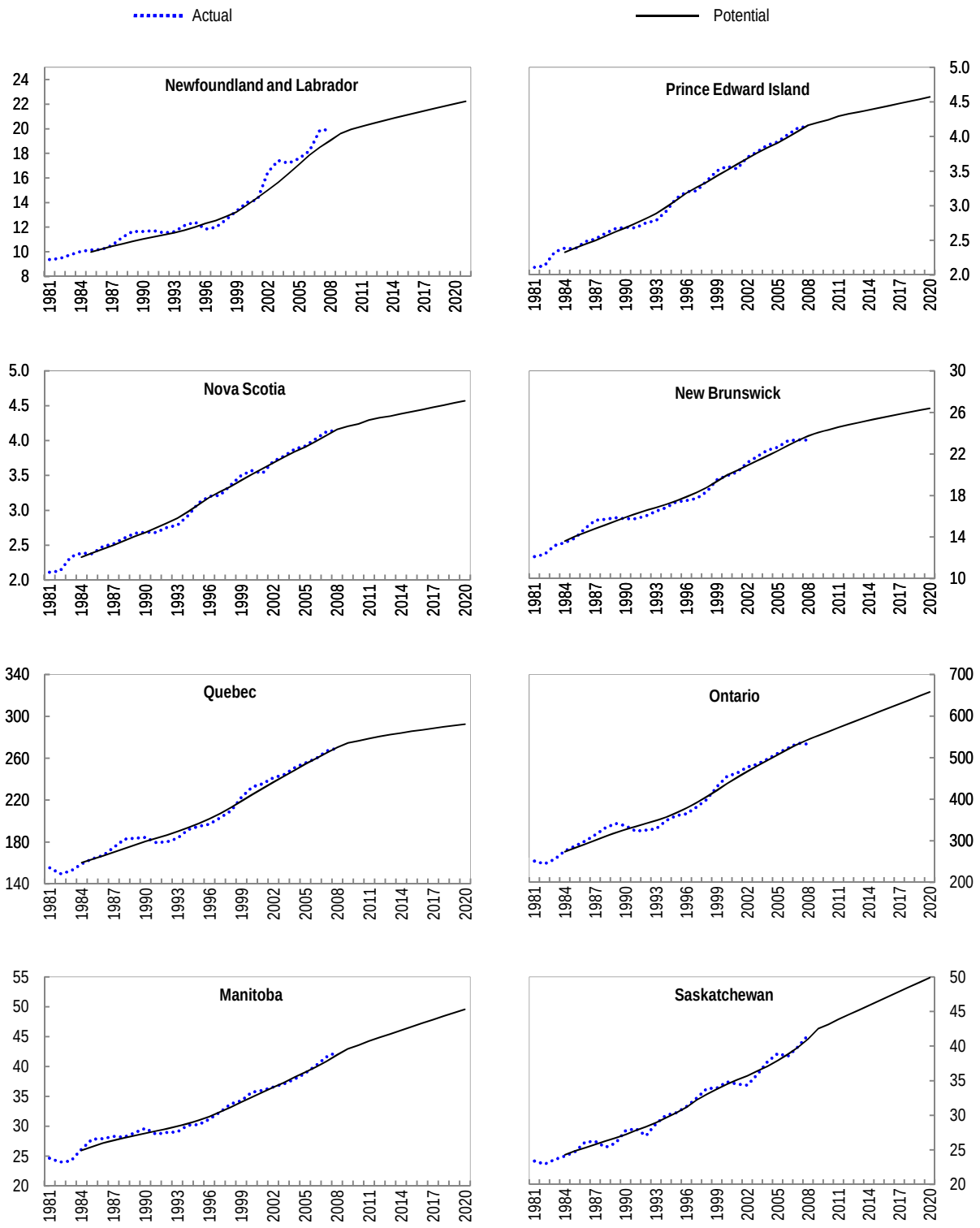
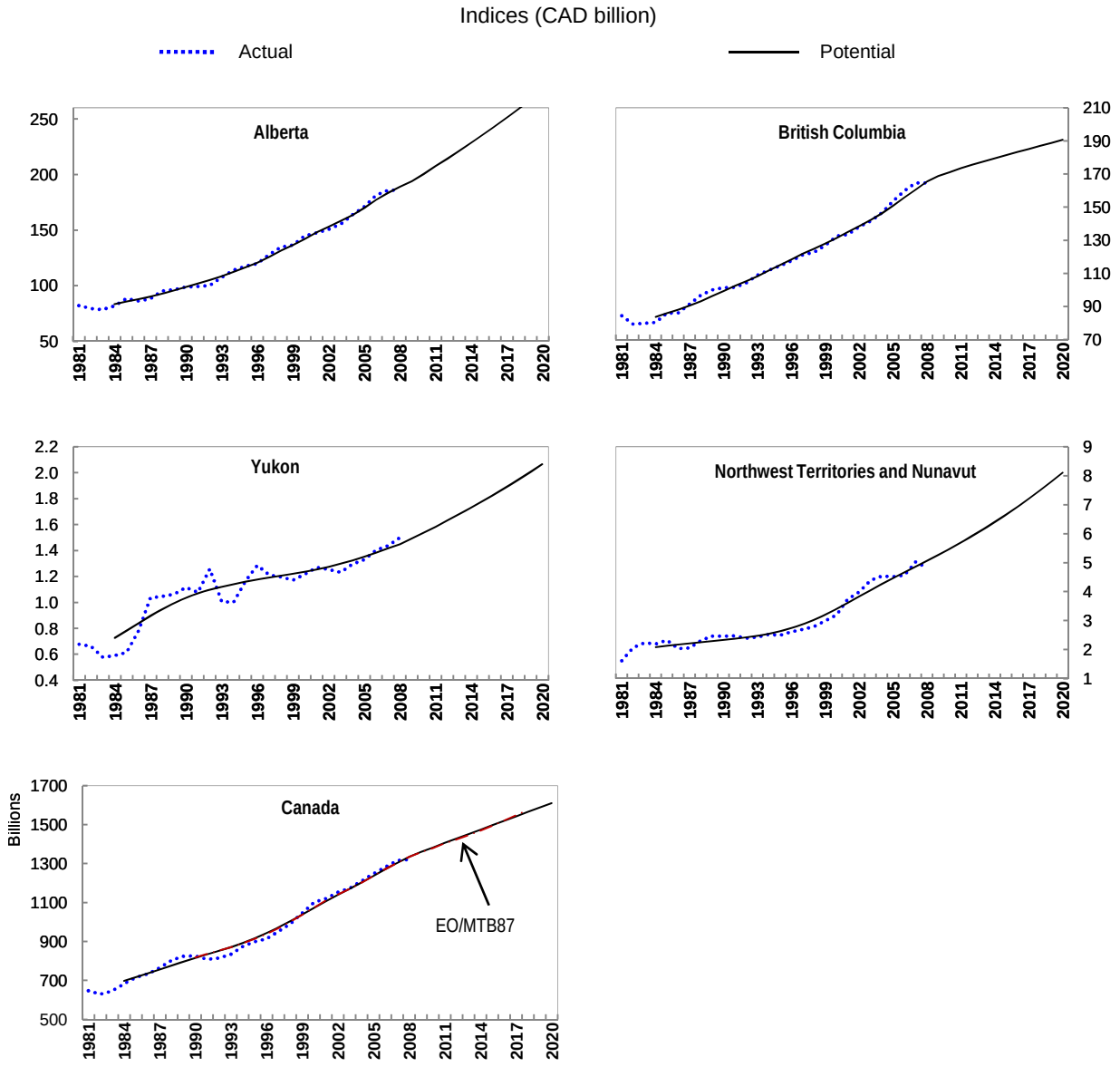


Figure 6. **Potential GDP estimates and projections** (*continued*)



3.2. Aggregate demand projections

Aggregate demand is assumed to fluctuate around the path of potential output determined in the previous subsection, thus determining the size of the output gap. The demand-side projections are not derived from a forecasting model, nor are they endogenous to fiscal variables. They are simply entered exogenously into the model. Two methods are used to construct demand-side scenarios. Both start with aggregate-demand growth projections for provinces/territories for 2009, 2010 and 2011 which are based on a private-sector forecast but adjusted to match in aggregate the *Outlook* 87 projections for Canada (Table 5). The GDP deflators for these three years are implicit in the differences between real and nominal growth projections. For years beyond 2011, the first method sets a speed of closure for provincial/territorial output gaps. The second method derives aggregate-demand growth rates for 2012 to 2020 from stochastic simulations that attempt to reproduce plausible growth scenarios based on past economic cycles.

Table 5. **Short-term economic growth assumptions**

Per cent growth rates

		NL	PE	NS	NB	QC	ON	MB	SK	AB	BC	YT	NT &NU	Cana -da
2009	Real GDP	-9.5	0.7	-0.4	-0.7	-0.8	-2.8	-0.1	-5.9	-4.7	-2.0	1.4	-7.1	-2.7
	Nominal GDP	-26.7	0.6	-0.5	-2.7	-1.4	-2.9	-0.5	-7.0	-9.0	-4.5	-3.0	-10.0	-4.5
2010	Real GDP	4.2	2.8	2.6	2.7	3.1	3.6	3.2	4.4	3.8	4.1	5.5	9.6	3.6
	Nominal GDP	20.0	4.5	4.0	5.5	6.0	6.2	6.2	8.5	9.5	8.1	8.1	13.0	7.2
2011	Real GDP	2.8	2.3	2.7	2.6	2.9	2.9	3.1	3.8	4.0	4.0	4.0	3.9	3.2
	Nominal GDP	4.0	3.7	4.0	4.0	4.8	4.8	4.9	5.2	6.0	5.5	8.0	8.0	5.1

3.2.1. Deterministic demand-side projections for 2012 to 2020

The deterministic demand-side projections are based on a single parameter: the speed of closure of the output gap, from 2012 onward, set in years. A different speed of closure can be set for each province/territory. Closure of the output gap happens linearly over those years. For example, if the output gap projected in 2011 in a given province is 4% of potential GDP, and the assumption made is that it closes over a four-year period, then the output gap will close by 1% of potential GDP per year until it is closed in the fourth year. After closure, real GDP is assumed to grow at the rate of potential output so that the output gap remains zero. The baseline scenario assumes that the 2011 output gaps projected for all provinces and territories close over a period of four years, so that they are closed in 2015. This assumption is made to reproduce the *Outlook* 87 medium-term baseline which makes a similar assumption. Figure 7 shows historical and projected output gaps in the baseline scenario.

3.2.2. Stochastic demand-side projections for 2012 to 2020

Although the deterministic projections provide a useful baseline, and allow direct comparison of Canada-wide results with the *Outlook* medium-term baseline as a check, the assumption of linear output gap closures for every province/territory is not realistic considering historical year-to-year fluctuations in aggregate demand, even in recovery phases. Producing a wide range of scenarios using this method would yield somewhat arbitrary growth profiles, all involving uninterrupted growth on the way to a zero output gap. Both the deterministic scenario described above and the *Outlook* medium-term baseline are projections *conditional* on the recovery having started and following a certain stylised recovery path. This stylised path follows the conventional view of the business cycle, according to which fluctuations in output represent temporary deviations from trend. Under this view, sometimes referred to as the trend-stationary hypothesis, periods of lower-than-normal growth, such as what Canada experienced recently, are followed by periods of higher-than-normal growth. If this were not the case, the level of output would never return to its potential level. But while it is true, from a backward-looking perspective, that periods of lower-than-average growth are followed by periods of higher-than-average growth, when taking a forward-looking perspective one cannot be certain that a sustained recovery has started, or that the economy will not soon fall back into another recession. An unconditional projection, therefore, has to give non-zero probabilities to the possibilities that the recovery will falter after a strong start, that it will be sluggish, or that the economy will never catch up to its estimated potential level, or at least not over the projection period. There is indeed evidence that the path of output tends to be depressed substantially and persistently following banking crises, with no rebound on average to the pre-crisis trend over the medium term (IMF, 2009). To simulate a wider range of more realistic scenarios, then, a second projection method is used, which relies on historical average growth rates and on stochastic methods to construct plausible provincial GDP growth profiles. This method has the advantage of giving non-zero probabilities to a plausible range of growth paths, from a much more rapid recovery to successive recessions.

Figure 7. **Historical and projected output gaps**

Per cent of potential GDP

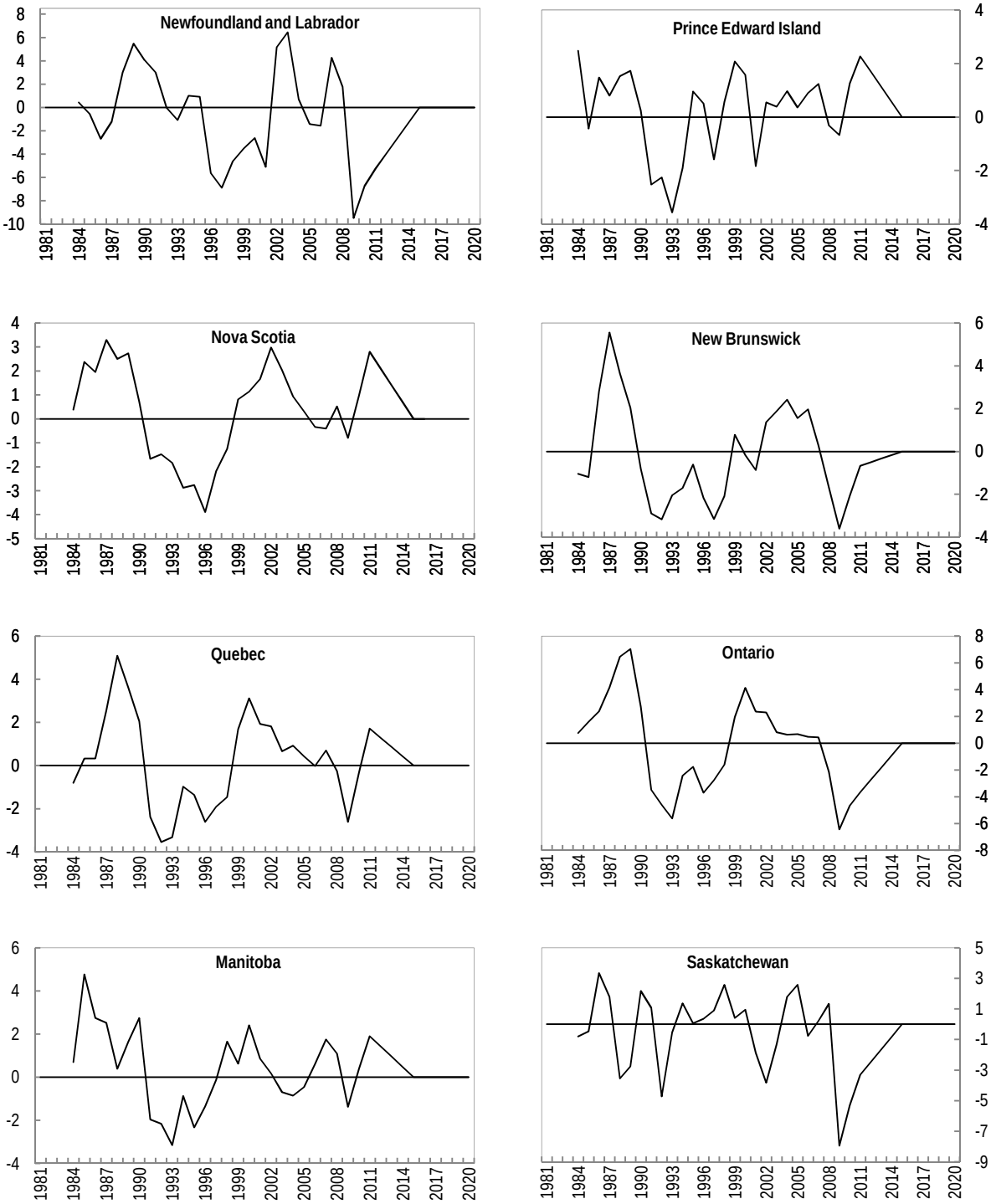
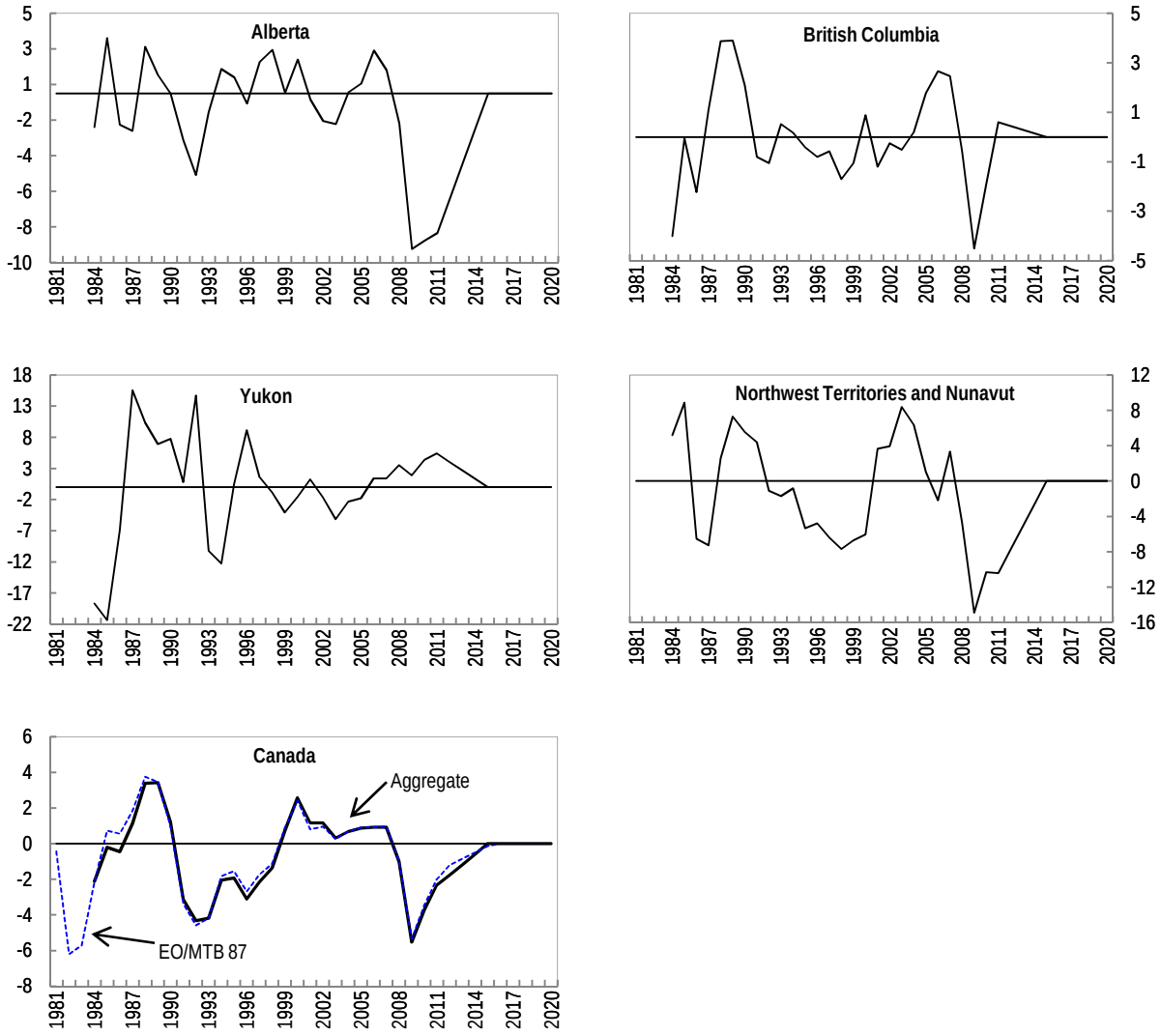


Figure 7. **Historical and projected output gaps** (*continued*)

Per cent of potential GDP



In this second method, annual provincial real GDP growth rates from 2012 to 2020 are assumed to follow a multivariate normal distribution. This assumption is used largely for simplicity, as tests of multivariate normality for provincial/territorial annual real GDP growth rates from 1981 to 2008 are not entirely conclusive. Table 6 shows the results of four statistical tests. The hypothesis of multivariate normality cannot be rejected at the 5% statistical level by Mardia's (1970) multivariate kurtosis test, or by Henze and Zirkler's (1990) consistent test, but it can be rejected at this level by Mardia's (1970) multivariate skewness test, or Doornik and Hansen's (2008) omnibus test. However, when considering only the four largest provinces, which together account for about 90% of the country's output, none of the tests can reject the hypothesis of multivariate normality at the 5% level of statistical significance.

Table 6. **Multivariate normality tests on historical provincial real GDP growth rates**

	Test statistic	chi^2	*p*-value
All provinces/territories			
Mardia mSkewness	86.04	437.43	0.00
Mardia mKurtosis	165.60	0.12	0.73
Henze-zirkler	0.99	0.88	0.35
Doomik-Hansen	..	36.83	0.05
Quebec/Ontario/Alberta/BC			
Mardia mSkewness	4.92	25.71	0.18
Mardia mKurtosis	25.10	0.17	0.68
Henze-zirkler	0.79	0.50	0.48
Doomik-Hansen	..	10.28	0.25

Accordingly, the distribution of real GDP growth rates across provinces for each of the years from 2012 to 2020 is assumed to follow a multivariate normal distribution where the mean growth rate and its standard deviation in a given province is based on the mean real GDP growth rate and its standard deviation in that province from 1981 to 2008. Note that 1981 corresponds to the peak of the economic cycle before the early 1980s recession, and 2008 was the peak of the last cycle before the 2009 recession. There was also a significant recession in the early 1990s, so the mean growth rates are drawn from two full peak-to-peak cycles. Furthermore, because of highly coincident economic cycles across provinces, the growth rates of different provinces in a given year are not independent from each other, so the correlations observed over the historical period between the growth rates of different provinces are assumed to hold over the projection period as well. For instance, the coefficient of correlation between Quebec and Ontario real GDP growth rates from 1981 to 2008 is 0.9. The multivariate normal distribution from which random samples of growth rates are drawn thus incorporates the full 12 x 12 correlation matrix of historical provincial/territorial growth rates. Serial correlation – correlation between growth rates across years in a given province – is assumed away, however. Tests of serial correlation on historical provincial GDP growth rates in most cases cannot reject the null hypothesis of serial independence (Table 7). The exceptions, at the 5% statistical significance level, are Ontario and Nova Scotia. Admittedly, because of the relatively small sample sizes, the tests suffer from low power. While it would be interesting and somewhat more realistic to model serial correlation, for simplicity, and because it likely would not substantially affect the fiscal results of ultimate interest here, it is not done.

Table 7. **Test of serial correlation on historical provincial/territorial real GDP growth rates**

	NL	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT&NU**
Ljung-box Q-statistic	0.54	0.45	7.34	1.72	3.36	4.84	0.86	0.01	1.39	0.77	0.01	0.36
p-value	0.46	0.50	0.01	0.19	0.07	0.03	0.36	0.93	0.24	0.38	0.91	0.55

The mean and standard deviation vectors used in the multivariate normal distribution to randomly generate future growth rates are not filled directly with the figures calculated from the historical period, because doing so would generate projected growth rates over the medium-term that would be inconsistent with their projected trend growth rates. Indeed, in all cases except Alberta and the territories, trend output is projected to grow more slowly over the projection period than it did over the historical period. To take this trend shift into account, the mean and standard deviation used in the random draws for a given province are both scaled down by a factor equal to half the ratio of the average projected growth rate of potential output from 2011 to 2020 to its estimated growth rate from 1984 to 2008. In other words, if

potential output in a given province is projected to grow 20% less quickly on average over the projection period as compared to the historical period, then the scale factor is 10%. Half the ratio is used instead of the full ratio to take into account that for the country as whole, the starting point (in 2011) is one of a negative output gap. If the full adjustment factor were used, projected actual output would fail to catch up to its trend path over the projection period. This fraction was chosen through calibration so that the mean projected national output gap lines up with that of the deterministic baseline projection, in which it closes in 2015. The scaling down procedure affects the mean and standard deviation vectors relative to history, but it does not affect the cross-correlation matrix. Each complete simulation requires 9 draws from the multivariate normal distribution, one for each of the years from 2012 to 2020, and each draw contains 12 growth rates, one for each of the ten provinces and the two territories.

When inputted into the model, the randomly generated growth paths are mildly constrained so as to prevent explosive and extremely unlikely growth paths, and to take into consideration that economic and policy forces would react to extreme outcomes. Specifically, in all projection years (2012 and beyond), when the previous year's positive output gap in a given jurisdiction is higher than the highest gap observed during the historical period in that jurisdiction, the real GDP growth rate for that year is assumed to be upwardly constrained by the potential growth rate. This assumption is a simplified way to mimic economic effects, such as labour shortage, that typically make an overheating economy cool down on its own. Likewise, when the previous year's negative output gap is greater than the largest negative gap observed during the historical period, the real GDP growth rate for that year is downwardly constrained by the potential growth rate. This assumption mimics the tendency for very depressed economies to bounce back, given idle resources and policy action.[18] For illustration, Figure 8 shows 50 random output gap paths for the country as a whole generated with the above procedure, with the mean path from 1000 simulations shown in bold. The resulting mean stochastic growth path is similar to the deterministic path, except that it ends with a mildly positive output gap of roughly 2% in 2020. It may seem odd to end the projection period in a disequilibrium position, but at the same time, after years of negative output gaps (on average), a typical business cycle would exhibit some deviation on the other side.

3.2.3. Projections of GDP deflators

GDP deflators for 2009, 2010 and 2011 are based on the short-term economic projections as explained above. For later years, GDP inflation depends on output gaps. Ideally, equations estimated on the basis of historical data linking GDP inflation to economic conditions would be used for projections. Attempts to estimate time-series regressions to link historical provincial-GDP inflation rates to the provincial output gaps estimated above were unsuccessful, however. The inflation-regime change in the early 1990s, when consumer-price inflation targeting was gradually adopted, and wide historical swings in commodity prices and exchange rates, make it difficult to isolate the influence of domestic conditions on provincial-GDP inflation. While these factors greatly influence GDP inflation, the baseline projection assumptions of no change in real natural-resource prices and exchange rates remove the need to project their effects on future GDP inflation. Hence, for 2012 to 2020, instead of using estimated equations, a simple approach is used in which year-over-year growth in the GDP deflator in province i at time t is assumed to follow:

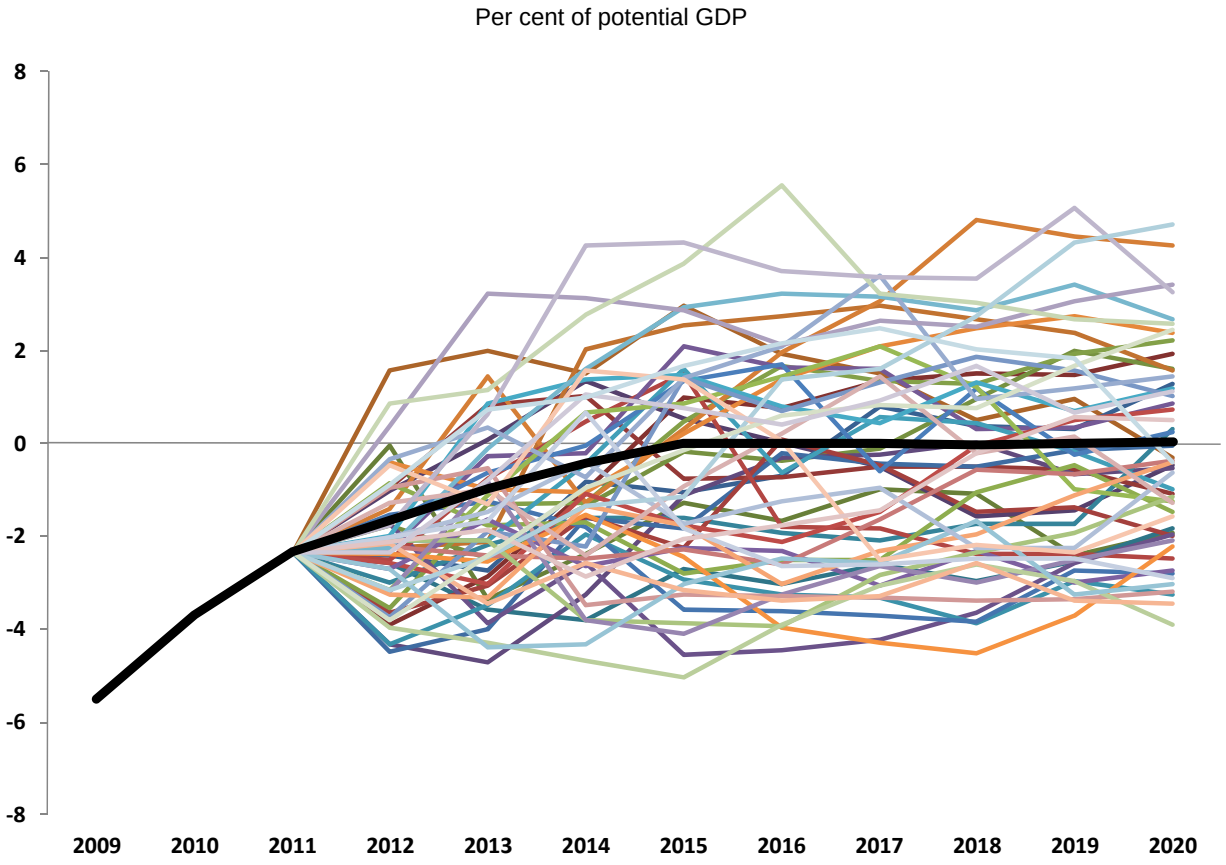
$$\Delta PGDP_{i,t} = 0.021 + 0.11 \cdot GAP_{i,t} + 0.11 \cdot GAP_{Canada,t} \qquad [16]$$

GDP inflation in a given year is thus simply assumed to be a function of the provincial and national output gaps in that year, with the two gaps having equal weights. The Canada-wide output gap is assumed to

18. In simulation years where these constraints are binding on one or more provinces, the assumed cross-correlations between provincial growth rates break down, but such occurrences are rare and considered a small price to pay to prevent extremely unlikely outcomes.

matter for provincial price setting as many markets are, at least to some extent, national in scope. The functional form means that provincial GDP inflation is 2.1% when both output gaps are zero (consistent with the *Outlook* medium-term baseline). The 0.11 parameters are chosen, somewhat arbitrarily, because they yield a plausible range for year-over-year inflation: assuming the provincial and national output gaps are the same for illustration, provincial GDP inflation would vary between 0.8% and 3.4% for output gaps of -6% and 6%, respectively. With an output gap of -5%, close to the one estimated for 2009, GDP inflation would be 1%. One could supplement this approach by adding random shocks to projections of GDP deflators, so that the model would be stochastic in both GDP volumes and prices. This approach is not followed here; in other words, the stochastic elements in medium-term projections for nominal GDP growth under the stochastic approach come from volumes but not prices.

Figure 8. **Partial sample of Canada-wide output gap projections and mean projection (in bold) under the stochastic approach**



4. Fiscal projection framework

This section presents the framework and some example outputs of the fiscal-projection part of the model. The fiscal part uses the economic projections described in section 3, the elasticities computed in section 2 and the output gaps estimated in section 1. Flow aggregates are separated into cyclical, non-cyclical and discretionary variables, and as was the case for the historical analysis, they are projected on a national-accounts basis as found in the Provincial Economic Accounts (PEA) of Statistics Canada. Stock aggregates are projected using the Government Financial Statistics accounting framework, from which the historical figures are sourced. This framework is consistent with the PEA. Cyclical flow aggregates are assumed to be influenced by the economy's position relative to trend, as reflected in output

gaps. Non-cyclical flow aggregates and some stock aggregates are generally assumed to grow at the same rate as potential output. Table 8 lists the provincial flows and stocks that are part of the fiscal model of a given province/territory along with the projection method used for each and refers to the subsection where the modelling strategy is explained in more details. For the federal government, one revenue category, direct taxes from non-residents (withholding taxes), and one expenditure category, direct transfers to non-residents, are added to the accounting framework. These are both assumed to grow at the rate of nominal potential output.

Table 8. **Fiscal projection framework for a given province/territory (for the federal government)**

		Budget component	Cyclical	Projection method	Subsection	Remarks
	1	Net lending	Yes	Identity		=18+19+20+21
	2	Total revenue	Yes	Identity		=3+4+5+6+7+8+9+10
	3	Direct taxes from persons	Yes	Affected by output gap	4.1.1	
	4	Direct taxes from corporations and government business enterprises	Yes	Affected by output gap	4.1.1	
	5	Contributions to social insurance plans	Yes	Affected by output gap	4.1.1	
	6	Taxes on production and imports	Yes	Affected by output gap	4.1.1	
	7	Other current transfers from persons	No	Grows at potential	4.2.1	
	8	Investment income	Partly	Function of assets and resource prices	4.1.2 & 4.2.2	
	9	Current transfers from federal government (from provincial government)	No	Decision variable (grows at potential)	4.3	
	10	Current transfers from local governments	No	Grows at potential	4.2.1	no such category for federal
	11	Total current expenditure	Yes	Identity		=12+13+14+15+16+17
Flows	12	Net current expenditure on goods and services	No	Decision variable	4.3	
	13	Current transfers to persons	Yes	Affected by output gap	4.1.1	
	14	Current transfers to businesses	No	Decision variable	4.3	
	15	Current transfers to federal government (to provincial government)	No	Grows at potential (decision variable)	4.3	
	16	Current transfers to local governments (to local government)	No	Decision variable (grows at potential)	4.3	
	17	Interest on the public debt	No	Function of market debt	4.2.3	
	18	Saving	Yes	Identity		=2-11
	19	Capital consumption allowances	No	Grows at potential	4.2.1	
	20	Net capital transfers	No	Set to zero		
	21	Acquisition of non-financial capital	No	Identity		=22+23
	22	Investment in fixed capital and inventions	No	Decision variable	4.2.1	
	23	Existing assets	No	Set to zero		
	24	Net debt	n.a.	Change equal to negative net lending	4.2.3	
	25	Financial assets	n.a.	Grows at potential	4.2.1	
Stocks	26	Gross debt	n.a.	Identity		=24+25
	27	Accounts payable and accrued liabilities	n.a.	Grows at potential	4.2.1	
	28	Market debt	n.a.	identity		=26-27

One caveat to anchoring both cyclical and non-cyclical revenue to potential output is that, in a progressive tax system, structural revenue tends to increase more than proportionally with nominal potential GDP. For instance, personal income tax progressivity would make personal income tax receipts grow slightly faster than nominal potential GDP even if the output gap were zero and the economy was growing at its trend rate. No attempt is made here to adjust the results for this effect.

4.1. Projections of cyclical budget flows

The cyclical components are the same ones that were used in the calculation of cyclically adjusted budget balances in subsections 2.2 to 2.4. They are all projected on the basis of output-gap projections, except revenue from royalties, which is explained separately.

4.1.1. All cyclical budget flows except royalties

The general projection method for a given year is to take the ratio of the revenue or expenditure component as a share of potential output in the previous year, multiply it by one plus the expected change in this ratio given the projected change in the output gap according to the scenario under consideration and the elasticities estimated previously, and apply the new ratio to the level of potential output projected for the current year. For instance, direct taxes from persons for province i in year t ($DTP_{i,t}$) is projected using:

$$DTP_{i,t} = \frac{DTP_{i,t-1}}{GDPVTR_{i,t-1} \cdot PGDP_{i,t-1}} (1 + \Delta GAP_{i,t} \cdot \varepsilon_{DTP,TPI,i} \cdot \varepsilon_{TPI,GAP,i}) \, GDPVTR_{i,t} \cdot PGDP_{i,t} \qquad [17]$$

where $\varepsilon_{DTP,TPI,i}$ is the elasticity of direct taxes from persons with respect to total personal income in province i and $\varepsilon_{TPI,GAP,i}$ is the elasticity of total personal income with respect to the output gap in that province, and other variables were defined in previous sections. All cyclical budget flows except investment income are projected using an equation similar to [17]. For the federal government, this equation is used for each cyclical tax/spending base in each province with the province-specific federal-government elasticities estimated previously and the results are aggregated into a federal-government total.

Some adjustments are made to take into account significant policy changes that have been announced. For projecting contributions to social insurance plans for the federal government, an adjustment is made for the increases in Employment Insurance (EI) contribution rates over the period 2011 to 2014 that are implicit in the federal government's fiscal projections.[19] These projections assume that the employee contribution rate will gradually increase by the 15 cents cap per year – consistent with EI Financing Board policy – from CAD 1.73 per CAD 100 of insured earnings in 2010 until it reaches 2.33 in 2014. The employer rate follows the same rate of increase as it is simply 1.4 times the employee rate. Accordingly, the 2011 estimate of contributions to social insurance plans for the federal government, which almost entirely consists of EI contributions, is bumped up over the level otherwise projected by [17] by applying a factor of 1.09 (the ratio of the combined employee-employer contribution rates in 2011 over 2010). Similar adjustments are made to the 2012, 2013 and 2014 estimates, the latter carrying through to later years *via* [17]. Another adjustment is made for the Quebec Sales Tax (QST) rate increases from 7.5% to 8.5% effective 1 January 2011 and from 8.5% to 9.5% effective 1 January 2012. Projected revenue from taxes on production and imports in Quebec is increased in both years by the estimated increases in QST revenue from the policy changes reported in the 2010 budget, these adjustments carrying through to later years *via* [17]. A similar adjustment is made for the two-percentage-point increase (from 8% to 10%) in the provincial portion of the Nova Scotia Harmonized Sales Tax (HST) effective 1 July 2010. Finally, Quebec government revenue is increased from 2010 to 2020 by the product of the projected adult population in Quebec and the new health contribution (of CAD 25 in 2010, CAD 100 in 2011 and CAD 200 as of 2012). While this new revenue stream should normally be counted in 'contributions to social insurance plans', it is not cyclically sensitive, and thus for technical reasons related to the calculation of cyclically adjusted measures, it is added directly to total revenue.

4.1.2. Provincial revenue from natural-resource royalties

For royalties from the exploitation of natural resources, the methodology is broadly the same, though the cyclical indicators are different (they were defined in subsection 2.2.5). They are projected using:

$$ROYALTIES_{i,t} = \frac{ROYALTIES_{i,t-1}}{GDPVTR_{i,t-1} \cdot PGDP_{i,t-1}} (1 + \sum_{j} \Delta COMPGAP_{j,t} * \varepsilon_{invinc,i,j})\, GDPVTR_{i,t} \cdot PGDP_{i,t} \qquad [18]$$

where $\varepsilon_{invinc,i,j}$ is the elasticity of investment income in province i to a change in the commodity-price gap for commodity index j (energy and non-energy) and other variables were defined previously. Making projections with this equation requires projections of commodity-price gaps. To this end, the level of the indices for the current year are estimated by taking their actual values for the months for which data are available and assuming the indices remain at the values of the last available month for the remainder of the year. For the following years to 2020, in the baseline projection, the indices are simply assumed to follow the US GDP deflator and the CAD/USD exchange rate as projected in *Outlook* 87's medium-term baseline, which means that they stay constant in real CAD terms. The commodity-price gaps then evolve

19. Projected increases in EI premiums engender about CAD 15 billion of extra revenue cumulatively over the 2011-2014 period. See Orr (2009) for the details.

following [9].[20] Because the equilibrium levels of the indices in [9] are determined by a 10-year moving average process, while the indices' projected real values remain constant, the commodity-price gaps tend toward zero near the end of the projection horizon. Observe from [18] that if commodity-price gaps do not change from one year to the next, revenue from resource royalties grows at the rate of potential output. The model's structure easily allows for simulating the effect of different commodity-price assumptions on government revenue.

4.2. Projections of non-cyclical budget flows and stocks

These are generally assumed to grow at the rate of potential output. Exceptions are investment income other than natural-resource royalties, and interest on the public debt. The general method is presented first, followed by the exceptions.

4.2.1. Non-cyclical budget components growing at nominal potential output

Most non-cyclical flows, as well as stocks of financial assets and accounts payable, are simply assumed to grow at the rate of nominal potential output. To take one example, other current transfers from persons (*OCTP*), a revenue entry, is assumed to evolve according to the equation:

$$OCTP_{i,t} = OCTP_{i,t-1}\frac{GDPVTR_{i,t}\cdot PGDP_{i,t}}{GDPVTR_{i,t-1}\cdot PGDP_{i,t-1}} \qquad [19]$$

which is equivalent to [17] with the elasticities in the parentheses set to zero. There is no particular rationale for assuming that non-cyclical budget flows and stocks grow at the rate of potential output, other than it is hard to think of a simpler and more neutral basis for a model in which the general trend is set by potential output growth. One could easily think of specific refinements to this projection method for each of the non-cyclical flow and stock categories. At the same time, these refinements would be unlikely to change the qualitative conclusions of the overall analysis significantly.

4.2.2. Investment income other than natural-resource royalties

Provincial investment income not attributable to natural-resource royalties (and all investment income at the federal level) is assumed to be a function of the previous year's stock of financial assets, which is assumed to grow at the rate of nominal potential output. In addition, as surpluses (positive net lending) are assumed to be applied to debt reimbursement, if market debt reaches zero, then surpluses are assumed to add to financial assets (in the form of negative market debt). This stock of financial assets is multiplied by an effective rate of return on financial assets to yield non-royalty investment income. The historical effective rate of return on financial assets is computed from historical data by dividing non-royalty investment income by financial assets. The average spread between this effective rate of return and the long-term interest rate in Canada (*IRL*, the interest rate on the 10-year federal government benchmark bond) is then computed for the period 2003-2007 (or 2004-2008 for the federal government, given the more up-to-date figures). Projections of the effective rate of interest on financial assets are then made by using the *Outlook* 87 medium-term baseline projections of *IRL* and assuming that the average spread just computed stays constant over the projection period.

20. For technical reasons having to do with the 10-year MA process and the large swings in commodity prices over the years 2007 to 2009, this method yields implausible projections for 2009 royalties in Saskatchewan and Alberta relative to official projections. The model's projections are thus overwritten with more plausible figures based on the observed level of commodity prices in 2009.

4.2.3. Public debt and interest on the public debt

Net debt in a given year is equal to net debt from the previous year minus net lending in that year. Gross debt and market debt are then obtained by identity with 'financial assets' and 'accounts payable and accrued liabilities' both assumed to grow at the rate of nominal potential output.[21] For the federal government, adjustments are made from 2009 to 2014 to take into account non-budgetary transactions that add to financial requirements. For instance, loans, investments and advances to Enterprise Crown Corporations as well as for the Insured Mortgage Purchase Program (part of the stimulus measures) add considerably to the federal government's stock of liabilities. Information on these transactions is sourced from budget documents.

Interest on the public debt is assumed to depend on the level of market debt, on interest rates and on the term structure of market debt. First, an effective interest rate on market debt ($r_{debt,t}$) is computed from historical data by dividing interest on the public debt by market debt. For projection purposes, this series is then modelled using a dynamic equation with interest-rate inertia. The degree of inertia is inversely related to the proportion of new debt issuance relative to current market debt. New debt is issued to refinance a certain proportion of existing debt and to finance the current year's deficit. Current market interest rates, a weighted average of short- and long-term rates, are paid on new debt issues, whereas the implicit interest rate of the previous period is paid on the non-refinanced debt. The dynamic equations are:

$$r_{debt,i,t} = \left(1 - RFSH_{i,t}\right) \cdot r_{debt,i,t-1} + RFSH_{i,t} \cdot (0.25 \cdot IRS_{federal,t} + 0.75 \cdot IRL_{federal,t}) \quad [20]$$

$$RFSH_{i,t} = \begin{cases} (RFSH_{i,ss} \cdot Debt_{i,t-1})/Debt_{i,t}, & Debt_{i,t} - Debt_{i,t-1} < 0 \\ (RFSH_{i,ss} \cdot Debt_{i,t-1} + Debt_{i,t} - Debt_{i,t-1})/Debt_{i,t}, & Debt_{i,t} - Debt_{i,t-1} \geq 0 \end{cases} \quad [21]$$

where $RFSH_{i,ss}$ is the steady-state share of debt refinanced each year in jurisdiction i and $RFSH_{i,t}$ is the share of market debt financed at current interest rates (including roll-overs and new issues to cover a deficit, if any). In the absence of new issues, $RFSH_{i,t} = RFSH_{i,ss}$. $IRS_{federal,t}$ is the 3-month government of Canada benchmark bond yield and $IRL_{federal,t}$ is the 10-year government of Canada benchmark bond yield, both from the *Outlook* database. The expression in parentheses in the second term of [20] is a composite interest rate assumed to represent the average interest rate at which new debt is issued. It is a weighted average of long and short-term federal rates, with the weights matching those used for all OECD countries in the *Outlook* medium-term baseline. $RFSH_{ss}$ is estimated econometrically using time-series data by substituting $RFSH_{ss}$ for $RFSH_t$ in [20] and constraining it to be between zero and one. The estimates not statistically significant at the 10% level (namely those for Newfoundland and the Northwest Territories) are set at the provincial average of 0.16. The Yukon's is also set at 0.16 as statistical problems prevent estimation. The results appear in Table 9 (detailed estimation results are in Table A2 in Appendix).

Table 9. **Estimated government debt refinancing shares**

Per cent of total market debt

	NL	PE	NS	NB	QC	ON	MB	SK	AB	BC	YT	NT&NU	Federal
RFSH	16	18	13	16	17	11	34	22	5	7	16	16	28

21. Note that unfunded liabilities of government employee pension plans are included in government debt figures from Statistics Canada's Provincial Economic Accounts on the basis that they have been explicitly recognised by governments and that these are broadly equivalent to issues of long-term government bonds. These liabilities amounted to 14.1% of GDP in 2007. However, they are not included in *Outlook* figures for general government gross financial liabilities, so aggregate debt figures from the model presented here cannot be directly compared to *Outlook* figures.

In the *Outlook* 87 medium-term baseline, IRS and IRL are projected on the basis of a gradual return to estimated neutral rates, taking into account the influence of projected national fiscal outcomes on government bond yields. There is indeed a literature showing that government bond rates are influenced by debt and deficits.[22] If and when general government indebtedness passes a threshold of 75% of GDP, the long-term interest rate is assumed to increase by four basis points for each additional percentage point increase in the debt-to-GDP ratio. This effect is consistent with the work of Laubach (2009) as well as with recent OECD work. In addition, on the basis of empirical evidence showing that historical interest-rate spreads between federal- and provincial-government bonds depend on relative debt burdens and fiscal balances,[23] $IRS_{t,i}$ and $IRL_{t,i}$ (for province/territory i) are based on their federal counterparts but adjusted upward by 0.3 basis points for each percentage-point difference between the net debt-to-GDP ratio of province i in year t and the federal government's; and downward by 4.4 basis points for each percentage point difference in net lending (a relatively higher deficit increases the spreads). The other underlying economic and fiscal assumptions are the baseline assumptions described in the next section. Figure 9 compares historical effective interest rates on market debt with the estimates obtained by [20]. It also shows projected future interest rates according to the methodology just described. A substantial fall in the effective cost of debt can be observed over the first few years of the projection period as governments are able to roll-over both short-term and long-term debt at historically-low yields.

Results in Table 9 show that the estimated refinancing share of the federal government is much higher than that of the provinces. To cross-verify this finding with other data sources, Table 10 shows recent statistics on government debt maturities for the federal and Ontario governments. These statistics indeed show that the federal government holds a higher proportion of short-term debt than the Ontario government. Federal debt instruments with a maturity within one year constitute a much higher proportion of total debt (37%) than the steady-state refinancing share estimated above (28%), but the latter is a historical average over many years. Also, the federal government now holds a lot of short-term debt, which was recently contracted to finance the extraordinary measures taken in response to the crisis (the Insured Mortgage Purchase Program, for example). Ontario, on the other hand, has about 16% of its market debt coming due within the next year, somewhat above the estimated re-financing rate (11%), the difference also no doubt partly due to recent borrowing activity in response to increasing deficits. Weighing federal and provincial estimated refinancing rates by their respective share of total market debt in 2006 yields a weighted-average steady-state refinancing share of roughly 20% for the country as a whole.

4.3. Discretionary fiscal variables and inter-governmental transfers

For both the federal and provincial/territorial governments, net current expenditure on goods and services, investment in fixed capital and inventories and current transfers to businesses are considered discretionary variables, that is, they are kept completely exogenous in the model. For the federal government, this is also true of federal transfers to provinces, which can be set independently for each province/territory, and for provinces and territories, it is true of transfers to local governments. These

22. For references to this empirical evidence as well as an analysis of the effects of fiscal policy on output and debt sustainability with endogenous government bond spreads in a dynamic stochastic general equilibrium framework, see Furceri and Mourougane (2010).

23. The provincial adjustments are based on results reported in Schuknecht, Hagen and Wolswijk (2008). See Booth, Georgopoulos and Hejazi (2007) for similar results.

Figure 9. **Historical estimates and projections of the effective interest rate on market debt**

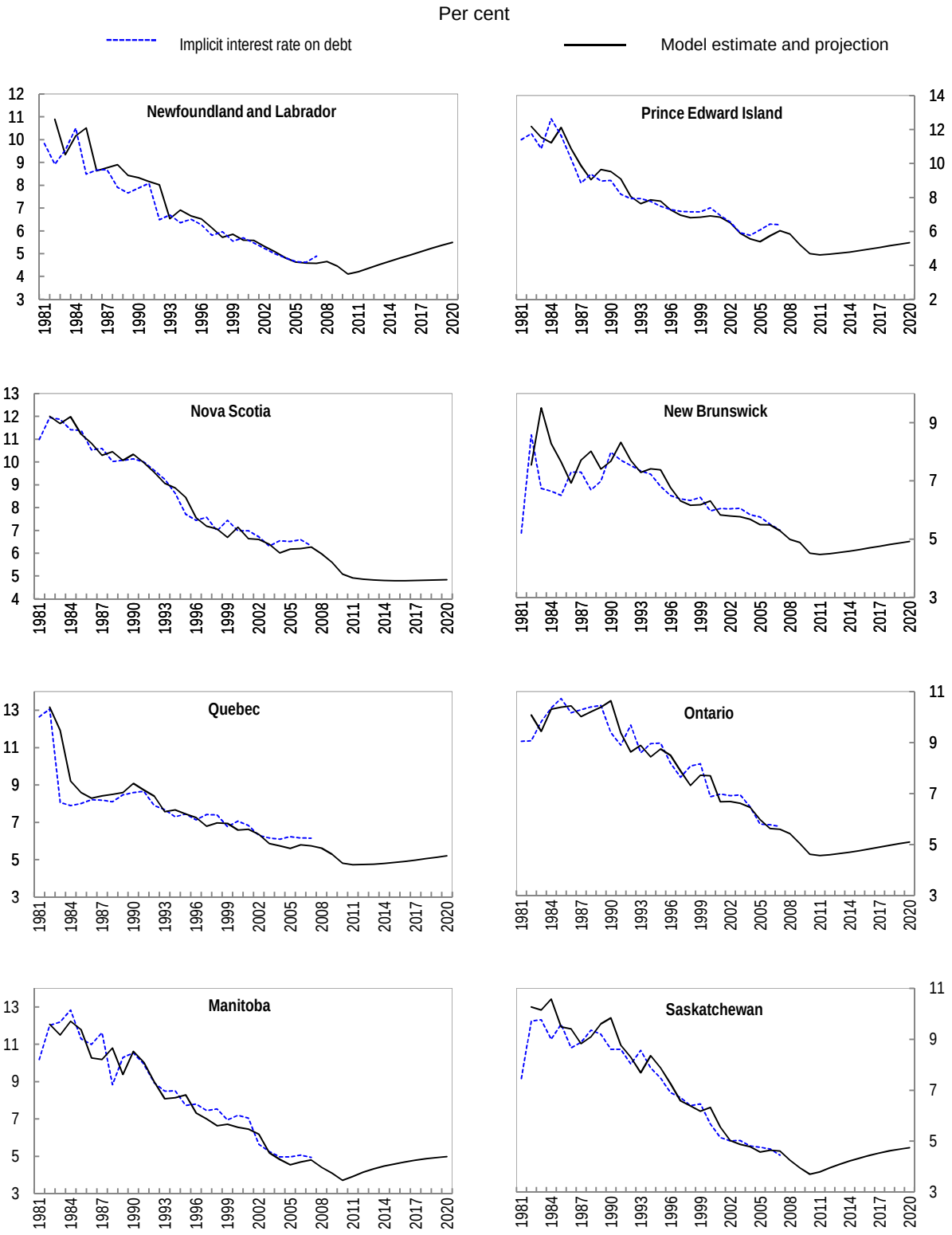


Figure 9. **Historical estimates and projections of the effective interest rate on market debt** (*continued*)

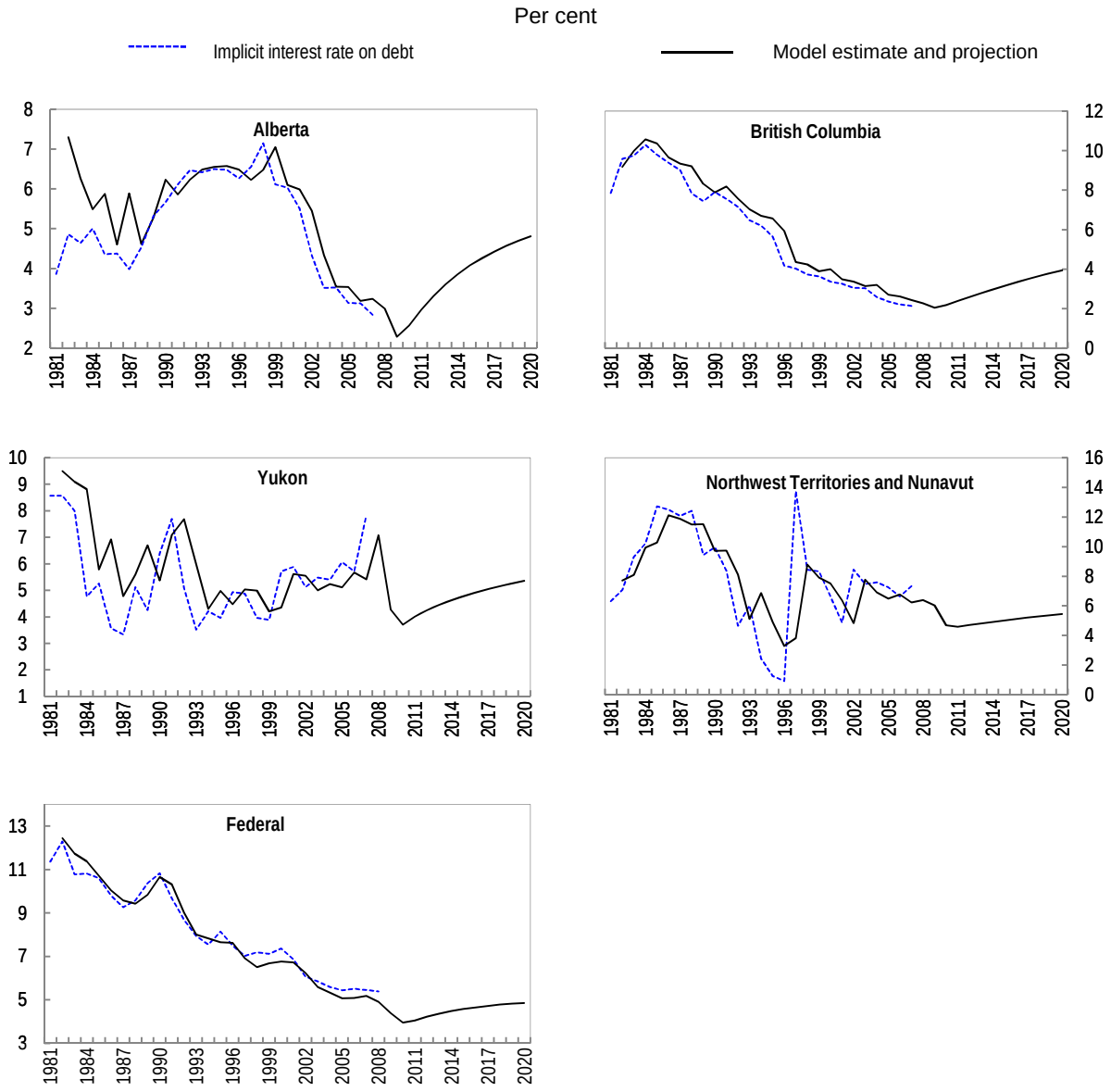


Table 10. **Government debt maturity structures as of spring 2010**

Per cent of total market debt to mature

	Federal	Ontario
Within 1 year	37	16
1 to 10 years	46	51
10 to 20 years	7	13
20 to 30 years	11	20

Sources: Figures for the federal government are from the Bank of Canada's April 2010 report *Government of Canada Treasury Bills and Domestic Marketable Bonds Outstanding*. Figures for Ontario are from the 2010 Ontario Budget.

categories are taken to be the most readily accessible levers of fiscal policy at the respective government levels, and together they account for a large share of expenditure. Tax rates are not considered discretionary variables. Except for some significant changes outlined in subsection 4.1.1, they are assumed unchanged. Part of the reason is that it is easier to construct scenarios using spending changes than tax changes. Also, the federal government has committed not to raise taxes as part of its fiscal consolidation strategy, and to focus on curbing direct programme spending. Some provinces may have to raise taxes, however, and the model could be refined to simulate such changes.

For the federal government, transfers received from provincial governments, which account for only a tiny share of federal government revenue, are assumed to grow at the rate of nominal potential output (see subsection 4.2.1), and there are no transfers received from local governments. Federal transfers to local governments, which are equally negligible, are also assumed to grow at the rate of nominal potential output. For the provincial/territorial governments, transfers received from the federal government are simply the counterpart to the assumed federal-to-provincial transfers, while transfers received from local governments are assumed to grow at the rate of nominal potential output. Transfers received from local governments account for only a tiny share of provincial/territorial revenue.

4.4. Local-government sector

As could be garnered from Table 8, the model includes a local-government sector for each province and territory. Because the model's eventual aim is to perform fiscal simulations for the federal and for provincial governments as separate from the local sector, projections for the local sector are not developed in detail. They are needed, however, for the construction of a total-government sector. Local-government-sector fiscal data come from the Provincial Economic Accounts, and the accounting framework is similar to the one shown in Table 8, except that, on the revenue side, transfers come from the provincial and federal governments, and, on the spending side, the only transfers are to provincial governments. These are of course assumed to be the counterpart to federal and provincial downstream transfers as described in the previous subsection. Every other revenue and spending category is simply assumed to grow at the rate of nominal potential output in the relevant province. In addition, the local-government part of the model contains only fiscal flows. Stocks (debt, etc.) are not considered. Municipal interest costs on debt and investment income are also assumed to grow at the rate of nominal potential output.

4.5. Other government-sector aggregates and other outputs of the model

The disaggregated fiscal projections for the federal and for provincial/territorial governments can be aggregated with those for local governments into a total-government sector. Recall from subsection 2.4.3 that the total-government sector is not directly comparable to the general-government sector as defined in the *Outlook* because the Canada and Quebec Pension Plans are excluded and government current expenditure on goods and services is recorded on a net basis. When considering total-government fiscal aggregates, federal-provincial, federal-local and provincial-local fiscal transfers are of no consequence, but all the other parts of the fiscal-projection model influence the results. Cyclically adjusted revenue, expenditure and net lending projections, disaggregated or aggregated at the total-government level, can be calculated in the same manner as for historical data as explained in subsection 2.4.1.

5. Assumptions and results for the baseline projections

This section describes the short- and medium-term fiscal assumptions that underlie the baseline projections. It then presents disaggregated results at the federal and provincial/territorial levels and also aggregated results at the total-government level and compares the latter to *Outlook* 87 projections. Results

for scenarios other than the baseline are presented and discussed in the 2010 *OECD Economic Survey of Canada*.

5.1. Assumptions for discretionary fiscal variables

To produce a baseline or any other fiscal projection, assumptions have to be made as to the evolution of discretionary fiscal variables over the projection period. As explained in section 2.1, for the federal government assumptions up to 2009 are not necessary because official estimates are available from the National Accounts. For the provinces and territories, 2009 assumptions are necessary. They are derived from official budget documents, including public accounts, spring budgets and budget updates. Budget estimates reflect fiscal-policy settings and commitments, some of which have already been passed into law, so it makes sense to base assumptions on them. As pointed out above, applying budget estimates to the Provincial Economic Accounts introduces imprecision due to differences of coverage and inclusion between the two frameworks. To reduce such imprecision, which come mainly from differences in levels, growth rates derived from budget figures are applied to the last official estimates. Imprecision related to taking growth rates on a fiscal-year basis as opposed to calendar-year remains, however, as does imprecision related to the differences between accrual and cash accounting. These sources of imprecision underlie the importance of not putting too much weight on the fiscal projections of any one year, but instead to consider the path of fiscal variables through time. For although in any given year a revenue or expenditure category in the model can be significantly affected by accounting-concept differences with budgets, the time path of that revenue or expenditure category – as well as whether a stock variable such as debt is above or below a certain threshold by the end of the projection period – should not be significantly affected. With these caveats in mind, the correspondence assumptions made for linking budget documents to the Provincial Economic Accounts framework are as follows:

- ‘net current expenditure on goods and services’ and ‘current transfers to businesses’ are assumed to grow at the budgeted rate of growth of programme/operating expenditure. The reason for applying this assumption to transfers to businesses is that there is typically no budget line that corresponds closely to transfers to businesses, and in any case these are invariably a small share of current expenditures.

- ‘investment in fixed capital and inventories’ is assumed to grow at the rate of growth of capital expenditure, or, when available in the statement of change in net debt, of acquisition of tangible capital assets.

- The rates of growth of federal transfers are collated from provincial and territorial budgets.

- The rates of growth of provincial transfers to local governments are assumed to remain at their 1997-2007 average growth rates.

For 2011 and beyond, the varying projection horizons of budget documents across jurisdictions present a dilemma. For some jurisdictions there is no information beyond the current (2010/11) fiscal year. Basing assumptions for 2011 and beyond on budget information for some jurisdictions when it is available but not for others would make the interpretation of the results difficult. A more neutral and easy-to-interpret approach is to use business-as-usual assumptions under which recent historical growth rates are used as a projection basis. The purpose of the model being to assess the influence of different decisions by policy makers regarding these discretionary variables on fiscal balances and sustainability, various assumptions can later be tried to generate different scenarios, and better reflect announced policy and published fiscal-consolidation paths, keeping the baseline as a guide to what would have happened without policy changes from recent history. Therefore, the assumptions made for 2011 and later years (except where indicated) in each jurisdiction are as follows:

- The rate of growth of federal 'current transfers to provincial governments' is assumed to be 4.8%, based on a weighted average of the size of major transfers and their expected growth rates. The Canada Health Transfer (CHT) and the Canada Social Transfer (CST) are currently legislated to grow at 6% and 3%, respectively, and Equalization grows at a three-year moving average of nominal GDP growth. After the current legislation expires in 2013/14, the overall rate of growth of federal transfers remains at 4.8% on a business-as-usual basis.

- The growth rates of 'net current expenditure on goods and services' and 'current transfers to businesses' are set equal to the average rate of growth of 'net current expenditure on goods and services' over the 1997 to 2007 period. The reason why historical growth rates of 'current transfers to businesses' are not used is that there is too much year-to-year variation in this expenditure category historically, especially in small provinces, so the growth rate would depend too much on the particular start and end years.

- The level of 'investment in fixed capital and inventories' returns to its 2008 level in 2011. Most jurisdictions have large increases in this spending category in both 2009 and 2010 because a significant portion of provincial stimulus spending is targeted to infrastructure with the help of federal co-financing. The assumption is that stimulus spending is gradually withdrawn in 2011 and capital spending falls back to its 2008 level. Post 2011, 'investment in fixed capital and inventories' grows at its average rate of growth over the 1997-to-2007 period (1999 to 2009 for the federal government).

- The growth rate of provincial/territorial 'current transfers to local governments' is assumed to remain at its 1997-2007 average until the end of the projection period.

Table 11 collects all the short- and medium-term fiscal assumptions made for the baseline projection, separating the ones that will change in other scenarios and simulations from those that will not.

Table 11. **Assumptions on fiscal variables for the projection period**

Per cent growth rates

Growth rate of…		NL	PE	NS	NB	QC	ON	MB	SK	AB	BC	YT	NT&NU	Federal
Variables that change after 2010 depending on the scenario														
… current transfers from federal government	2009	-38.1	13.5	10.5	4.3	8.6	11.9	5.3	-6.8	18.8	14.1	3.9	2.3	n.a.
	2010	15.1	-0.2	-1.7	0.5	0.6	27.6	1.3	5.8	2.4	12.5	5.2	6.4	
	2011-13	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	
	2014-20	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	
… net current expenditure on goods and services and transfers to businesses	2009	15.7	9.8	6.3	6.7	3.8	14.8	6.9	-1.9	0.3	6.7	11.5	1.3	actual
	2010	3.5	5.9	-0.3	1.6	2.9	6.5	1.5	0.6	3.9	2.0	-3.8	1.2	3.1
	2011	8.7	5.9	5.1	5.1	5.4	6.5	6.4	5.9	8.5	4.4	6.1	6.5	5.3
	Post-2011	8.7	5.9	5.1	5.1	5.4	6.5	6.4	5.9	8.5	4.4	6.1	6.5	5.3
… investment in fixed capital and inventions	2009	24.4	50.1	18.1	42.7	56.9	37.1	30.9	14.8	-1.3	6.2	54.2	5.1	actual
	2010	79.6	-2.8	-9.2	45.0	3.8	15.3	39.2	-17.3	5.9	34.9	-13.8	-33.3	9.1
	2011	-55.2	-31.5	-6.8	-51.7	-38.6	-36.7	-45.1	5.3	-4.3	-30.2	-24.8	42.6	-15.9
	Post-2011	7.0	6.8	8.7	2.8	10.6	9.3	7.0	7.0	20.0	10.6	7.0	7.0	3.7
Variables that do no change														
… current transfers to local governments	2009	2.8	5.2	2.9	1.0	4.4	5.8	1.7	5.3	8.0	2.0	-0.4	6.1	n.a.
	2010	2.8	5.2	2.9	1.0	4.4	5.8	1.7	5.3	8.0	2.0	-0.4	6.1	
	2011	2.8	5.2	2.9	1.0	4.4	5.8	1.7	5.3	8.0	2.0	-0.4	6.1	
	Post-2011	2.8	5.2	2.9	1.0	4.4	5.8	1.7	5.3	8.0	2.0	-0.4	6.1	

5.2. Results for the baseline case

Using the baseline fiscal assumptions just described, the model can produce fiscal projections to 2020 under deterministic- or stochastic-demand approaches.

5.2.1. Results under the deterministic approach

Recall that the baseline projection uses the same assumption used in the *Outlook* 87 medium-term baseline, in which the country-wide output gap closes smoothly by 2015. This assumption is implemented here by assuming that the provincial/territorial output gaps projected for 2011 on the basis of the supply-side and the fixed short-term demand-side projections close linearly by 2015. The resulting projected primary- and total-budget balances are shown in Figure 10, while Figure 11 shows the evolution of gross and net debt. Because assets and debt at the local level are not part of the model, there is no balance-sheet projection for total government.

5.2.2. Results under the stochastic approach

Recall that stochastic provincial GDP growth projections for years 2012 to 2020 are randomly drawn out of a multivariate normal distribution whose mean, standard deviation and cross-correlation parameters are based on historical provincial growth rates from 1981 to 2008. The stochastic-approach fiscal projections are based on 1 000 simulations. Table 12 shows summary statistics for average real and nominal GDP growth rates over 2012-2020 in these simulations. Short-term projections are also shown for comparison purposes. Table 13 presents summary statistics for net lending as a percentage of GDP for each projection year, as well as summary statistics for net and gross debt as a percentage of GDP in 2020. Figure 12 shows the full statistical distributions of provincial net debt in 2020. Based on these distributions, which can be produced for any fiscal variable of interest and any projection year, the probability that governments will be able to meet certain fiscal targets over a given period can be calculated. For instance, the probability that the federal government would meet a target of reducing the net debt-to-GDP ratio below 25% by 2020 is 52% in the baseline scenario. A desired likelihood of reaching some fiscal target by a certain year can be based on these probabilities and fiscal rules or strategies that meet this likelihood can be devised. For instance, if the federal government would like to be at least 80% sure that the above target will be achieved by 2020, a series of intermediate deficit targets consistent with achieving the objective can be derived.

Figure 10. **Projections of total and primary budget balances in the deterministic approach**

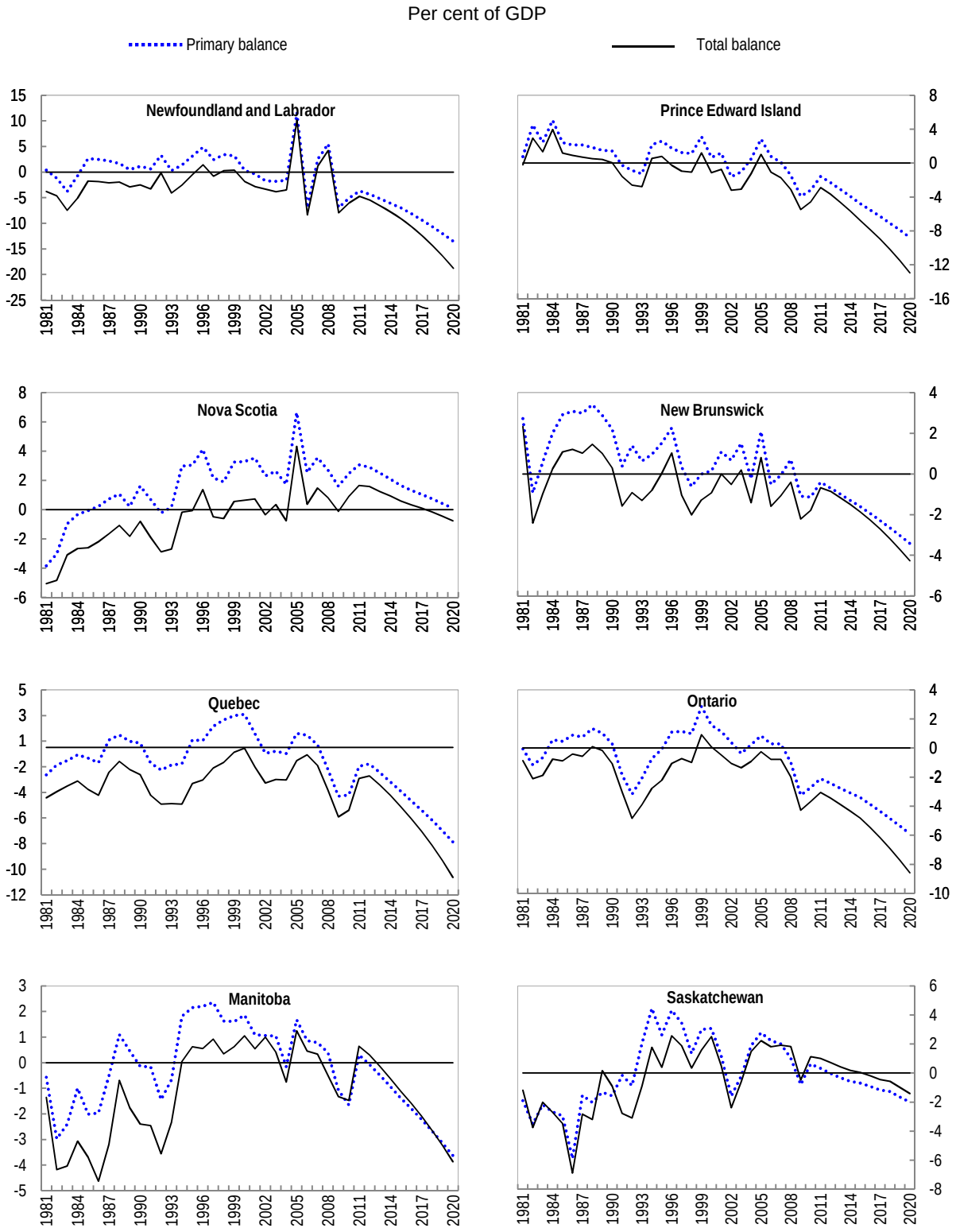


Figure 10. **Projections of total and primary budget balances in the deterministic approach** *(continued)*

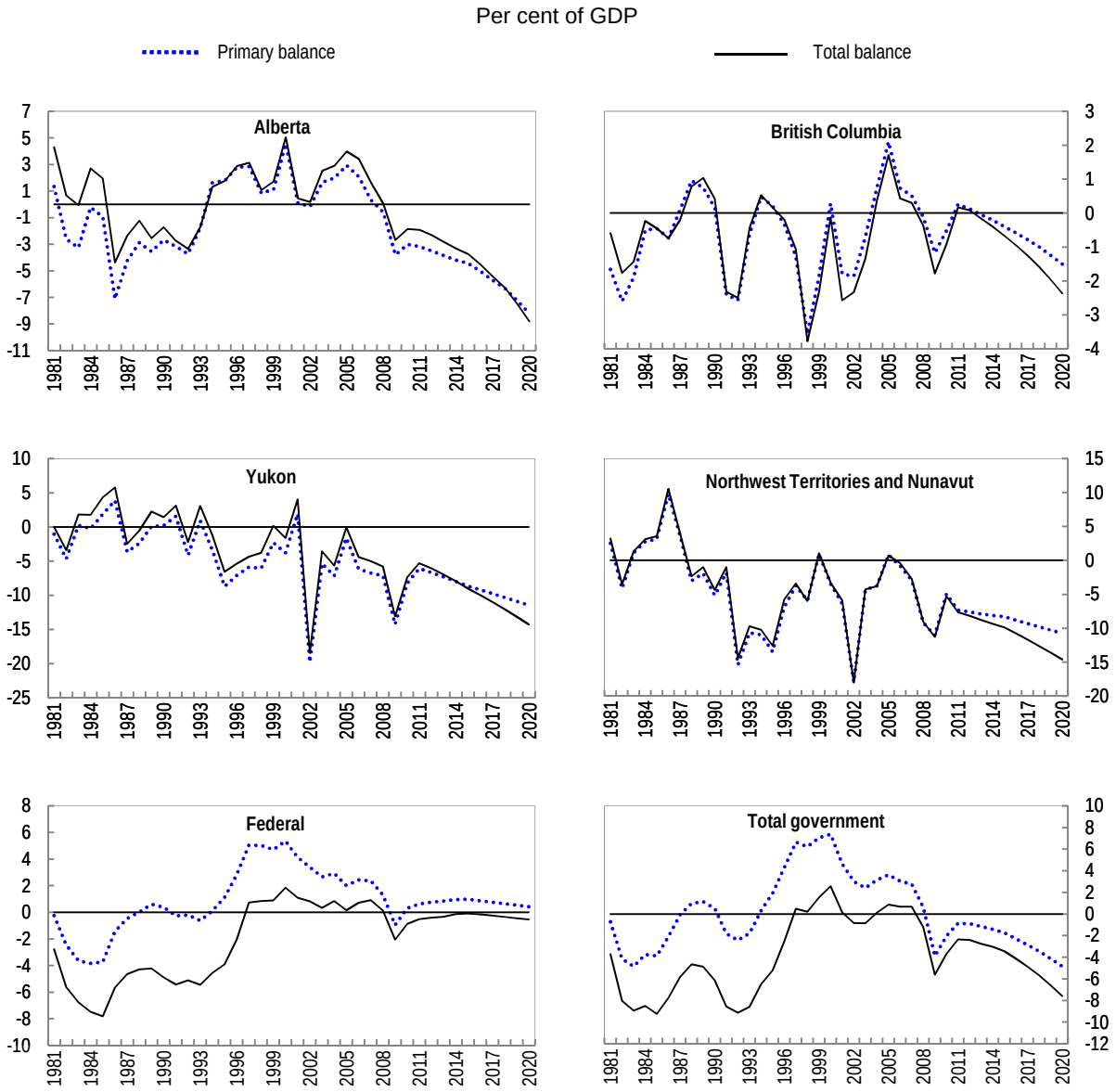


Figure 11. **Projections of gross and net government debt in the deterministic approach**

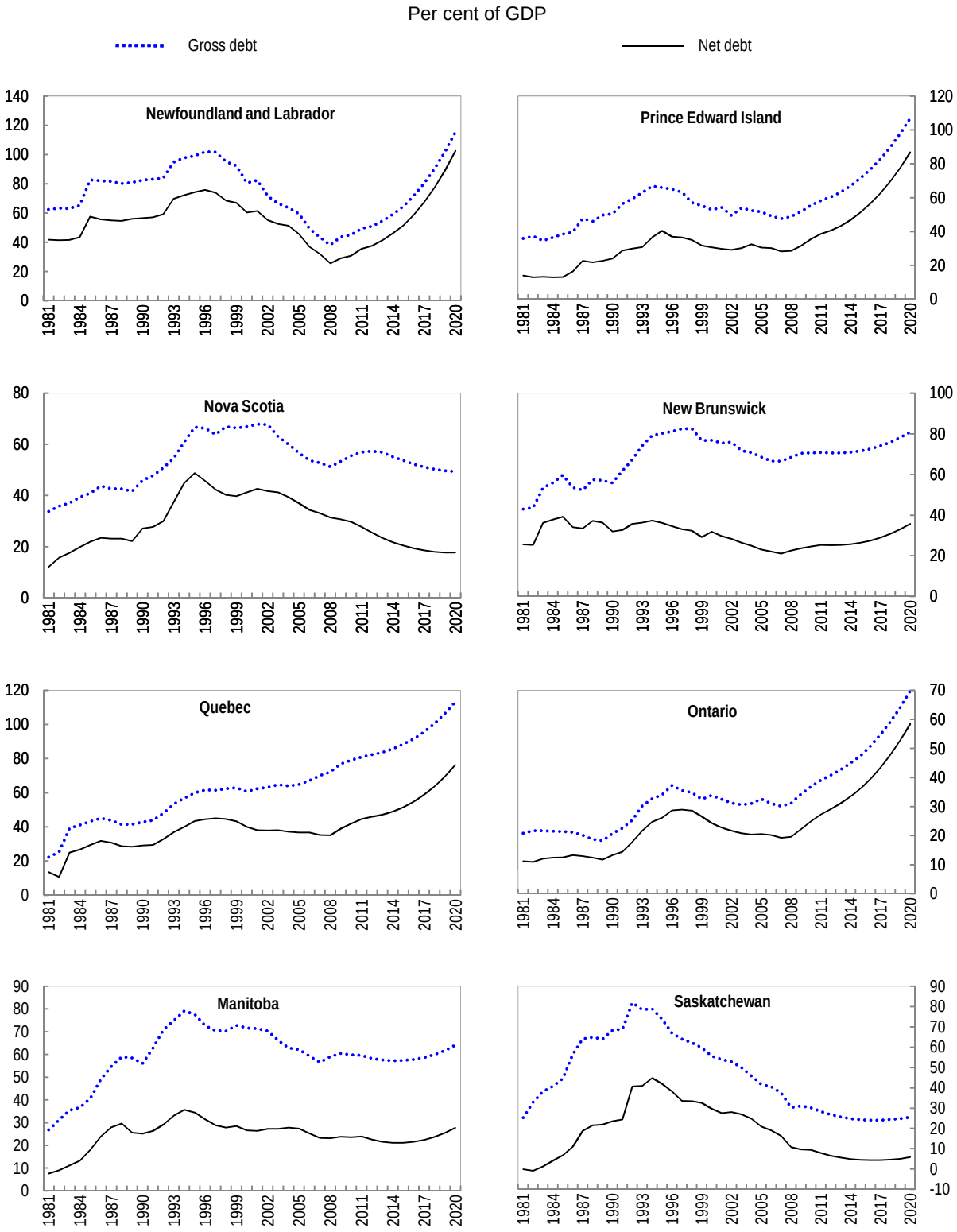


Figure 11. **Projections of gross and net government debt in the deterministic approach** (*continued*)

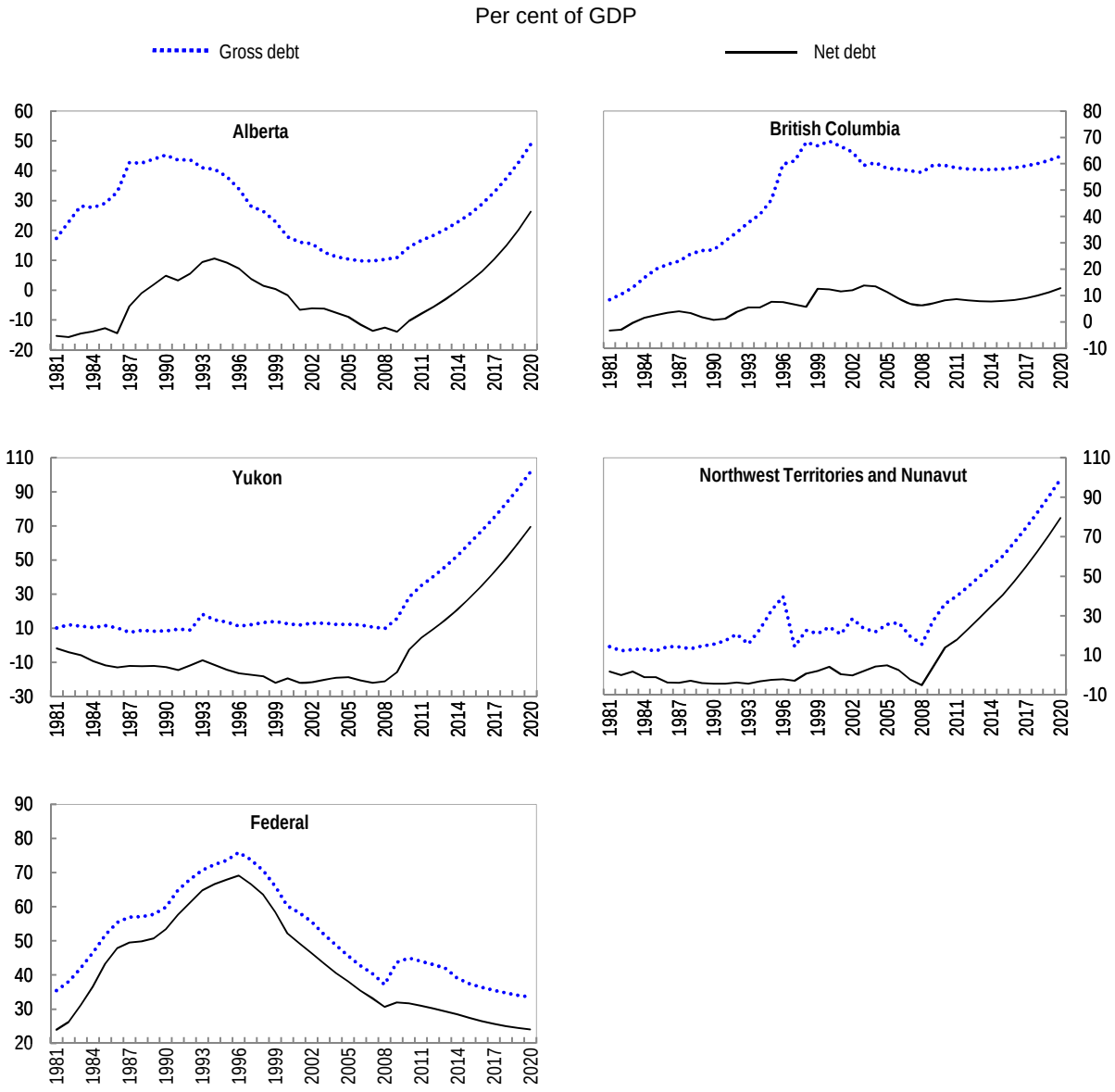


Table 12. **Summary statistics on GDP growth in the stochastic approach**

Per cent growth rates

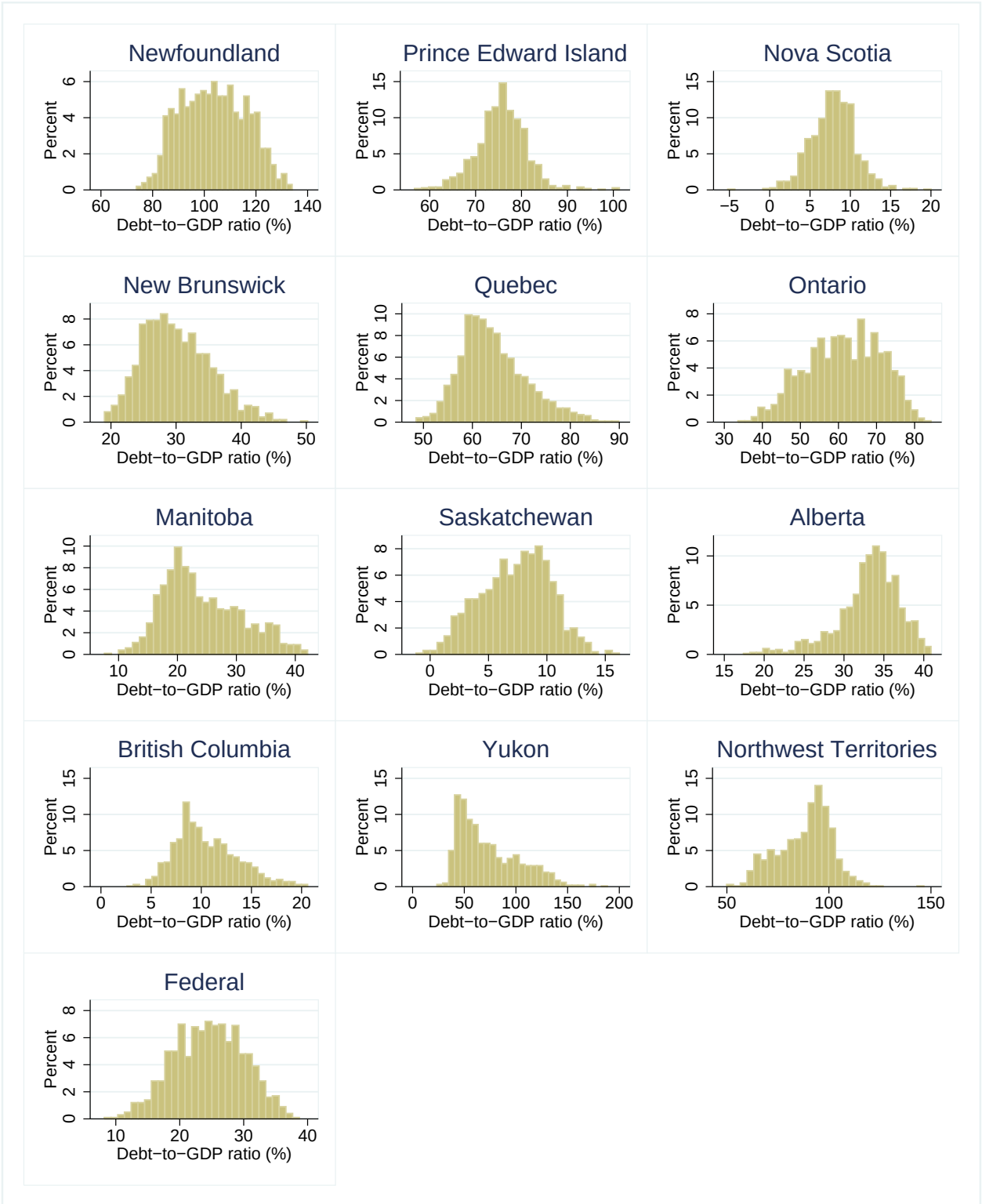
		NL	PE	NS	NB	QC	ON	MB	SK	AB	BC	YT	NT&NU	Canada
		Real GDP growth												
2009		-9.5	0.7	-0.4	-0.7	-0.8	-2.8	-0.1	-5.9	-4.7	-2.0	1.4	-7.1	-2.7
2010		4.2	2.8	2.6	2.7	3.1	3.6	3.2	4.4	3.8	4.1	5.5	9.6	3.6
2011		2.8	2.3	2.7	2.6	2.9	2.9	3.1	3.8	4.0	4.0	4.0	3.9	3.2
	2012	2.5	0.2	-0.1	1.1	0.3	2.6	0.9	2.4	5.5	1.0	1.7	7.0	2.2
	2013	2.4	0.0	-0.1	1.0	0.2	2.6	0.9	2.4	5.4	1.0	1.7	6.9	2.2
	2014	2.4	0.2	-0.1	1.0	0.1	2.6	0.8	2.3	5.4	1.0	1.6	6.9	2.2
Deter-	2015	2.3	0.1	-0.1	1.0	0.1	2.6	0.8	2.3	5.3	0.9	1.6	6.8	2.2
minis-	2016	0.9	0.7	0.5	0.8	0.5	1.6	1.3	1.4	3.2	1.0	3.0	4.0	1.5
tic	2017	0.9	0.8	0.5	0.8	0.5	1.5	1.2	1.4	3.2	1.0	3.0	4.0	1.5
	2018	0.9	0.6	0.5	0.7	0.5	1.5	1.2	1.4	3.1	1.0	3.0	4.0	1.5
	2019	0.9	0.7	0.4	0.7	0.5	1.5	1.2	1.3	3.1	1.0	3.0	4.0	1.5
	2020	0.9	0.7	0.4	0.7	0.4	1.4	1.2	1.3	3.1	0.9	3.0	4.0	1.4
	Average 2012-20	1.6	0.8	0.6	1.3	0.9	1.9	1.2	1.6	3.5	1.2	4.7	2.1	1.8
Sto-	S.D.	0.5	0.1	0.1	0.3	0.2	0.5	0.4	0.4	0.3	0.3	0.9	1.8	0.3
chas-	Min	0.5	0.0	0.2	0.4	0.0	0.9	0.4	0.8	2.7	0.3	2.2	-2.2	1.1
tic	Max	2.8	1.3	1.1	1.8	1.4	3.2	2.0	2.6	4.9	1.9	7.6	5.9	2.5
		Nominal GDP growth												
2009		-26.7	0.6	-0.5	-2.7	-1.4	-2.9	-0.5	-7.0	-9.0	-4.5	-3.0	-10.0	-4.5
2010		20.0	4.5	4.0	5.5	6.0	6.2	6.2	8.5	9.5	8.1	8.1	13.0	7.2
2011		4.0	3.7	4.0	4.0	4.8	4.8	4.9	5.2	6.0	5.5	8.0	8.0	5.1
	2012	6.9	2.4	2.1	3.0	2.5	4.4	3.1	4.4	7.4	3.3	4.3	8.9	4.4
	2013	4.1	2.1	2.0	3.0	2.3	4.4	3.0	4.2	7.1	3.0	4.0	8.4	4.2
	2014	4.3	2.3	2.0	3.0	2.2	4.5	2.9	4.3	7.3	3.0	3.9	8.7	4.3
Deter-	2015	4.5	2.2	2.0	3.1	2.2	4.7	3.0	4.5	7.5	3.0	3.8	9.0	4.5
minis-	2016	3.0	2.8	2.6	2.9	2.6	3.7	3.4	3.6	5.4	3.2	5.2	6.2	3.7
tic	2017	3.0	2.9	2.6	2.9	2.6	3.7	3.4	3.5	5.3	3.1	5.2	6.2	3.7
	2018	3.0	2.8	2.6	2.8	2.6	3.6	3.4	3.5	5.3	3.1	5.2	6.2	3.7
	2019	3.1	2.8	2.5	2.9	2.6	3.6	3.3	3.5	5.3	3.1	5.2	6.2	3.7
	2020	3.0	2.8	2.5	2.8	2.5	3.6	3.3	3.5	5.3	3.1	5.2	6.2	3.7
	Average 2012-20	3.9	3.2	3.1	3.7	3.4	3.8	3.6	3.5	5.1	3.6	6.4	4.6	3.9
Sto-	S.D.	1.0	0.4	0.3	0.6	0.5	1.0	0.8	0.7	0.6	0.7	1.5	3.2	0.6
chas-	Min	1.7	1.5	2.0	1.6	1.7	1.7	1.7	1.6	3.8	1.7	1.7	-3.7	2.5
tic	Max	6.7	4.5	4.3	5.1	4.9	7.1	5.6	5.5	7.7	5.4	11.9	12.8	6.1

Table 13. **Summary statistics on deficits and debt in the stochastic approach**

Per cent of GDP

		NL	PE	NS	NB	QC	ON	MB	SK	AB	BC	YT	NT&NU	Federal
								Net lending						
2009		-8.0	-5.5	-0.1	-2.2	-5.4	-4.3	-1.3	-0.5	-2.7	-1.8	-13.1	-11.3	-2.1
2010		-6.0	-4.6	0.9	-1.8	-4.9	-3.7	-1.5	1.1	-1.9	-0.9	-7.3	-5.3	-0.9
2011		-4.7	-2.9	1.7	-0.7	-2.4	-3.1	0.6	1.0	-1.9	0.2	-5.3	-7.6	-0.5
2012	Average	-5.6	-3.3	1.9	-0.8	-2.1	-3.5	0.4	0.7	-2.5	0.1	-6.0	-8.1	-0.4
	S.D.	0.3	0.4	0.2	0.2	0.2	0.4	0.4	0.1	0.2	0.1	1.2	0.6	0.3
	Min	-6.6	-4.6	1.1	-1.6	-2.7	-4.8	-0.7	0.2	-2.7	-0.3	-10.5	-8.6	-1.3
	Max	-4.5	-2.1	2.7	-0.1	-1.5	-2.4	1.5	1.0	-1.2	0.6	-3.4	-6.0	0.5
2013	Average	-6.8	-4.0	1.9	-1.0	-2.5	-4.0	0.1	0.4	-3.2	0.0	-6.9	-8.9	-0.3
	S.D.	0.5	0.4	0.3	0.3	0.4	0.6	0.5	0.2	0.4	0.2	1.9	0.9	0.5
	Min	-8.2	-5.6	0.7	-2.0	-3.8	-5.5	-1.4	-0.2	-3.7	-0.9	-16.8	-13.4	-1.5
	Max	-5.1	-2.6	3.2	0.1	-1.5	-2.0	1.4	1.0	-1.6	0.5	-3.4	-5.5	1.1
2014	Average	-8.0	-4.7	1.9	-1.1	-3.0	-4.5	-0.3	0.1	-3.9	-0.2	-7.7	-9.7	-0.2
	S.D.	0.8	0.5	0.3	0.5	0.6	0.8	0.6	0.3	0.5	0.3	2.5	1.3	0.6
	Min	-9.9	-6.9	0.5	-2.8	-5.2	-6.4	-2.1	-0.7	-4.8	-1.3	-19.2	-14.9	-1.7
	Max	-5.8	-3.1	3.3	0.1	-1.5	-2.1	1.2	0.9	-2.0	0.5	-3.6	-5.8	1.5
2015	Average	-9.4	-5.6	1.8	-1.4	-3.6	-5.1	-0.6	-0.1	-4.6	-0.4	-8.7	-10.6	-0.2
	S.D.	1.1	0.6	0.4	0.6	0.7	1.0	0.8	0.4	0.6	0.4	3.2	1.5	0.6
	Min	-11.9	-8.5	0.2	-3.3	-6.3	-7.6	-2.9	-1.0	-5.9	-1.5	-22.6	-17.0	-1.8
	Max	-6.7	-3.7	3.4	0.0	-2.0	-2.2	1.1	0.9	-2.3	0.5	-3.6	-6.1	2.0
2016	Average	-11.0	-6.5	1.7	-1.6	-4.3	-5.8	-1.1	-0.4	-5.6	-0.6	-9.9	-11.6	-0.2
	S.D.	1.3	0.7	0.4	0.7	0.8	1.1	0.9	0.4	0.7	0.4	3.8	1.8	0.7
	Min	-14.3	-9.9	0.1	-4.1	-7.3	-8.6	-3.6	-1.6	-7.1	-1.9	-26.4	-19.3	-2.0
	Max	-7.8	-4.3	3.5	-0.2	-2.4	-2.4	1.0	0.8	-2.9	0.4	-3.6	-6.4	2.1
2017	Average	-12.7	-7.4	1.6	-2.0	-5.0	-6.5	-1.5	-0.7	-6.7	-0.9	-11.1	-12.8	-0.3
	S.D.	1.6	0.8	0.4	0.8	0.9	1.3	1.0	0.5	0.8	0.5	4.5	2.0	0.8
	Min	-16.3	-11.4	-0.3	-4.8	-8.3	-9.9	-4.4	-2.1	-8.3	-2.4	-29.4	-21.1	-2.4
	Max	-8.9	-5.0	3.6	-0.3	-2.8	-2.8	0.9	0.7	-3.6	0.4	-3.6	-7.0	2.0
2018	Average	-14.6	-8.5	1.5	-2.3	-5.8	-7.4	-2.1	-0.9	-7.8	-1.2	-12.4	-14.0	-0.4
	S.D.	1.9	0.9	0.4	0.9	1.0	1.5	1.1	0.6	0.8	0.6	5.2	2.2	0.8
	Min	-19.1	-12.6	-0.7	-5.7	-9.9	-10.9	-5.3	-2.6	-9.7	-3.0	-33.9	-23.6	-2.7
	Max	-10.1	-5.6	3.5	-0.4	-3.4	-3.0	0.8	0.8	-4.5	0.3	-3.5	-7.7	2.2
2019	Average	-16.7	-9.6	1.3	-2.6	-6.7	-8.2	-2.6	-1.3	-9.2	-1.5	-13.8	-15.3	-0.5
	S.D.	2.2	1.0	0.5	1.0	1.2	1.7	1.3	0.7	0.9	0.7	6.0	2.5	0.9
	Min	-21.9	-14.5	-1.1	-6.5	-11.4	-12.5	-5.9	-3.4	-11.3	-3.6	-39.0	-25.6	-2.9
	Max	-11.3	-6.4	3.5	-0.5	-3.9	-3.2	0.3	0.6	-5.5	0.2	-3.5	-8.1	2.2
2020	Average	-19.0	-10.8	1.2	-3.0	-7.7	-9.1	-3.2	-1.8	-10.8	-1.8	-15.3	-16.5	-0.7
	S.D.	-2.6	1.1	0.5	1.1	1.3	2.0	1.4	0.8	1.1	0.8	6.8	2.7	1.0
	Min	-25.4	-16.4	-1.3	-7.1	-12.5	-13.8	-6.7	-4.2	-13.4	-4.3	-41.4	-28.5	-3.0
	Max	-12.7	-7.2	3.5	-0.6	-4.4	-3.5	0.1	0.3	-6.4	0.1	-3.8	-8.4	2.3
								Net debt						
2009		29.0	31.6	30.7	23.6	39.0	22.2	23.8	9.7	-13.9	7.0	-15.8	4.3	32.0
2010		30.8	35.4	29.7	24.5	41.9	25.0	23.6	9.4	-10.3	8.1	-2.5	13.8	31.7
2011		35.4	38.6	27.7	25.3	44.7	27.3	23.9	7.9	-7.9	8.6	4.5	17.7	31.0
Average in 2020		103.7	75.6	7.9	30.1	64.4	61.3	24.2	7.4	33.1	10.6	73.4	88.3	24.6
S.D.		12.5	5.5	2.8	5.3	6.7	9.7	6.6	3.0	3.9	3.1	29.4	13.0	5.4
Min		73.7	56.7	-5.2	19.0	48.5	33.6	7.6	-1.2	17.4	2.6	23.5	49.9	8.2
Max		134.0	101.3	20.0	50.2	89.9	84.3	42.1	16.2	40.9	20.6	188.4	146.5	38.7
								Gross debt						
2009		43.6	51.9	53.3	70.5	76.9	34.3	60.5	31.1	10.8	59.5	15.7	27.6	43.6
2010		45.1	55.4	55.5	70.6	78.9	36.8	59.7	30.2	14.4	59.3	28.3	36.0	45.0
2011		49.4	49.4	49.4	49.4	49.4	49.4	49.4	49.4	49.4	49.4	49.4	49.4	49.4
Average in 2020		116.5	95.2	38.0	73.6	99.6	72.7	59.9	27.4	56.9	59.5	106.7	109.2	34.1
S.D.		13.0	5.7	3.1	6.2	7.2	10.2	7.6	3.5	4.3	4.2	34.5	14.5	5.7
Min		85.4	75.4	23.2	60.5	82.2	43.7	41.3	17.5	39.1	48.9	47.3	66.2	16.8
Max		148.1	122.4	51.9	96.9	126.8	96.7	79.4	37.7	65.3	73.0	237.0	171.9	48.7

Figure 12. **Frequency distributions of government net debt in 2020 in the stochastic approach**



Concluding remarks

Results from the baseline projections suggest that, prior to the post-crisis fiscal-consolidation strategies announced by the federal government and most provinces and territories, several governments were on unsustainable fiscal paths, with rapidly worsening deficits over the coming decade and no doubt even worse to come after 2020 when fiscal costs associated with demographic change will intensify. The 2010 *OECD Economic Survey of Canada* makes use of the model described in this paper to study fiscal sustainability for each government in more details and examine the required degree of fiscal stringency to balance the budget or achieve some other suggested fiscal objectives over the medium term.

The outputs and analyses derived from the model are only as reliable as the model is realistic. It is therefore useful to conclude on the model's weaknesses, which point toward the main avenues for improvement:

- *Improving the quality of provincial fiscal inputs for years just before the projection period.* Provincial-government accounts being published with approximately a two-year lag in the Provincial Economic Accounts (PEA), estimates for missing years are made on the basis of timelier budget documents that rely on the public-accounts accounting framework. However, as pointed out above, there are important discrepancies between the accounting conventions of the two sets of accounts. Developing tools to estimate government accounts more precisely on the basis of public-accounts documents before official PEA releases would greatly improve the starting point for the fiscal projections and therefore improve their reliability.

- *Including channels for the effects of fiscal policy on economic activity*. The very simplified way in which the demand side of the economy is modelled, whether in the deterministic or stochastic approaches, does not allow for fiscal-policy effects on aggregate demand. Including such effects would provide more realistic results and would allow the model to be used to study both the economic and fiscal effects of fiscal stimulus measures, for instance. In addition, a more disaggregated demand side would allow the estimation of more precise elasticities between demand components and fiscal variables, for instance between consumption spending and indirect tax revenue.

- Estimating government-revenue and expenditure elasticities more precisely. All the elasticities used in the model are estimates from univariate regressions where the only explanatory variable is the cyclical indicator, the output gap. The explanatory power of many of these regressions is low, and the estimates probably imprecise. Although degrees-of-freedom considerations limit the number of regressors that can be included because of the short samples available, precision could potentially be improved by adding explanatory factors other than the economic cycle that can affect government revenue and expenditure, and/or by adding dummy variables for years when significant policy changes took place (such as important personal- or income-tax reforms).

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Appendix

Table A1. **Detailed regression results for elasticities**

	NFLD	PEI	NS	NB	QC	ON	MB	SK	AB	BC	YK	NWT	Aggregate
Elasticity of total personal income with respect to the output gap. Sample: 1985-2008. Total system (balanced) observations: 312													
Elasticity coefficient	0.456***	0.410***	0.687***	0.188**	0.211***	0.399***	0.657***	0.757***	0.473***	0.340***	0.102*	0.453***	n/a
Standard error	0.14	0.13	0.10	0.09	0.06	0.07	0.08	0.09	0.09	0.08	0.05	0.13	n/a
Durbin-Watson	1.19	2.50	1.45	1.50	1.78	1.28	1.58	2.16	1.82	1.20	1.44	1.54	1.18
Wald test for the joint significance of elasticity variables: Chi-square statistic = 248.27, df = 12, p-value = 0.000													
Elasticity of profit share of GDP with respect to the output gap. Sample: 1985-2008. Total system (balanced) observations: 312													
Elasticity coefficient	1.587***	1.123***	1.106***	2.229***	1.780***	1.798***	1.880***	1.461***	1.511***	1.946***	2.001***	1.606***	n/a
Standard error	0.15	0.22	0.18	0.22	0.14	0.15	0.15	0.16	0.14	0.15	0.13	0.19	n/a
Durbin-Watson	1.53	2.37	1.85	1.58	1.61	1.03	1.97	1.73	1.80	1.08	1.65	1.86	0.83
Wald test for the joint significance of elasticity variables: Chi-square statistic = 1187.60, df = 12, p-value = 0.000													
Elasticity of total compensation with respect to the output gap. Sample: 1985-2008. Total system (balanced) observations: 312													
Elasticity coefficient	0.434**	0.848***	1.071***	0.278**	0.576***	0.579***	0.399***	0.404***	0.525***	0.409***	0.426***	0.639***	n/a
Standard error	0.17	0.13	0.11	0.11	0.08	0.08	0.10	0.12	0.12	0.06	0.07	0.12	n/a
Durbin-Watson	1.86	2.17	1.80	1.66	1.93	1.05	1.69	1.48	2.02	1.39	1.53	1.70	0.97
Wald test for the joint significance of elasticity variables: Chi-square statistic = 328.86, df = 12, p-value = 0.000													
Elasticity of personal expenditure on goods and services with respect to the output gap. Sample: 1985-2008. Total system (balanced) observations: 312													
Elasticity coefficient	0.557***	0.355***	0.646***	0.162	0.254***	0.379***	0.392***	0.400***	0.286***	0.376***	0.029	0.243**	
Standard error	0.15	0.11	0.14	0.10	0.07	0.04	0.12	0.09	0.09	0.07	0.04	0.11	
Durbin-Watson	1.03	2.11	2.06	1.89	1.61	1.75	1.93	1.30	1.48	1.83	1.02	1.67	1.19
Wald test for the joint significance of elasticity variables: Chi-square statistic = 193.04, df = 12, p-value = 0.000													
Elasticity of provincial taxes on production and imports with respect to the output gap. Sample: 1985-2007. Total system (balanced) observations: 276													
Elasticity coefficient	0.228	0.741***	1.500***	1.120***	0.329	0.697**	0.741***	0.336	1.344**	0.041	0.155	-0.019	
Standard error	0.24	0.26	0.41	0.23	0.24	0.27	0.13	0.39	0.56	0.28	0.12	0.25	n/a
Durbin-Watson	1.26	1.32	1.82	1.28	1.55	2.05	1.34	1.55	1.71	1.62	1.95	1.65	
Wald test for the joint significance of elasticity variables: Chi-square statistic = 85.57, df = 12, p-value = 0.000													
Elasticity of royalties with respect to commodity prices. Sample: 1985-2007. Observations: 23 (separate regression for each province with non-trivial royalties)													
Non-energy coefficient	-1.499		-0.232	0.685*	1.040	0.168	-0.192	0.957	0.386	1.013*			
Standard error	2.20		0.86	0.39	1.12	0.51	0.77	0.70	0.66	0.56			
Energy coefficient	0.199	n/a	0.114	-0.228	0.078	-0.097	-0.290	1.343***	1.472***	0.297		n/a	
Standard error	0.14		0.29	0.16	0.38	0.17	0.26	0.24	0.22	0.19			
R^2	0.03		0.01	0.22	0.04	0.02	0.06	0.64	0.69	0.23			
Durbin-Watson	1.65		2.38	2.52	2.56	2.59	2.09	2.12	2.37	2.69			
	NFLD	**PEI**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YK**	**NWT**	**Federal**
Elasticity of transfers to persons with respect to the output gap. Sample: 1986-2007/08. Total system (unbalanced) observations: 287													
Elasticity coefficient (*t*)	-0.570	-4.463*	1.232	0.0570	-0.438	-1.263***	-0.312	1.054***	-2.056**	0.324	-0.490***	0.064	-1.463***
Standard error	0.45	2.34	1.08	0.48	0.56	0.41	0.84	0.27	0.80	0.47	0.18	0.33	0.29
Elasticity coefficient (*t-1*)	-0.014	0.699	-3.894***	-0.214	-1.466***	0.862**	-0.620	0.747***	-0.299	-0.002	0.300	0.039	-0.401
Standard error	0.48	2.15	1.01	0.51	0.56	0.40	0.77	0.26	0.75	0.41	0.19	0.34	0.29
Durbin-Watson	1.20	2.46	1.70	1.70	1.57	1.73	1.81	1.41	2.04	1.54	1.46	1.71	1.11
Wald test for the joint significance of elasticity variables: Chi-square statistic = 120.64, df = 25, p-value = 0.000													
Change in government primary expenditure on lagged output change. Sample: 1983-2007/08. Total system (unbalanced) observations: 326													
Cyclicality coefficient	0.302	0.132	0.014	0.131	0.312	0.417***	0.423***	0.132	0.668***	0.508**	-0.004	-0.075	0.068
Standard error	0.31	0.19	0.12	0.11	0.20	0.14	0.13	0.19	0.13	0.21	0.08	0.11	0.28
Durbin-Watson	2.50	1.49	1.53	1.16	1.04	0.81	1.75	1.82	1.81	1.24	1.84	1.24	1.43
Wald test for the joint significance of cyclicality variables: Chi-square statistic = 51.48, df = 13, p-value = 0.000													

Note: *** signifies that the coefficient is statistically significant at the 1% level, ** at the 5% level and * at the 10% level. R^2 is not reported for systems estimated using SUR because the statistic no longer has its usual meaning. Instead, the Chi-square statistic and the corresponding Wald test for the joint significance of elasticity coefficients are reported.

Table A2. **Detailed regression results for government debt refinancing**

	NFLD	PEI	NS	NB	QC	ON	MB	SK	AB	BC	YK	NWT	Federal
Sample: 1982-2007 (2008 for federal government)													
ω	3.799	1.493***	1.889***	1.682***	1.578**	2.127***	0.665*	1.273***	2.954***	2.628***		0.482	0.968***
Standard error	3.78	0.45	0.33	0.37	0.71	0.50	0.33	0.34	0.52	0.92	n/a	0.66	0.27
R^2	0.85	0.90	0.96	0.19	0.49	0.89	0.92	0.92	0.84	0.95		0.24	0.95
Durbin-Watson	2.42	1.76	2.05	1.88	1.65	2.45	2.64	2.01	1.51	0.86		2.24	1.21

Note: *** signifies that the coefficient is statistically significant at the 1% level, ** at the 5% level and * at the 10% level. To constrain the *RFSH* coefficients to between 0 and 1, the following equation is estimated: $r_{debt,t} = \frac{\exp(\omega)}{1+\exp(\omega)} \cdot r_{debt,t-1} + (1 - \frac{\exp(\omega)}{1+\exp(\omega)}) \cdot (0.25 \cdot IRS_t + 0.75 \cdot IRL_t)$ where *exp()* is the exponential function. The table reports the ω coefficients. The *RFSH* values appearing in Table 9 are then computed from these coefficients as $RFSH = 1 - \frac{\exp(\omega)}{1+\exp(\omega)}$.

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