OFFICE OF THE
PARLIAMENTARY
BUDGET OFFICER

BUREAU DU DIRECTEUR
PARLEMENTAIRE DU
BUDGET

CANADA

Sensitivity of PBO's Fiscal Outlook to Economic Shocks

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The mandate of the Parliamentary Budget Officer (PBO) is to provide independent analysis to Parliament on the state of the nation's finances, the Government's estimates and trends in the Canadian economy; and, upon request from a committee or parliamentarian, to estimate the financial cost of any proposal for matters over which Parliament has jurisdiction.

The PBO has prepared sensitivity estimates of our fiscal outlook to three types of economic shocks. An interactive web application has also been launched, which allows the public to assess how changing certain macroeconomic assumptions for growth and interest rates will affect the PBO fiscal projection.

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Parliamentary Budget Officer

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Executive Summary

The PBO has launched a new web-based simulator that allows the public to assess how sensitive our fiscal projection is to changes in certain economic assumptions.

The new application will be updated twice a year with the PBO's most recent Economic and Fiscal Outlook.

Context

Since 2011, as requested by the House of Commons Standing Committee on Finance, the Parliamentary Budget Officer (PBO) has prepared an Economic and Fiscal Outlook for twice a year.[1] The purpose of this analysis is to provide parliamentarians and the public with an independent view regarding Canada's economic prospects and the implications for the Government's finances.

The cornerstone of ensuring independence and objectivity is transparency. This is why the PBO endeavors to publish technical details that explain how our analyses are prepared; including the assumptions used and limitations of our work. While these technical explanations serve to support transparency for an "expert" audience (that is, those also in the business of preparing similar types of economic and fiscal analysis), they often fall short in engendering greater understanding of our work with non-technical audiences.

This is why the PBO has increasingly invested in alternate media, such as web-based applications, to allow people to more easily interpret our work. These novel approaches also permit parliamentarians and the public to gain a greater appreciation for the sensitivity of our fiscal projection to changes in economic assumptions.

As a continuation of this effort, the PBO published its first estimate of fiscal multipliers in April 2016 and has now prepared estimates of the sensitivity of our five-year federal fiscal outlook to changes in key economic assumptions. These estimates have been integrated into a new web-based application on our website that allows users to specify their own changes to key economic assumptions. This will allow parliamentarians and the public to assess how PBO's fiscal outlook would change if real GDP growth, GDP inflation and/or interest rates were higher (or lower) than projected in our baseline.

Over time, the PBO will publish more of our models on-line in an interactive format. In doing so, we think it will serve to encourage independence and objectivity through transparency, and allow for greater scrutiny and understanding of our work.

The Sensitivity of Fiscal Projections to Economic Shocks

The PBO's fiscal outlook is a fully integrated series of projections for each major component of federal expenses and revenues. While each aspect of the outlook relies on its own set of variables (for instance, the population over the age of 65 for elderly benefits, or under the age of 18 for children's benefits), the PBO's economic projection underpins it all.

Three key economic indicators drive overall federal fiscal results:

1. *Real growth in Canada's gross domestic product (GDP).* That is, the year-over-year change in the total amount of goods and services produced within Canada in a given year.
2. *GDP inflation*. That is, the year-over-year change in the prices of goods and services produced within Canada in a given year.
3. *Interest rates*. That is, the level of interest rates over the projection horizon for both short-term (90-day Treasury Bills) and long-term (10-year Government of Canada bonds) government securities.

As noted in previous PBO analysis, much of the federal fiscal framework is directly or indirectly linked to nominal GDP growth (that is, real GDP growth combined with GDP inflation).[2] For revenues, nominal GDP represents the broadest single measure of the Government's tax base. In constructing our sensitivity estimates, we assume that changes in nominal GDP are proportional across income and expenditure components. That is, increases (decreases) in nominal GDP are commensurate with changes in the incomes and expenditures of firms and individuals. This, in turn, will result in increases (decreases) in corporate and personal income taxes, as well as indirect taxes.

On the expense side, many major transfer payment programs are either legislated to grow at the rate of nominal GDP (such as the Canada Health Transfer and Equalization), or increase in line with the Consumer Price Index (CPI).[3] This includes elderly benefit payments and the Gas Tax Fund. In constructing our sensitivity estimates, we assume that changes to GDP inflation are reflected, one for one, in changes to CPI inflation. As such, when

the GDP price level increases (decreases), this typically results in an increase (decrease) in program expenses.

While most components of federal revenues and expenses are positively correlated with real GDP growth and GDP inflation, there are some components that are negatively correlated. For instance, lower real GDP growth rates, which are assumed to be driven equally by lower productivity and employment growth, will result in higher unemployment and a corresponding increase in Employment Insurance expenses.

Finally, interest rates, in particular the Government of Canada short-term and long-term borrowing rates, will directly affect the cost of financing the federal debt. Higher (lower) rates will result in higher (lower) public debt interest expenses. Offsetting this impact are loans made by the Government to Crown Corporations and other outside parties. The interest revenue earned from these investments will generally increase (decrease) with higher (lower) borrowing rates.

Fiscal Sensitivity Estimates

Following Finance Canada's approach to assessing fiscal sensitivity, PBO estimated the impacts of three key economic shocks on its fiscal outlook[4]:

1. A permanent one per cent reduction in the level of real GDP.[5] This means that compared to the our most recent Economic and Fiscal Outlook, the level of real GDP is assumed to be 1 per cent lower throughout the five-year horizon. [6]
2. A permanent one percent reduction in the GDP price level.[7] This means that compared to our most recent Economic and Fiscal Projection, the GDP price level is assumed to be 1 per cent lower throughout the five-year horizon.
3. A one percentage point (100 basis points) increase in the level of interest rates. This means that over the five-year projection horizon, both 90-day and 10-year Government of Canada borrowing costs are assumed to be one percentage point higher.

These economic shocks are illustrative and simplifications of a complex and endogenous system. For example, in reality, it is highly unlikely for real GDP growth to increase/decrease without corresponding effects on prices and interest rates. Further, a shock concentrated in one sector of the economy (such as the energy sector), could have an actual impact that differs from the generated results. As such, these estimates should be considered stylized rules of thumb.

Each of the three shocks is assessed independently of the others. As such, the fiscal results reflect each of the three shocks in isolation from one another. All of the fiscal impacts presented below are symmetrical. That is, the same magnitude of fiscal results would arise from an increase or a decrease in the three macroeconomic factors (although the signs would change). Finally, the data presented in the tables below assume that the shocks occur at the beginning of the fiscal year (that is April 1st).

In general, the mechanisms by which each shock affects the fiscal projection is consistent with the results published by Finance Canada. However, we also incorporate a feedback effect of interest rate changes on the actuarial valuation of federal pensions and other benefits, which is not included in Finance Canada's results.

The Fiscal Impact of a 1 Percent Decrease in Real GDP

A one percent decrease in real GDP driven equally by lower productivity and employment over the next five years would result in corresponding decreases in household income, consumer spending and corporate profits.

As a result of the decreases in incomes and expenditures, the overall budgetary balance would deteriorate by an estimated $4.0billion in year 2017-18, falling slightly to $3.9 billion in 2021-22 (Table 3-1).

Compared to the baseline projection, revenues would be lower as a result of smaller taxable personal income base for individuals (fewer people working, earning lower wages), and corporations (taxable profits would be lower than they otherwise would have been). Other taxes, such as the GST, would also decrease due to lower consumer spending. Finally, Employment Insurance premiums would also fall, stemming from lower employment and fewer workers paying premiums.[8]

Program expenses would be higher compared to the baseline projection, primarily attributable to an immediate jump in Employment Insurance benefits due to an increase in the number of unemployed. Furthermore, there are also increases in the cost of means-tested Children's Benefits, due to lower household incomes (that is, households have less income, meaning they are eligible for greater benefits). These increases are partially offset by decreases in some of the federal transfers to other levels of government, which are indexed to nominal GDP growth.[9]

As a result of larger budgetary deficits, government debt levels would rise, thus increasing public debt interest expenses.

Table 3-1 Fiscal impact of 1 per cent decrease in real GDP

$ billions	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022
Income taxes					
Personal income tax	-2.3	-2.5	-2.6	-2.7	-2.8
Corporate income tax	-0.2	-0.4	-0.4	-0.5	-0.5
Non-resident income tax	-0.1	-0.1	-0.1	-0.1	-0.1
Total income tax	-2.6	-2.9	-3.1	-3.3	-3.4
Excise taxes/duties					
Goods and Services Tax	-0.4	-0.4	-0.4	-0.4	-0.4
Custom import duties	-0.1	-0.1	-0.1	-0.1	-0.1
Other excise taxes/duties	0.0	0.0	0.0	0.0	0.0
Total excise taxes/duties	-0.4	-0.4	-0.4	-0.4	-0.5
EI premium revenues	0.1	1.0	1.1	1.1	1.2
Other revenues	-0.2	-0.2	-0.2	-0.2	-0.2
Total budgetary revenues	-3.1	-2.5	-2.7	-2.8	-3.0
Major transfers to persons					
Elderly benefits	0.0	0.0	0.0	0.0	0.0
Employment Insurance benefits	0.9	0.9	0.9	1.0	1.0
Children's benefits	0.0	0.1	0.1	0.1	0.1
Total	0.9	1.0	1.0	1.1	1.1
Major transfers to other levels of government					
Canada Health Transfer	0.0	0.0	-0.1	-0.3	-0.3
Canada Social Transfer	0.0	0.0	0.0	0.0	0.0
Equalization	0.0	0.0	-0.1	-0.2	-0.2
Territorial Formula Financing	0.0	0.0	0.0	0.0	0.0
Gas Tax Fund	0.0	0.0	0.0	0.0	0.0
Other fiscal arrangements	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	-0.2	-0.4	-0.5
Direct program expenses	0.0	0.0	0.0	0.0	0.0
Public debt charges	0.0	0.1	0.1	0.2	0.3
Total expenses	0.9	1.1	1.0	0.9	1.0
Budgetary balance	**-4.0**	**-3.5**	**-3.6**	**-3.7**	**-3.9**

Source: Parliamentary Budget Officer.

The Fiscal Impact of a 1 percent Decrease in the GDP Price level

A one percent decrease in GDP prices over the next five years would result in corresponding decreases in consumer prices, household income, consumption and corporate profits. However, unlike the shock to real GDP, employment levels are assumed to be unaffected.

The increase in budgetary deficits relative to our baseline would require additional government borrowing, raising public debt interest costs.

As a result of these decreases in incomes and expenditures, the budgetary balance would deteriorate by an estimated $2.4 billion in year 2017-18, growing marginally to $2.5 billion in 2021-22 (Table 3-2).

Relative to our baseline projection, revenues would be lower as a result of lower household and corporate incomes. Other taxes also decrease due to lower consumer spending. Finally, Employment Insurance premiums, which are indexed to the average weekly wage, would also fall. [10]

Program expenses would fall relative to our baseline projection due to lower levels of indexed federal programs that provide benefits for the elderly (indexed to consumer prices), unemployed (indexed to the average weekly wages) and transfers to other levels of government (indexed to nominal GDP). This is partially offset by an increase in means-tested children's benefits, which results in more families being eligible for greater benefits as a result of lower wage growth.

Table 3-2 Fiscal Impact of 1 percent Decrease in GDP Prices

$ billions	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022
Income taxes					
Personal income tax	-1.9	-1.5	-1.6	-1.7	-1.8
Corporate income tax	-0.2	-0.4	-0.4	-0.5	-0.5
Non-resident income tax	-0.1	-0.1	-0.1	-0.1	-0.1
Total income tax	-2.2	-2.0	-2.1	-2.3	-2.4
Excise taxes/duties					
Goods and Services Tax	-0.3	-0.4	-0.4	-0.4	-0.4
Custom import duties	-0.1	-0.1	-0.1	-0.1	-0.1
Other excise taxes/duties	0.0	0.0	0.0	0.0	0.0
Total excise taxes/duties	-0.4	-0.4	-0.4	-0.4	-0.5
EI premium revenues	-0.1	-0.1	-0.1	-0.1	-0.1
Other revenues	-0.2	-0.2	-0.2	-0.2	-0.2
Total budgetary revenues	-2.9	-2.7	-2.9	-3.1	-3.2
Major transfers to persons					
Elderly benefits	-0.4	-0.5	-0.6	-0.6	-0.6
Employment Insurance benefits	-0.1	-0.1	-0.1	-0.1	-0.1
Children's benefits	0.0	0.2	0.2	0.2	0.2
Total	-0.5	-0.4	-0.4	-0.5	-0.5
Major transfers to other levels of government					
Canada Health Transfer	0.0	0.0	-0.1	-0.3	-0.3
Canada Social Transfer	0.0	0.0	0.0	0.0	0.0
Equalization	0.0	0.0	-0.1	-0.2	-0.2
Territorial Formula Financing	0.0	0.0	0.0	0.0	0.0
Gas Tax Fund	0.0	0.0	0.0	0.0	0.0
Other fiscal arrangements	0.0	0.0	0.1	0.1	0.1
Total	0.0	0.0	-0.2	-0.4	-0.5
Direct program expenses	0.0	0.0	0.0	0.0	0.0
Public debt charges	0.0	0.0	0.1	0.2	0.2
Total expenses	-0.4	-0.3	-0.5	-0.7	-0.7
Budgetary balance	**-2.4**	**-2.3**	**-2.4**	**-2.4**	**-2.5**

Source: Parliamentary Budget Officer.

The Fiscal Impact of a 100 Basis Point Increase in Interest Rates

A one hundred basis point increase in interest rates over the next five years would result in corresponding increase in market rate of interest paid for government borrowing and loans, as well as the discount rate for public sector pension and benefit liabilities. [11]

As a result of the increase in interest rates, the budgetary balance would fall by an estimated $0.3 billion in 2017-18, deteriorating in 2021-22 to a $1.2 billion net decrease (Table 3-3).

Revenues are slightly higher from the baseline results, owing to increased interest revenue from government loans. Expenses would increase due to higher interest costs on the public debt, which rise over the medium term as the debt matures and is refinanced at higher rates. This increase is partially offset by the downward revaluation of public sector pension and benefit liabilities, and the consequential amortization of this savings through operating expenses (which are part of direct program expenses).

Table 3-3 Fiscal Impact of a Sustained 100 Basis Point Increase in Interest Rates

$ billions	**2017-2018**	**2018-2019**	**2019-2020**	**2020-2021**	**2021-2022**
Income taxes	0.0	0.0	0.0	0.0	0.0
Excise taxes/duties	0.0	0.0	0.0	0.0	0.0
EI premium revenues	0.0	0.0	0.0	0.0	0.0
Other revenues	1.5	1.9	2.2	2.5	2.7
Total budgetary revenues	1.5	1.9	2.2	2.5	2.7
Major transfers to persons	0.0	0.0	0.0	0.0	0.0
Major transfers to other levels of government	0.0	0.0	0.0	0.0	0.0
Direct program expenses	-1.7	-1.7	-1.7	-1.7	-1.7
Public debt charges	3.5	4.3	5.0	5.4	5.7
Total expenses	1.8	2.5	3.2	3.6	3.9
Budgetary balance	**-0.3**	**-0.6**	**-1.0**	**-1.1**	**-1.2**

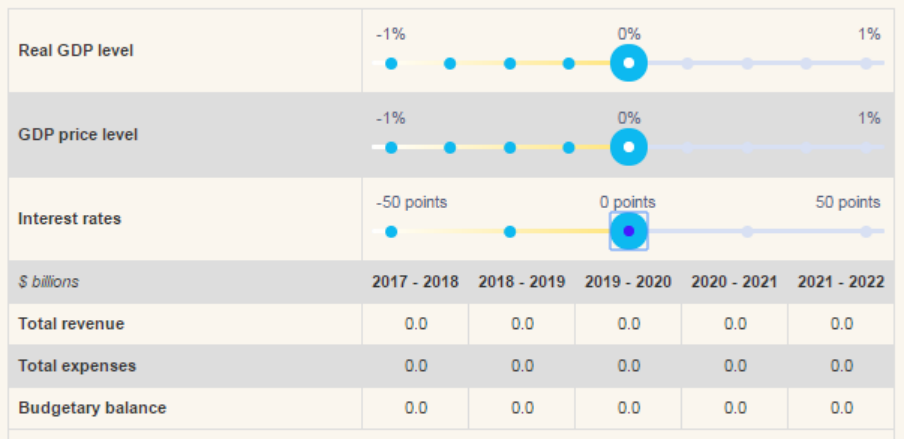
Source: Parliamentary Budget Officer.

How to use the Web-Based Application

Our web-based application allows parliamentarians and the public to specify their own changes to key economic assumptions, assessing the impact on the PBO's medium-term fiscal projection.

As outlined above, the new fiscal sensitivity module allows users to vary real GDP growth, GDP inflation and the level of interest rates over PBO's medium-term projection.

Figure 4-1 Screenshot of Fiscal Sensitivity Tool



$ billions	2017 - 2018	2018 - 2019	2019 - 2020	2020 - 2021	2021 - 2022
Total revenue	0.0	0.0	0.0	0.0	0.0
Total expenses	0.0	0.0	0.0	0.0	0.0
Budgetary balance	0.0	0.0	0.0	0.0	0.0

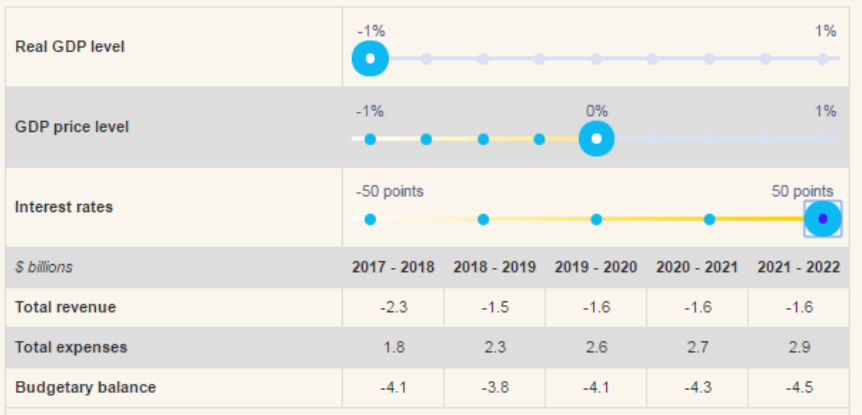
Using the toggle button for each economic variable, users can choose to change each variable by up to one-half percentage point (or 50 basis points for the level of interest rates). The impact of each change is a linear extrapolation of the economic shocks described in section 3 (that is, a change of one quarter a percentage point will have one half the impact on the fiscal projection). [12]

The changes in economic assumptions are additive. This means that users can choose to adjust more than one variable at a time; the impact of each change will be added together to calculate the net impact on the fiscal outlook.

As an example, you might believe the PBO's projection for real GDP growth over the next five years is too optimistic (by 1 percentage point annually, on average), and our interest rate outlook too low (by 50 basis points annually, on average).

By adjusting the variables in the application, users can determine how much these changes to the economic assumptions would affect the outlook for the budgetary balance.

Figure 4-2 Screenshot of Results from Revised Macroeconomic Assumptions



$ billions	2017 - 2018	2018 - 2019	2019 - 2020	2020 - 2021	2021 - 2022
Total revenue	-2.3	-1.5	-1.6	-1.6	-1.6
Total expenses	1.8	2.3	2.6	2.7	2.9
Budgetary balance	-4.1	-3.8	-4.1	-4.3	-4.5

As presented in Figure 4-2, the impact on the budgetary balance would be -$4.1 billion in 2017-18, rising to -$4.5 billion in 2021-22.

Notes

[1] In the current Parliament, the House of Commons Standing Committee on Finance passed a motion in February 2016 that "consistent with the Parliamentary Budget Office (PBO) mandate to provide independent analysis about the state of Canada's finances and trends in the national economy (as outlined in section 79.2 of the *Parliament of Canada Act*), the PBO provide an economic and fiscal outlook to the Committee the fourth week of October and April of every calendar year, and be available to appear before the Committee to discuss its findings shortly thereafter."

[2] Further details are presented in the PBO's April 2014 Economic and Fiscal Outlook.

[3] Starting in 2017-18, the Canada Health Transfer (CHT) is legislated to grow at the three-year moving average of nominal GDP growth, with a minimum floor of 3% per year.

[4] In budgets and fall updates, Finance Canada provides estimates of the fiscal sensitivity of the budgetary balance to economic shocks. For example, see pages 261-264 in Budget 2017.

[5] This is approximately equal to a one-year one-percentage point decrease in real GDP growth.

[6] For the initial assessment presented in this note, the results are based on the PBO's April 2017 Economic and Fiscal Outlook. The results will be updated with each iteration of the PBO's projection.

[7] This is approximately equal to a one-year one-percentage point decrease in GDP inflation.

[8] Pursuant to statute, the Employment Insurance (EI) Account must be balanced over a 7-year cycle. To do so, the Employment Insurance Chief Actuary annually sets the premium required to ensure that the EI Account will break even over this period. PBO's economic shocks do not account for the secondary effect of changes to the EI premium rate due to higher (or lower) revenues and expenses.

9 These federal transfers are indexed to the lagged moving average of nominal GDP growth. Hence, the fiscal impact builds over time.

[10] Ibid.

[11] In general, as interest rates fall (rise), the estimated cost of accrued pension benefits that the government owes its employees will rise (fall) in turn. As such, sustained decreases (increases) in interest rates will increase the amount of the liability owing. Under Public Service Accounting Board standards, this change must be amortized, meaning that the government must make extra payments to pension funds when the estimated value of the liability rises, or can take a contribution "holiday" when the estimated value falls. The changes in these contributions are reflected in the government's operating expenses, which are part of direct program expenses.

[12] While a linear assumption is reasonable for a limited range, this is less plausible for larger changes. As such, we limit the maximum changes that users can make for the economic assumptions. This ensures that the results are generally consistent with the PBO model.