



OFFICE OF THE
PARLIAMENTARY
BUDGET OFFICER
BUREAU DU DIRECTEUR
PARLEMENTAIRE DU
BUDGET

CANADA

Corporate Tax Model

Ottawa, Canada
31 January 2017
www.pbo-dpb.gc.ca

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.

PBO has developed a new microsimulation model of the federal corporate income tax system to undertake analytical and costing work. This report describes the technical elements and properties of the model. Model simulation results are also available on the PBO website through the interactive Ready Reckoner tool.

The authors wish to acknowledge officials from Finance Canada and Statistics Canada who provided helpful discussion on this project. In particular, the authors thank Danny Leung, Lydia Couture and Robby Bemrose for the support provided by the Canadian Centre for Data Development and Economic Research.

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Executive Summary

The Parliamentary Budget Officer (PBO) has developed a microsimulation model to produce cost estimates for federal corporate income tax measures. The model replicates tax filings for over two million Canadian firms under the baseline tax code and alternative policies.

This new tool enables PBO to produce costing and analysis on the following corporate tax topics:

1. general and small business income tax rates and eligibility;
2. tax incentives for capital investment, research and development activities and resource development; and,
3. the impact of federal corporate tax measures on industries.

This report describes the technical properties of the model and will serve as a reference for PBO work in this area.

Model simulation results for major corporate tax changes are included in section 5 of the report. They are available on the PBO website through the interactive Ready Reckoner tax tool. These mechanical simulations are intended to showcase model properties and may differ from a cost estimate of a specific policy.

Additional model documentation is available upon request.

1. Introduction

Corporate income tax is the second largest revenue source for the federal government. Yet the Parliamentary Budget Officer has faced significant challenges undertaking policy analysis in this area.

Key barriers are the confidentiality and complexity of corporate tax data, which are highly sensitive, heterogeneous and difficult to synthesize for public use. Further, given the nuances of the corporate tax system, the full population of actual tax returns is required to accurately analyze and cost corporate tax measures.

PBO utilizes the Social Policy Simulation Database and Model (SPSD/M) created and maintained by Statistics Canada to analyze personal income tax changes. No publicly available model exists for corporate income tax in Canada. Reister et. al. (2009) note four corporate tax microsimulation models that are used for policy analysis, including one employed by Finance Canada.¹

Reister et. al. (2009) describe a number of important requirements for corporate tax microsimulation models. These include a transparent and modular set-up; integration of balance sheets; financial and real tax returns data; multi-period capabilities; and full accounting of interdependencies. They note in conclusion that no existing microsimulation model fulfills all these requirements. Likewise, PBO's model contains important limitations, which are discussed in section 4.

PBO obtained access to Canadian T2 returns data² through Statistics Canada's Canadian Centre for Data Development and Economic Research (CDER) program under a Memorandum of Understanding. Through this research program, PBO developed a microsimulation model to estimate the fiscal impact of changes to the federal corporate tax system.³ The model replicates the tax returns of real firms to perform a static costing of major policy changes.

Numbers, figures and tables in this report containing analytical results produced using the T2-LEAP database are explicitly sourced as such. They have been vetted for confidentiality by Statistics Canada officials.

2. Corporate income tax system

Corporate tax trends

Tax rates have fallen in Canada, while corporate tax base has been broadened, but the basic structure remains a tax on shareholder income. (Boadway, 2014)

A key purpose of the corporate income tax system is to serve as a withholding tax on corporate shareholders. It is designed so that tax-exempt earnings cannot be retained indefinitely within the firm until withdrawal when a taxpayer faces a lower marginal tax rate, such as in retirement, or when there is a legislated future tax rate reduction.

As dividends are taxed at the personal rate, the immediate incidence of changes to corporate tax rates is primarily on retained earnings.

A thorough overview of Canada's corporate income tax system is beyond the scope of this technical report.⁴ This section highlights a few core elements of the system that PBO deems most relevant in the design and construction of its model.

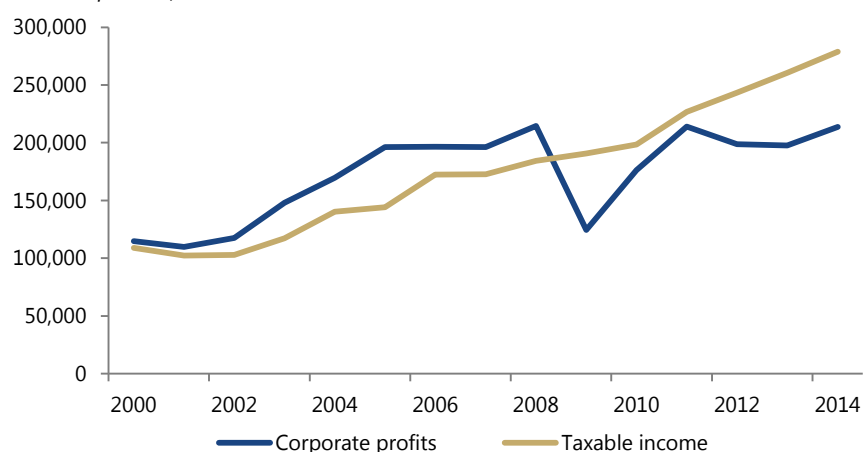
The first issue concerns the tax definition of a corporation's income. There is typically a difference between the annual income that a corporation reports in its financial statement, and the income reported for tax purposes.

Adjustments to a corporation's accounting income to determine taxable income smooth some of the volatility from year to year.⁵ As a result, the corporate tax base is more stable than before-tax corporate profits (Figure 2-1).

Figure 2-1

Corporate profits vs. taxable income

Millions of dollars, all industries



Sources: Parliamentary Budget Officer, Statistics Canada

Note: PBO estimates pre-tax corporate profits as net operating surplus less net interest payments.

Another feature of the system is that firms can carry back or defer losses for three years and 20 years respectively. This practice ensures that the corporate tax system does not discriminate against firms with volatile profits.⁶ However, this “loss smoothing” creates challenges for policy analysis, as tax revenues from previous years can be revised while current-year losses can affect future tax liabilities.

The corporate tax system is also used to achieve public policy objectives through measures such as preferential tax rates, exemptions, deductions, deferrals and credits (Finance Canada, 2010). These measures are often referred to as “tax expenditures” because they achieve policy objectives at the cost of lower tax revenue.

Policy objectives

Policy objectives targeted through the corporate income system often involve “tax expenditures” that reduce the taxes payable for corporations engaging in certain activities or meeting eligibility requirements.

For example, a corporation may earn a tax credit for expenditures related to scientific research or film and video production. Another tax credit allows small businesses to pay a lower statutory rate of tax on revenues than larger corporations. There are also tax credits for manufacturing and processing profits, as well as deductions for resource development expenditures.

Further, as tax on business income is ultimately born by individuals, changes to one element of either the corporate or personal income tax system may necessitate other, balancing, adjustments to the other, which can alter the revenue impact.⁷

...the existing corporate tax is designed to be a tax on shareholder income, reflecting its prevailing rationale as a withholding device for the personal income tax. This tax is complemented by the dividend tax credit and preferential treatment of capital gains as mechanisms for crediting Canadian shareholders for corporate taxes withheld on their behalf.

-Robin Boadway, 2014

Lastly, a core consideration for corporate tax analysis is the degree to which corporations undertake planning activities to reduce their tax payable. The literature suggests that such tax planning can have a meaningful fiscal impact.

3. Data

PBO's Corporate Tax Microsimulation model (CTM) uses administrative tax data collected from corporations by the Canada Revenue Agency (CRA). To maintain confidentiality, there are restrictions on the way the data are used (see Box 3-1).

Other microsimulation models attempt to address confidentiality through synthetic databases that are representative of the underlying population, but do not contain identifiable information. The Social Policy Simulation Database and Model (SPSD/M) created and maintained by Statistics Canada is one such model.⁸

CTM runs on the T2-LEAP dataset, available at the Canadian Centre for Data Development and Economic Research (CDER).⁹ The T2-LEAP dataset combines the T2 dataset, administrative tax filings for incorporated businesses in Canada, with the Longitudinal Employment Analysis Program (LEAP) dataset. The LEAP dataset, which contains employment data through time, allows for the analysis of employment dynamics.

Box 3-1 Confidentiality issues when using administrative data

Microsimulation models can use synthetic or actual administrative data. These two types of models have benefits and drawbacks, primarily a trade-off between precision and confidentiality.

Synthetic data are representative of the underlying population, but do not allow for identification of actual individuals. While the model is based on individual units, any one unit does not represent an actual person or entity. Rather, the individuals are simulated in such a way that aggregates and distributional characteristics match the population.

Administrative data, the underlying units, represent actual observations. In the case of CTM, the individual units are corporations that file income tax returns with the CRA. Administrative data are a true representation of the underlying population, but they are usually confidential, and must be handled with care.

When developing and using CTM, PBO used an administrative dataset, but was unable to directly examine individual records. Instead, the majority of the development process used a synthetic subset of the dataset, generated for that purpose. The completed model was then used to obtain results from the actual administrative data.

CTM's data input draws mostly from the T2 side of the dataset. This dataset, the Corporate Tax Statistical Universe File (T2SUF), originates from the Canada Revenue Agency's collection of corporate tax. All resident corporations, including non-profits, inactive and tax-exempt corporations, must file a T2 tax return.¹⁰ This is a requirement even if the corporation has no tax payable. Included in the T2SUF are data on each tax filers' taxable income, deduction and credits.

4. Model properties

CTM is a microsimulation model (see Box 4-1) designed to mimic the corporate tax filing process. It is comprised of distinct steps or “modules”, each of which represents a schedule of the T2 form. This modular approach is similar to the structure of the corporate tax microsimulation model used by the Department of Finance (Morin & Séguin, 2009). CTM includes six core schedules from the T2 form selected based on fiscal materiality and potential policy relevance (Table 4-1).¹¹

Table 4-1 Core schedules in CTM

	Description	Policy relevance	Financial materiality
Schedule 8	Capital cost allowance	Investment, depreciation	\$1.5 billion
Schedule 12	Resource deductions	Resource sector	\$1.7 billion
Schedule 1	Taxable income	Tax base	N/A
Schedule 31	Investment tax credit	R&D credits	\$3.0 billion
Schedule 4	Loss continuity	Tax deferrals	\$7.8 billion
Schedule 200	Tax return	Rates, eligibility	N/A

Sources: Parliamentary Budget Officer, Statistics Canada

Note: PBO approximates financial materiality using the core outputs of each schedule in 2014. These are intended to be illustrative and are not comprehensive estimates.

This structure enables PBO to capture interdependencies, as well as add schedules to respond to questions or evolving tax changes. Greater detail on the core modules and assumptions is provided in Appendix A.

Box 4-1 Microsimulation models

Microsimulation models are programs that simulate and aggregate the actions of individual agents. This is useful when decision making is undertaken at the individual level and the population is heterogeneous, as in the case of corporations.

In the context of policy analysis (in particular, tax policy), a microsimulation model can reveal nuances that are not always available from aggregated models, particularly when the relationships between variables are non-linear (Orcutt, 1957). Microsimulation models provide the ability to determine the impact of policy changes to different classes of individuals and to determine the distribution of these impacts.

Microsimulation models can be static, a mechanical calculation in response to a policy change, or dynamic, which allows agents to adjust their behaviour. The model described in this paper is primarily static, while future model development will focus on incorporating dynamic aspects.

There are some microsimulation models in Canada, but due to the financial and technical barriers, they are not widespread. A recent paper found that there were 17 such models available in Canada in 2011 (Décarie, 2011). Since that time, at least one of these models, LifePaths, has been discontinued and is no longer supported.

PBO's CTM represents a new entry to this list, the second known corporate income tax microsimulation in Canada. The first corporate model was developed by the Department of Finance.

CTM mechanically replicates the tax return of each firm in the T2-LEAP database by performing line-by-line calculations to reproduce a firm's return. The model introduces alterations to the parameters and variables by replacing documented values with user-specified values.

PBO views CTM as a useful policy tool for assessing major corporate tax changes. A key advantage is that CTM fully utilizes actual returns data and the entire population of firms. However, it has a number of important limitations:

1. CTM is well suited for costing major policy changes, but less capable of costing more targeted changes. For this reason, the structure allows for new schedules to be easily added;
2. CTM runs on tax data and has minimal integration with firms' balance sheet and financial statements. Any real economic effects must be integrated via tax variables;
3. CTM is primarily a single-period, static model. Multi-period revenue impacts and adjustments for behavioural responses are calculated

outside the model (see sections A.8 and 6.2). The impacts on revenue of capital cost allowance measures are also calculated outside the model;

4. CTM simulates impacts on federal income tax variables only and treats the provincial and foreign jurisdictions as exogenous; and,
5. A core assumption is that the baseline tax year represents a firm's optimal tax filing. It does not adjust firm decisions related to the use of deductions, even if these may appear sub-optimal from the firm's perspective (see further explanation in A.9). In PBO's view, this reflects real world behaviour, but implicitly incorporates one-off or idiosyncratic filings into costing.¹²

CTM's parameters and structure are calibrated to the 2016 tax year, but use tax return data from the 2014 reference year, the last complete year available.

5. Simulation results

PBO simulated changes to the corporate tax system to demonstrate CTM's model properties.

Mechanical simulations serve as a starting point for more detailed, nuanced analysis; these simulations can differ from actual policy costing in important ways. At a minimum, static costing estimates generated by CTM would be adjusted for potential behaviour effects (see Section 6.2).

Simulations also do not include potential complementary policy adjustments (for example, gross-ups for investment income) unless otherwise specified.¹³

All figures are based on the 2014 tax reference year using 2016 tax year parameters.

5.1. General corporate income tax rate

This simulation increases (decreases) the general corporate income tax rate by 1 percentage point. Mechanically, this is done by reducing (increasing) the value of the general income tax reduction credit.

<i>Simulation of annual fiscal impact, millions of dollars</i>	Increase 1 p.p.	Increase 1 p.p. (no maximization)	Decrease 1 p.p.
Taxable income	-1,884	-	-
Credits	-1,543	-1,724	1,702
Refunds	-	-	-
Tax payable	1,543	1,724	-1,702

Sources: Parliamentary Budget Officer, Statistics Canada, T2-LEAP database

Note: This simulation does not include raising (reducing) the tax rate on manufacturing profits, which is currently set at the same rate.

Raising (reducing) the general corporate income tax rate increases (reduces) taxes payable. However, in CTM, the revenue impacts are not symmetric. This is due to PBO's "maximization" assumption. It enables firms to re-calculate their return to offset any additional tax payable with unused deferred losses, credits and deductions (see Section A.9). Without this setting, which can easily be switched on or off in CTM, the revenue impacts would be roughly symmetrical.

5.2. Small business tax rate

Income of certain “small” businesses is eligible for a 10.5 per cent rate of taxation subject to limits relating to total income and taxable capital.¹⁴ This simulation increases (decreases) by 0.5 percentage point the tax rate on such income. This is also done by reducing (increasing) the value of the credit.

<i>Simulation of annual fiscal impact, millions of dollars</i>	Increase 0.5 p.p.	Decrease 0.5 p.p.
Taxable income	-205	-
Credits	-380	405
Refunds	-	-
Tax payable	380	-405

Sources: Parliamentary Budget Officer, Statistics Canada, T2-LEAP database

Raising (reducing) the small business income tax rate increases (reduces) taxes payable. Fewer small CCPCs have unused tax assets with which to apply against increases in taxes payable. Therefore, the impacts on revenue from changes to the small business tax rate are roughly symmetrical.

5.3. Small business limit

This simulation raises (reduces) the limit on income eligible for the small business deduction by \$100,000 to \$600,000 (\$400,000).

<i>Simulation of annual fiscal impact, millions of dollars</i>	Increase 100,000	Decrease 100,000
Taxable income	-	-176
Credits	112	-319
Refunds	-	-
Tax payable	-112	319

Sources: Parliamentary Budget Officer, Statistics Canada, T2-LEAP database

According to CTM estimates, the impacts on revenue from raising the small business limit are roughly one-third those of lowering the limit. This reflects the distribution of eligible income around this limit including clustering effects as observed by Dachis and Lester (2015). Indeed, in its 2013 Tax Expenditures and Evaluations, Finance Canada shows that the distribution of taxable income of small CCPCs is concentrated at low levels.

5.4. SR&ED expenditure percentages

This simulation raises (reduces) the maximum percentages of SR&ED expenditures added to the current year ITC (see A.5) by 5 p.p. to 45 (35) per cent for the refund rate, to 40 (30) per cent for the enhanced rate and to 20 (10) per cent for the general rate.

<i>Simulation of annual fiscal impact, millions of dollars</i>	Increase 5 p.p.	Decrease 5 p.p.
Taxable income	-	-205
Credits	73	-29
Refunds	180	-180
Tax payable	-253	209

Sources: Parliamentary Budget Officer, Statistics Canada, T2-LEAP database

The differing revenue impacts between raising and reducing the rate result from the expenditure limit becoming more binding when the rate is increased and less binding when the rate is reduced.

5.5. Tax expenditures

Costing tax expenditures

PBO estimates the cost of a tax expenditure simply as revenue forgone in the absence of a such a measure. Differences between the estimates are due to methodology (where computed) and underlying source data.

PBO cost estimates for tax expenditures are derived from the T2-LEAP database and where necessary computed using CTM. The cost of a tax expenditure is assumed to be the revenue forgone if such measure is eliminated from the tax code. In some cases, such as the SR&ED refund, aggregating a specific line number in the tax data is used.

Table 5-1 contains an example of PBO estimates for tax expenditures, as well as Finance Canada estimates from the 2016 Tax Expenditures and Evaluations report.

Table 5-1

<i>Simulation of annual fiscal impact, millions of dollars 2014</i>	CTM	Finance Canada
SR&ED credit current year	1,690	1,400
SR&ED refund current year	1,220	1,500
Low tax rate for small businesses	3,210	3,225
Other non-capital losses applied to current year	5,400	4,920

Sources: Parliamentary Budget Officer, Statistics Canada, T2-LEAP database, Finance Canada Tax Expenditures and Evaluations 2016

6. Future model development

Future work will be guided by topics of relevance to parliamentarians and fiscal materiality. Model development will also focus on deriving implicit elasticities and behavioural effects within the model to replicate real world decision making. Further to these efforts, new modules and tax planning features will be added to enhance the capacity of the model.

6.1. Base elasticity and marginal effective tax rates

Estimating the implicit elasticity of corporate tax revenues to changes in the tax base (before-tax corporate profits) is important to understand how the government's fiscal position is affected by economic shocks. A model such as CTM can estimate this elasticity by applying a shock to the base (before tax profits) and assessing how this shock flows through to revenues.

PBO plans to integrate a firm's balance sheet and financial variables, as well as to further develop the Schedule 1 module to more completely capture a shock to a firm's income statement.

Developing a better "real-world" relationship between profit shocks and corporate tax revenues would enable PBO to estimate marginal effective tax rates. Such capabilities would also support "rolling the model forward" to simulate multi-period costing.

6.2. Behavioural response

The extent to which firms respond to a policy change by taking action to reduce taxes payable is an important consideration in corporate tax analysis. Such behavioural responses include profit shifting, tax planning and economic action (Box 6-1). The fiscal and economic impacts of these actions are meaningful. Moreover, the process is fluid, as firms are regularly finding new ways to reduce taxes, while authorities are implementing measures to close existing loopholes.

This elasticity of the corporate tax base to changes in the statutory rate is relevant for fiscal costing. Canadian studies of CIT elasticities have primarily focused on inter-provincial tax planning,¹⁵ which is useful but incomplete for federal tax analysis. Riedl and Rocha-Akis (2009) assess behaviour across OECD countries and estimate a CIT base elasticity of 0.7.

Box 6-1 Examples of behavioural response

Profit shifting: changes to the corporate income tax system can induce firms to shift income to jurisdictions with more favourable tax conditions (for example, moving their head office). Large firms with operations in multiple jurisdictions have greater scope to undertake these actions.

Tax planning: even smaller firms operating in a single jurisdiction may respond to policy changes by engaging in more aggressive tax planning such as changing the structure of a company, hiring accountants and changing deductions.

Economic decisions: changes to the corporate income tax system can affect a firm's user cost of capital, which can disincentivize investments, hiring and other economic behaviour. One example would be moving the production of a good or service to a different jurisdiction.

Integrating behavioural responsiveness at the firm level in a theoretically and empirically sound manner is a large and complex undertaking. PBO staff plan to conduct further research and consult with external experts on how to advance this work.

In the interim, PBO will continue to use macro-based elasticity estimates from the literature and its macroeconomic and fiscal model to adjust static costings produced by CTM.

6.3. New modules

CTM has more capacity for analysis of non-capital (or active) business income rather than passive (capital and investment) income. The integration of Schedules 6 and 7 could build additional capacity to analyze passive income.

To support the integration of behavioural components, Schedule 15 which concerns firm income distribution by jurisdiction, could be added to CTM.

Moreover, PBO plans to further develop industry-level capacity at the two-digit NAICS level, to assess the impact of policy changes, relevant elasticities and effective rates on industry groupings.

Appendix A: Modules and assumptions

A.1 Data preparation

Data organization

Administrative tax data are fully vetted for errors, but remain raw. The size and heterogeneity of Schedule 8 entries are particularly challenging. PBO developed a program that cleans and organizes the data for model simulations.

Preparing the administrative tax data for input into the model requires cleaning separate datasets. The first dataset contains variables associated with the tax schedules filed by corporations ("main dataset"), with the exception of Schedule 8 (Capital Cost Allowance). The format of Schedule 8 differs from most of the other schedules in that there are multiple lines for a single corporation that must be combined into a single line output.

The Schedule 8 dataset is integrated into the main dataset to form a single dataset for input to the model. Policy changes in Schedule 8 are first implemented, and firm-level aggregates are merged with the main dataset. A unique identifier, which includes the business number, tax year reference, and the fiscal start and end dates, enables merging between schedules.¹⁶

Further data preparation involves controlling missing values, reducing the size of the dataset to the tax year of interest, and general data clean-up. (For example, tax years that are 364 days long are coded to 365 days). Finally, both datasets are merged into one comprehensive dataset to analyze a given tax year.

A.2 Schedule 8: Capital cost allowance

Canada has a relatively simple and stable system of capital cost recovery for businesses, largely based on allowing taxpayers to claim deductions annually that are not in excess of a maximum rate applied to a declining balance of unrecovered capital costs.

- Report of the Technical Committee on Business Taxation, 1996

The capital cost allowance (CCA) is the sum of the undepreciated capital cost of an asset multiplied by the CRA-stipulated rate of depreciation ("CCA rate"). There are some exceptions to this general statement, for example the "50 per cent rule", which restricts the CCA amount claimed in the year that an asset is acquired.

The calculation of a corporation's Capital Cost Allowance (CCA) is determined by two factors: the type of asset and the length of time the asset has been in use. CTM calculates or infers the pertinent CCA rate for each entry by a corporation and computes a base CCA amount by summing the asset-specific CCA amount calculated on each line of a return.

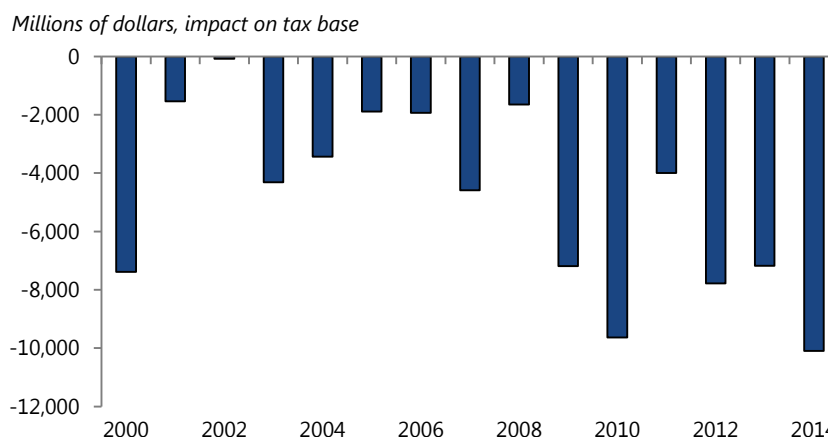
Policy shocks are applied to the CCA rates by specifying a level change in the CCA rate. The shock is added to the implied base CCA rate and the total is recalculated to obtain a policy shock scenario. This new scenario is then fed into Schedule 1, which in turn feeds into line taxable income in Schedule 200 (Taxable Income).

Changes to capital cost allowances are fiscally neutral over time, not including the time value of money. Costing a multi-period profile for such changes is done outside the CTM Model.

The difference between the accounting depreciation rates and capital cost allowances reduced the tax base by \$10.1 billion in 2014 (Figure A-1).

Figure A-1

Difference between accounting and tax treatment of capital depreciation



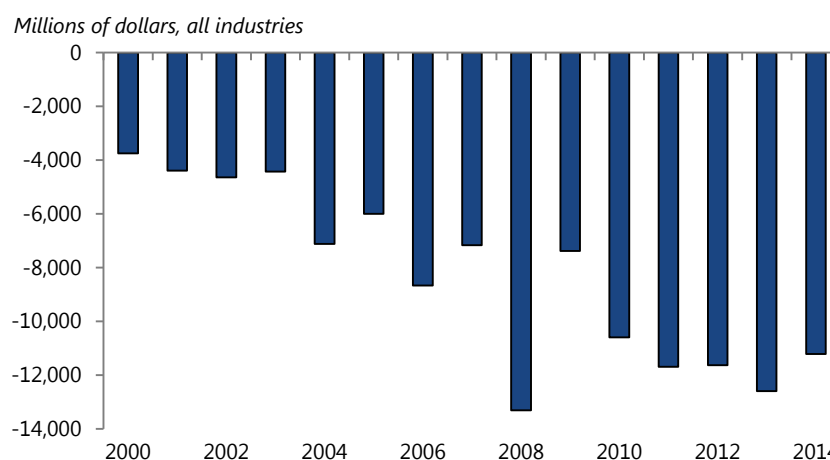
Source: Statistics Canada

A.3 Schedule 12: Resource-related deductions

Schedule 12 determines a firm's resource-related deductions which are subtracted from accounting profits to determine taxable income. The discrepancy between the accounting and tax treatment of resource expenses reduced the tax base by \$11.2 billion in 2014 (Figure A-2).

In some ways, this schedule provides tax treatment for the capital assets that do not have a corresponding capital cost allowance in Schedule 8.

Figure A-2 Difference between accounting and tax treatment of resource expenses



Source: Statistics Canada

CTM simulates deductions for exploration, development and oil and gas expenses, which represent over 90 per cent of total deductions. Depletion and foreign deductions are treated as exogenous.

CTM assumes that the vast majority of firms claim the maximum allowed deduction of eligible expenses. In some cases, where a firm's deduction is significantly different from the maximum allowable rate, presumably for tax efficiency reasons, CTM treats the deduction as exogenous. The deduction does not increase under simulated higher limits, but is reduced if the simulated allowable percentage falls below the real deduction.

A.4 Schedule 1: Net income for tax purposes

The Schedule 1 module performs adjustments to firms' accounting profits (or losses) to derive net income for tax purposes. The majority of these adjustments are taken exogenously, with the exception of a few line items. These lines include:

- Line 403 - Capital cost allowances
- Line 340 - Canadian development expenses
- Line 341 - Canadian exploration expenses
- Line 342 - Canadian oil and gas property expenses

In the model, a firm's (book) depreciation expense is replaced with their capital cost allowance (via Schedule 8) and resource expenses are replaced with deductions calculated (as per Schedule 12).

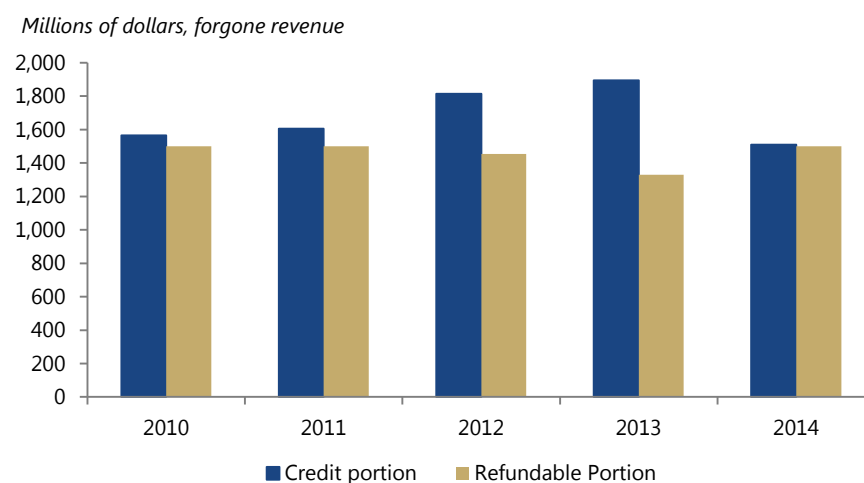
A firm's net income for tax purposes provides the starting point for a corporation filing the T2 form and is one of the most important variables in the model. CTM replicates this variable in the 2014 tax filings very closely. Nonetheless, CTM uses balancing items to ensure that any discrepancies between the model and actual are prevented from affecting downstream simulation results.

A.5 Schedule 31: Investment tax credit

The Schedule 31 module calculates a firm's investment tax credit and refund (ITC).¹⁷ This credit is refundable for some firms and can also be carried back or forward to other tax years.

CTM focuses on firms' expenditures under the Scientific Research and Experimental Development (SR&ED) program, the largest component of the ITC. According to Finance Canada estimates, the SR&ED program reduced government revenues by about \$3 billion in 2014 (Figure A-3).

Figure A-3 Annual revenue impacts of the Scientific Research and Experimental Development credit



Source: Finance Canada Tax Expenditures Report (2016)

CTM calculates a firm's SR&ED expenditure limit for the tax year based on its taxable status, income and capital.¹⁸ Increasing (decreasing) the limit increases (decreases) the ITC and reduces (increases) tax payable (see simulation 5.4). Expenditures can be added to a credit or refund at different rates, ranging from 15 per cent to 100 per cent.

Figure A-4 shows a simplification of the SR&ED ITC calculation.

Figure A-4 ITC calculation in CTM

Start:	Unused credit from previous tax year		
Plus lesser of:	Current year	Current year	
	expenditure limit	expenditures rate	
Equals:	Current year credit available		
Decision:	Refund	Credit	Credit
	(current year)	(current year)	(carry back)
End:	Unused ITC carried forward		

Source: Parliamentary Budget Officer

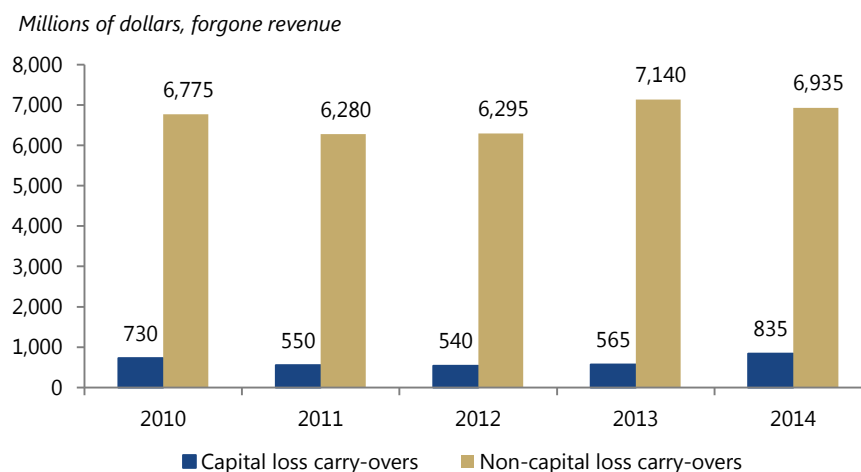
A firm's ITC for the tax year is the lesser of qualified SR&ED expenditures from current and past tax years, or the expenditure limit. Each corporation must then decide whether to take the ITC as a refund or a credit to reduce tax payable in past, current or future tax years.¹⁹

CTM assumes that corporations opt to receive the maximum portion as a refund in the current tax year, subject to eligibility criteria²⁰, after which they use the remaining credit to reduce current year Part I payable. Any credit left over (i.e., Part I is zero) can be carried back or deferred for use in future tax years (see A.8).²¹

A.6 Schedule 4: Loss continuity and application

Firms reporting negative taxable income cannot pay negative tax. Such losses may be used to reduce tax payable in other tax years during which they recorded a profit. Losses can be carried back up to three years and carried forward up to 20. According to Finance Canada estimates, loss carryovers reduced government revenues by almost \$8 billion in 2014 (Figure A-5).

Figure A-5 Annual revenue impacts of capital and non-capital loss carryovers



Source: Finance Canada Tax Expenditures Report (2016)

CTM simulates loss claims for non-capital (that is, income) and capital losses which comprise the majority of total losses.²² Importantly, capital losses can only be used to reduce current year capital gains. Unused losses are carried forward for use in future years.

Under the baseline scenario, a firm's loss claim for the current year is taken as exogenous.²³ However, under policy simulations, CTM assumes that firms react to higher tax payable by increasing current year loss claims from their stock of loss carryovers. This reduces current year tax payable, but also reduces the value of deferred tax assets, thereby raising future revenues relative to the baseline. (See A.8 and A.9 for discussion of maximization and timing differences).

Losses can be used to reduce Part I and IV tax payable. CTM simulations include the former and take the latter as exogenous.

A.7 Schedule 200: T2 tax return

The Schedule 200 module is the component of CTM into which all other modules feed. It contains many important policy parameters, particularly the taxation rates for different firms and income. Its chief input is taxable income (determined jointly with Schedule 1), while its main output is taxes payable.

CTM uses loss claims from Schedule 4 outputs to determine each firm's taxable income from their net income for tax purposes from Schedule 1. CTM then uses eligibility criteria to determine whether income is taxed at the general corporation taxation rate of 15 per cent or the small business rate of 10.5 per cent. Finally, CTM applies other credits and refunds from

schedules 27 and 31 to determine each firm's federal tax payable for the given reference year.

Table A-1

Key corporate taxation rates

<i>Effective January 2016</i>	Rate (%)	Eligibility
General tax rate	15	Active business income
Small businesses	10.5	Up to \$500,000 of active business income for corporations with less than \$15 million in taxable capital
Manufacturing	15	Manufacturing and processing profits

Source: Canada Revenue Agency

CTM can also simulate tax changes to investment and manufacturing income by completing subsets of other schedules within the Schedule 200 module.

A.8 Timing differences

Future Income Tax Benefits

Losses and creditable expenses in previous years that cannot be applied in that year (for example, if a firm has no taxable income) can be saved by firms for use in future years.

CTM computes the year-end stock of undepreciated capital, losses, ITC credits and resource deductions for each firm. CTM simulations induce changes to these stocks which are used to estimate future federal revenue impacts of policy changes.

The annualized revenue impact of changes to these stock variables is calculated outside the model using the expiration rate, or how much expires on average per year, and the effective tax rate, or the capacity of each deduction to reduce taxes payable, of each deduction (Table A-7). In this way, potential future revenue impacts can be directly compared to the current year fiscal impact of a policy change.

Table A-2

Assumptions relating to deferred deductions and credits

	<i>% , 2014</i>	Expiration rate	Tax rate
Losses		10	15
Undepreciated capital		2	15
Resource related		25	15
Investment tax credit		10	100

Source: Parliamentary Budget Officer

For undepreciated capital, losses and resource deductions, PBO multiplies these stocks by the general corporate income tax rate, given that these deductions reduce taxable income and larger firms retain the majority of stock variables.

A.9 Maximization

CTM does not incorporate fundamental changes to firms' behaviour (for example, profit shifting, economic decisions) in response to a policy change. Rather, CTM follows a "maximization" principle which enables firms to re-optimize their return by offsetting any additional tax payable with unused deferred credit and deductions.²⁴ This optimization remains within the scope of each firms' baseline tax filings.

Simulation 5.1 illustrates a likely upper bound of this effect. Costing policies in CTM require careful analysis of the type of firms that are affected by a given policy change and the potential reasons for their not fully using losses and credits in the baseline tax year.

This adds a modest behavioural component to CTM. A Finance Canada analysis of interprovincial tax planning found that responsiveness was greater for corporations that have accumulated unused losses (2014).²⁵

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Notes

1. The other three include the Italian project "Development of a System of Indicators on Competitiveness and Fiscal Impact on Enterprise Performance," the BizTax model of the German Institute for Economic Research and the ZEW Corporate Taxation Microsimulation Model as outlined by Reister et. al. (2009) and developed in the Centre for European Economic Research.
2. Model development and troubleshooting was enabled using a synthetic database. Simulation results are derived from real returns to which PBO staff accessed through a confidential batch submission process. PBO staff did not directly access real tax returns.
3. This report refers exclusively to the federal component of the Canadian corporate income tax system.
4. Boadway (2014) provides an excellent summary of taxation in Canada including corporate income tax. For a more in-depth discussion, see Canada, Report of the Royal Commission on Taxation (Ottawa: Queen's Printer, 1966) ("the Carter report") and Canada, Report of the Technical Committee on Business Taxation (Ottawa: Department of Finance, April 1998) ("the Mintz report").
5. This largely stems from corporation's ability to smooth losses and greater flexibility to value assets on a mark to market basis for accounting purposes.
6. According to the Mintz Report (1996), "Full refundability of tax losses would ensure that the tax system does not discriminate against businesses facing risk in markets and against sectors that inherently have more volatility in earnings. It also allows growing firms that experience economic losses incurred in early years to compete on the same basis as established firms with a steady or increasing level of income over time."
7. The Middle Class Tax Cut announced in December 2015 provides a useful example of harmonization between the two systems. By introducing a new rate of tax (33%) on incomes over \$200,000, the government also raised the corresponding rates for taxes on dividends and investment income earned by firms to dissuade holding income in the corporate tax system to avoid the higher personal tax rate.
8. A brief description of the SPSPD/M model can be found here: <http://www.statcan.gc.ca/eng/microsimulation/spsdm/spsdm>
9. A list of all available datasets at CDER is provided here: <http://www.statcan.gc.ca/eng/cder/data#a8>
10. There are some exceptions to this requirement. For example, charities and Hutterite colonies are exempted. See: <http://www.cra-arc.gc.ca/tx/bsnss/tpcs/crprtns/rtrn/menu-eng.html>
11. CTM also includes portions of schedules 3, 27, 33 and 34.

12. An alternative approach would be to run costing scenarios off an optimal baseline scenario rather than one that mimics real returns. This has important implications for the use of loss provisions. In practice, we observe that some firms do not always fully use loss provisions to reduce tax payable to zero.
13. For example, PBO was asked by a Member of Parliament to provide an independent costing of the Budget 2016 decision to defer planned reductions in the small business tax rate. The costing used CTM results from 5.2 as a starting point, but required adjusting for income growth, compliance measures and complementary personal income tax changes. See: <http://www.pbo-dpb.gc.ca/en/blog/news/Small%20Business%20Tax%20Rate>
14. See: http://www.cra-arc.gc.ca/E/pub/tg/t4012/t4012-06-e.html#P2862_208254
15. Dahlbe & Ferede (2012), Mintz & Smart (2004) find the elasticity of the corporate tax base to a one percentage point increase the tax rate to be greater than one at the provincial level. Finance Canada (2014) finds the elasticity of corporate income to be -1.1 to -0.4 for firms with capacity to shift income between provinces and -0.2 for those without. An analysis of OECD countries by Riedl & Rocha-akis (2009) finds an elasticity of -0.7 across countries.
16. It is possible that a company will file multiple returns for a single year, either filing for a period of less than one year, or refiling a past tax year in response to updated information. Within our database, in the case of refiling, the previous entry is overwritten by the new return, preserving the uniqueness of our matching variable.
17. Under the ITC, corporations can claim a credit or a refund on investments and expenditures related to research and development, child care spaces, apprenticeship job creation and other qualified expenditures.
18. Eligibility, the expenditure limit and the credit rate varies greatly depending on a firm's size, status and other factors. See: <http://www.cra-arc.gc.ca/txcrdt/sred-rsde/clmng/srdnvstmnttxcrdt-eng.html>
19. The ITC from SR&ED expenditures can be used to reduce Part I and Part IV tax payable.
20. Only certain qualified firms and SR&ED expenditures are eligible for a refund. See: <http://www.cra-arc.gc.ca/txcrdt/sred-rsde/clmng/srdnvstmnttxcrdt-eng.html>
21. Technically, firms for which tax payable is nil in the current tax year have the option to carry back unused ITC reduce tax payable in previous years subject to tax payable in this year. CTM does not yet have the capabilities to integrate this decision. However, the current approach fits the 2014 returns data reasonably well and this will be refined in the course of future work.
22. Other losses include those related to farming and limited partnerships.
23. An override assumption that imposes maximized use of losses for the baseline does not perform well in replicating real returns. This likely indicates discretion and multi-period planning with respect to loss allocation.

24. For the application of losses, this adjustment is done residually using each firms' effective tax rate to approximate additional taxes payable.
25. See: <http://www.fin.gc.ca/taxexp-depfisc/2014/taxexp1403-eng.asp#toc12>