What Happens If Alberta Returns to the Flat Tax System?

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FRASER INSTITUTE

2021

Contents

Executive Summary

An overall tax advantage had long been an essential attraction of Alberta for individuals and businesses. However, this tax advantage was substantially eroded when the newly elected NDP government replaced the single-rate personal income tax (PIT)—also known as the "flat tax"—system with a progressive one in 2015. As part of this tax reform, the province's income tax rate on high-income earners rose from 10 percent to 15 percent. Recognizing the potentially harmful economic effects of the tax increase, many commentators and analysts expressed their concern that the tax reform eroded Alberta's tax advantage and they called for a return to the previous flat tax system. However, the revenue effects and budgetary implications for the provincial government of returning to a 10 percent flat rate have not been thoroughly investigated before.

This paper examines the revenue effects of Alberta's possible return to the previous single-rate PIT system that was in effect before 2015. The impact of tax rate cuts on tax revenue depends on the magnitude of the tax rate change and taxpayers' behavioural responses to the rate reductions. Many theoretical and empirical studies show that income tax rate cuts have positive incentive effects on individuals and businesses in an economy. The positive economic impact associated with a lower PIT rate includes increased entrepreneurial activities, more skilled workers migrating to or remaining in Alberta, the development over time of a stronger base of corporate head offices in the province, and others. One way of measuring taxpayers' behavioural responses to tax rate changes is by estimating the taxable income semi-elasticity—the percentage change in taxable income associated with a one percentage point change in the tax rate. This study uses time-series data from 1974 to 2019 to estimate the total personal taxable income semi-elasticity with respect to Alberta's top marginal PIT rate. The paper finds a taxable income semi-elasticity of about -0.64. This indicates that a one percentage point reduction in the statutory marginal top PIT rate is associated with an *increase* in Alberta's total personal taxable income of 0.64 percent. This estimate also corresponds to a taxable income elasticity with respect to the net-of-tax rate of about 0.55, and the result is robust to different sensitivity checks.

This study then conducts a simulation analysis of the dynamic revenue effects of Alberta's possible return to the flat tax system using the key taxable income semi-elasticity estimate. The revenue estimation assumes a gradual four-year tax reform that replaces the province's current progressive income tax system with a single rate tax of 10 percent. More specifically, the analysis considers a gradual elimination of the province's current top four personal income tax brackets. For high-income earners, such a tax reform reduces the statutory marginal top PIT rate from 15 percent to 10 percent. This paper's analysis suggests that this five-percentage-point cut in the PIT rate would cause the provincial government to collect about $16 million less in PIT revenue in the first year. Further, at the end of the fourth year of the tax reform, the provincial government's revenue loss would be about $1.36 billion. To put this in perspective, the PIT revenue decreases by about 9 percent compared to the baseline scenario of no tax reform. However, when one considers the many positive economic benefits that the tax rate cut can bring, this revenue loss is relatively modest.

Nevertheless, some analysts may still be concerned that such a significant tax policy reform is not feasible or appropriate given the province's budgetary pressures that have been worsened by the Covid-19 pandemic and the decline in its non-renewable resource revenue. To address these concerns, the provincial government could undertake a smaller-scale tax reform that eliminates only the current top income tax bracket. Such minor tax reform would reduce the top PIT rate in Alberta from 15 percent to 14 percent, which would make Alberta the jurisdiction with the lowest PIT rate of any province. Even this small tax change would help strengthen the Alberta tax advantage. This paper's analysis suggests that the provincial government's revenue loss from eliminating the top income tax bracket would be $16 million in the first year. The loss rises slightly over time and reaches roughly $20 million after five years. This is roughly equivalent to a reduction of the province's PIT revenue only by 0.13 percent compared to the baseline scenario of no tax reform.

Thus, this paper's empirical analysis suggests that reducing the personal income tax rate will have a significant impact on strengthening Alberta tax advantage, which will also encourage more economic activities in the province with relatively marginal revenue loss.

1. Introduction

Historically, Alberta has been the lowest tax jurisdiction in Canada, and amongst the lowest tax jurisdictions in North America. Various commentators and politicians frequently refer to the province's low tax environment as the "Alberta Tax Advantage." Until 2015, Alberta's tax advantage was mainly due to the low corporate tax rate, the single-rate personal income tax (PIT)—also known as the "flat tax"—system, and the absence of provincial sales tax. Alberta's low tax environment has indeed been a powerful tool to attract individuals and businesses to the province (Alberta, 2021). However, in 2015, Alberta's newly elected NDP provincial government embarked on tax reforms that partly eroded the Alberta tax advantage. More specifically, in this reform, the government raised the corporate income tax rate and replaced the single-rate income tax system with a progressive one with five tax brackets.[1] As part of this tax reform, the province's income tax rate on high-income earners rose from 10 percent to 15 percent. Although the current provincial government significantly lowered the corporate income tax rate to regain a part of the lost tax advantage, the progressive personal income tax system introduced in the 2015 tax reform is still in place. Recognizing the potentially harmful economic effects of the tax increase, many commentators and analysts expressed their concern that the tax reform had eroded Alberta's tax advantage and called for a return to the previous flat tax system. What are the revenue effects for the province of returning to the flat-rate personal income tax system?

Alberta heavily relies on the energy sector and as a result the provincial government's budget is prone to the recurrent boom-bust cycle in global commodity prices. The economy's dependence on the oil sector also substantially affects the provincial government's budget because a signifi-

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[1] Besides the already existing income tax rate of 10 percent, the Alberta NDP government introduced four additional income tax brackets. These new income tax rates were 12 percent (for income from $125,001 to $150,000), 13 percent (for income from $150,001 to $200,000), 14 percent (for income from $200, 001 to $300,000), and 15 percent for income above $300,000. Thus, for high-income earners, this 50 percent tax rate hike also increased?the associated capital gain taxes. The corporate income tax rate was also raised from 10 percent to 12 percent effective July 1, 2015.

cant portion of government revenue is often accounted for by non-renewable resource revenue. (See table A1 in appendix 1.) For instance, due to the decline in global oil prices in 2015 (which began in summer 2014), the economy experienced a downturn, and provincial government revenue was adversely affected.[2] According to the newly elected provincial government, the fall in government revenue necessitated income tax rate increases to collect more revenue (Alberta, 2016). But despite the introduction of the progressive PIT system, the provincial government's PIT revenue fell by $594 million in 2016-17 from the year before. The government argued that this revenue drop was due to decreased household income (Alberta, 2017), suggesting the importance of adverse economic shocks on the government's total revenue.

The amount of additional revenue that governments can collect through a tax rate increase depends on the magnitude of the tax rate change and the behavioural responses of taxpayers to the rate increase (see Fullerton (1982) and Dahlby and Ferede (2012)). Several previous theoretical and empirical studies show that tax rate increases reduce the incentive to work, save, and invest.[3] Such distortion in economic activities associated with a higher tax rate reduces the tax base. In addition, higher tax rates encourage greater tax avoidance as individuals and businesses have incentives to deploy more aggressive and sophisticated tax planning strategies to reduce their tax liabilities. In other words, due to the adverse behavioural responses from taxpayers, tax rate increases typically cause a reduction in the taxable income. Thus, income tax rate increases often produce less revenue than governments seek to collect. This implies that accounting for the behavioural responses of taxpayers is vital in assessing any tax policy reform. Consequently, in this study, we estimate the taxable income semi-elasticity—the percentage change in taxable income associated with a one percentage point change in the tax rate—for Alberta. We then use this parameter to investigate the revenue effects of Alberta's possible return to the flat tax system.[4]

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[2] The West Texas Intermediate (WTI) oil price fell from annual average of about US$93 per barrel in 2014 to about US$48 in 2015.

[3] See Dahlby and Ferede (2021) and the references contained therein for a discussion of such studies.

[4] An alternative approach used in most individual-level data-based studies is to estimate what is commonly referred to as *taxable income elasticity.* Taxable income elasticity measures the response of taxable income to changes in the net-of-tax rate (one minus the tax rate). There is a simple algebraic relationship between semi-elasticity and taxable income elasticity estimates. However, we believe the former provides a more straightforward link between tax rate changes and taxable income. Thus, in this study we choose to focus on obtaining taxable income semi-elasticity

One strand of the existing literature focuses on estimating taxable income elasticity using individual-level data. Most of these studies use data from the United States. For instance, earlier studies such as Lindsey (1987) and Feldstein (1995) find estimates of taxable income elasticity higher than one. On the other hand, other researchers such as Goolsbee (1999, 2000), Gruber and Saez (2002), and Giertz (2007) obtain very low taxable income elasticity estimates.[5] There are also limited similar studies that employ Canadian data, such as Sillamaa and Veall (2001) and Milligan and Smart (2019). Using individual-level Canadian data, Sillamaa and Veall (2001) find taxable income elasticity of 0.25 for all individuals, but their comparable estimate is higher for high-income earners. Similarly, Milligan and Smart (2019) employ Canadian individual-level data to study the responsiveness of top 1 percent income earners to changes in provincial personal income tax rates. They find that the behavioural response of those high-income earners to provincial income tax rate changes is much higher than for low-income earners. This suggests that governments are likely to collect substantially less revenue through tax rate increases than they would in the absence of behavioural responses. Veall (2012) also argues that governments are likely to raise minimal revenue by raising the top income tax rate due to the behavioural responses of high-income earners.

On the other hand, other aggregate-level data-based studies examine taxpayers' behavioural responses by estimating the tax base semi-elasticity (i.e., the sensitivity of taxable income to tax rate changes). Previous Canadian studies such as Dahlby and Ferede (2012, 2018), Ferede (2019, 2020) and US studies such as Haughwout (2004) follow such an approach. Dahlby and Ferede (2012) rely on a panel-data estimation strategy to obtain short-term and long-term semi-elasticity estimates for Canadian provinces. These estimates assume the same behavioural responses across all provinces and use this to investigate the economic costs of the Canadian provincial personal income tax system. Dahlby and Ferede (2018) also examine taxpayers' long-term behavioural responses to changes in

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estimates for Alberta and then use the result to assess the revenue effects of tax rate changes. Our use of taxable income semi-elasticity instead of taxable income elasticity is consistent with that of similar previous aggregate data-based studies such as Haughwout (2004), Ferede (2019, 2020) and Dahlby and Ferede (2012, 2018). Furthermore, taxable income semi-elasticity estimates provide a more straightforward relationship between tax rate changes and taxable income, which is advantageous in assessing the revenue effects of tax rate changes. However, for the sake of completeness, we also show the comparable taxable income elasticity estimates in our empirical results.

[5] Saez et al. (2012) provide an excellent survey of the literature on taxable income elasticity.

the provincial top PIT rate for all Canadian provinces separately. Using an empirical approach close to that used in this paper, recent studies by Ferede (2019) and Ferede (2020) also analyze the revenue effects of personal income tax rate changes for the federal government and the Ontario provincial government, respectively.

The main objective of this paper is to add to the existing Canadian tax policy literature by investigating the likely revenue effects of reducing Alberta's top statutory marginal PIT rates. Doing so requires that we first measure the sensitivity of Alberta's taxpayers to tax rate changes. Therefore, we empirically estimate Alberta's short-term taxable income semi-elasticity and then use this crucial parameter to assess the revenue effects of returning to the previous single-rate personal income tax system. This study's empirical analysis finds a statistically significant total taxable income semi-elasticity of about - 0.64. This estimate suggests that a one percentage point cut in Alberta's top marginal PIT rate is associated with an increase of the province's total taxable income by about 0.64 percent. Alternatively, this taxable income semi-elasticity estimate corresponds to a taxable income elasticity (with respect to the net-of-tax-rate) of about 0.55. Thus, this paper's estimate of Alberta's elasticity is well within the range of values obtained in similar previous studies.

We also use our uniquely estimated tax base semi-elasticity to simulate the revenue effects of Alberta's possible gradual return to a single provincial personal income tax of 10 percent over four years.[6] The simulation analysis indicates that the tax rate cut would cause the provincial government to collect about $16 million less in PIT revenue in the first year. More importantly, the provincial government's revenue loss would rise to about $1.36 billion over four years, by the end of which the tax reform would be fully implemented. To put this in perspective, the PIT revenue would decrease by about 9 percent compared to the baseline scenario of no tax reform. When one considers the many positive economic benefits that the tax rate cut can bring and its contributions in enhancing Alberta's tax advantage, such a revenue loss is arguably very modest.[7] However,

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[6] Currently, Alberta's PIT system has five income tax brackets. 10 percent (for income up to $131,220), 12 percent (for income from $131,221 to $157,464), 13 percent (for income from $157,465 to $209,952), 14 percent (for income from $209, 953 to $314,928), and 15 percent for income above $314,928. Thus, the provincial government is assumed to cut the top PIT rate over a four-year period to 14 percent, 13 percent, 12 percent, and 10 percent, respectively. This is essentially a gradual elimination of the top four income tax brackets.

[7] The positive economic effects associated with lower PIT rate include increased entrepreneurial activities, more skilled workers migrating to or remaining in Alberta,

some may question the feasibility of such a major tax reform in the face of the current provincial government's budgetary pressures, which have been worsened by the Covid-19 pandemic and the decline in non-renewable resource revenue. In this context, the provincial government could embark on a very limited tax reform by cutting the top statutory marginal PIT rate by one percentage point. This would help the province regain the mantle of being the lowest tax jurisdiction in Canada, and the revenue loss would be only $16 million in the first year. The revenue loss from such a minor reform would rise only slightly over the years and become about $20 million after five years.

The remaining part of this paper is organized as follows. Section 2 provides an empirical analysis of the effects of tax rate changes on taxable income and discuss the results. Then, using our taxable income semi-elasticity estimate, we simulate the personal income tax revenue effects of Alberta's possible return to the previous flat income tax system in section 3. Section 4 concludes.

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the development over time of a stronger base of corporate head offices in the province, and others.

2. Empirical Results and Discussions

Specifications and data

As indicated earlier, the revenue implication of any tax reform depends in large part on how taxpayers respond to the reform. Consequently, we are interested in investigating the possible behavioural responses of taxpayers if Alberta returns to the previous flat income tax system. A return to the flat income tax system involves gradually reducing the province's current statutory top marginal personal income tax (PIT) rates. Thus, we first seek to examine how Alberta's taxable income responds to the cut in its top PIT rate. The empirical specification is similar to those of previous studies such as Dahlby and Ferede (2012, 2018), Milligan and Smart (2019), and Ferede (2019, 2020). We use the following simple empirical specification:

$$\Delta \ln B_t = \theta + \varepsilon \Delta \tau_t^T + Z_t + u_t \qquad (1)$$

In Eq. (1) above, Δ denotes change, $\Delta \ln B_t$ is the log of Alberta's real per capita total taxable personal income in year t. Due to the log specification, the dependent variable is simply the annual growth rate of the real per capita total taxable income. Further, $\Delta \tau_t^T$ is the province's top statutory marginal PIT rate in year t. To account for the effects of inflation, we deflate the province's taxable income with the Consumer Price Index (CPI) (2019 =100). Further, we divide the taxable income by total population to account for the provincial population growth. Thus, the dependent variable is the log of real per capita total taxable income. We use total taxable income rather than taxable income associated with the top income tax bracket due to the lack of data on the latter. As appendix 2 shows, this will not pose any problem in assessing the revenue effects of tax rate changes.

In Eq. (1), we are particularly interested in the coefficient of the top PIT rate (ε), which indicates the *taxable income semi-elasticity* with respect to the statutory top marginal PIT rate. The semi-elasticity estimate ε shows the percent change in total taxable income associated with a one percentage point change in the top PIT rate. Income tax rate cuts

encourage more economic activities, reduce tax avoidance and evasion. This, in turn, expands taxable income when governments cut tax rates. Thus, we expect the taxable income semi-elasticity (ε) to be negative. Our main specification in Eq. (1) is consistent with the empirical approaches of previous similar aggregate data-based studies. Moreover, such a specification provides a more direct way to assess the revenue effects of the top PIT rate.[8] In time-series-based empirical studies such as ours one needs to employ an appropriate method if the variables of interest are non-stationary.[9] Consequently , we specify Eq. (1) in terms of first differences. As the empirical model is in the form of first differences, it provides the short-term taxable income semi-elasticity estimate. As appendix 2 indicates, an estimate of taxable income semi-elasticity obtained from such an empirical model plays a critical role in assessing the revenue effects of tax rate changes.

In addition to the income tax rate, other variables can impact taxable income in a province. In Eq. (1), Z denotes a vector of control variables that can affect the PIT base, and u_t is the error term. Alberta's provincial budget heavily relies on the energy sector and as a result the province's fiscal balance is significantly related to fluctuations in the global and North American oil prices. We account for this by including oil price as an additional control variable in our economic analysis. We include a two-year moving average of the real Canadian dollar price of West Texas Intermediate oil (the benchmark price of oil in North America). We expect the oil price to have positive effects on the province's taxable income. Further, we account for the effects of the business cycle by including the unemployment rate as one of our control variables.

We also control for the statutory top PIT rate of other provinces and the federal government to account for horizontal and vertical tax competition, respectively. As both the federal and the provincial governments occupy the same tax base, changes in the federal PIT rate can have an impact on Alberta's taxable income. For instance, federal PIT rate increases that adversely affect taxable income can reduce the tax base for Alberta's prov-

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[8] An alternative empirical approach commonly employed in individual-level based empirical studies of taxable income elasticity is the use of the log of the net-of-tax rate (i.e., one minus the tax rate) as the key explanatory variable. In such a specification, the coefficient estimate shows the elasticity of taxable income with respect to the net-of-tax rate. Such estimates can easily be obtained from our specification. Further, we check the robustness of our main finding to the use of such an alternative specification as part of our sensitive analysis section.

[9] An economic variable is termed "nonstationary" if its mean and variance are not stable over time.

incial government. Thus, we expect the federal PIT rate to affect Alberta's taxable income negatively.

In fiscal federations such as Canada, individuals and businesses can easily move across provinces. If tax rate changes induce people to move from one province to another, the tax rate of other provinces could affect Alberta's taxable income. To account for such effects of horizontal tax competition typical in a federation, we include the weighted average (weighted by population) of other provinces as a control variable. An increase in the PIT rate of other provinces can encourage labour mobility to Alberta, and this can expand Alberta's taxable income. Thus, we expect this variable to have positive effects on taxable income.

The Canadian federal government embarked on one of the most significant personal income tax revenue reforms in 1988 when it reduced the number of income tax brackets and expanded the tax base. However, as provincial governments' taxes were then based on the federal income tax rates, the reform greatly expanded the provinces' taxable income. For instance, Alberta's taxable income rose by a remarkable 61 percent following the 1988 federal tax reform.[10] In our empirical analysis, we account for such a dramatic spike in taxable income by including a dummy variable (dummy 1988) which is equal to 1 in years after 1987 and zero otherwise.

Data

Our analysis is based on time-series data from Alberta from 1974 to 2019. The choice of the sample period reflects the availability of data for our key variables of interest. The data come from various sources. We obtained the provincial and federal personal and corporate income tax rates from *Finances of the Nation*.[11] The taxable income dataset was obtained from various issues of the Canada Revenue Agency's *Income Statistics* (formerly *Tax Statistics on Individuals*).[12] Data on the CPI, population, and the unemployment rate come from Statistics Canada's database, CANSIM. Further, data on the West Texas Intermediate oil price come from *BP Statistical Review of World Energy* (June 2020) and the Federal Reserve Bank of St. Louis. Table 1 provides summary statistics for our key variables of interest.

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[10] According to data from Canada Revenue Agency, Alberta's personal taxable income increased from $20.5 billion in 1987 to $33 billion in 1988.

[11] See https://financesofthenation.ca/statutory-tax-rates/.

[12] 2017 is the latest year for which complete taxable data is available from the Canada Revenue Agency. Consequently, we use the annual growth rate of Alberta's PIT revenue to extrapolate and obtain taxable income data for years 2018 and 2019.

Table 1: Summary Statistics, 1974-2019

Variable	Mean	Std. Dev.	Min	Max
PIT base (per capita in 2019 Canadian $)	29687	8973	14439	44914
Top statutory PIT rate	0.1343	0.0259	0.1	0.1807
The growth rate of the PIT base	0.02	0.0872	-0.1746	0.4415
Change in the top statutory PIT rate	-0.0004	0.0153	-0.047	0.0433
Change in the federal PIT rate	-0.0031	0.0188	-0.09	0.04
Change in the unemployment rate	0.0009	0.0116	-0.016	0.038
Change in the Oil price (per barrel in 2019 C$)	0.9124	12.4164	-25.3757	39.7882
Change in Other provinces' PIT rate	0.0006	0.0091	-0.0217	0.0359
Change in the combined CIT rate	-0.0051	0.0171	-0.0412	0.064

Source: Author's computation based on the dataset described in the text.

Table 1 shows that Alberta's marginal top statutory PIT rate ranges between 10 percent and 18.07 percent during the period under investigation. Alberta had the lowest PIT rate of any province between 2000 and 2015. Figure 1 shows the current top PIT rate of selected provinces.

Figure 1 focuses on the two provinces immediately neighbouring Alberta (British Columbia and Saskatchewan) and the two larger provinces of Ontario and Quebec. Note that Quebec's PIT rate takes into account the presence of the federal tax abatement for the province's residents.

Figure 1: Top Statutory PIT Rates of Selected Provinces (in percent), 2021
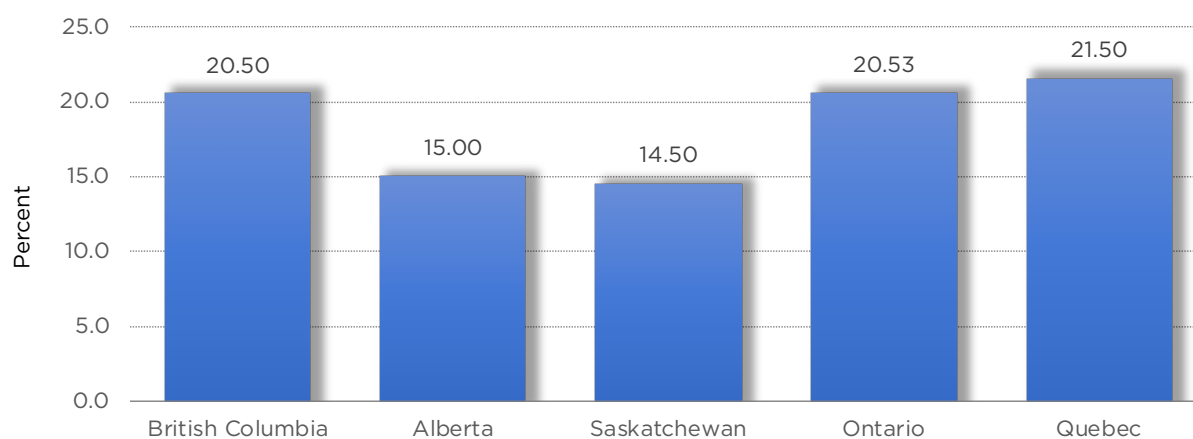
Source: Canada Revenue Agency (2021).

Further, Ontario's top PIT rate of 20.53 percent is inclusive of all applicable surtaxes. The figure indicates that, due to the tax rate increases of 2015, Alberta has now the second lowest PIT rate.

Empirical results and discussions

Table 2 reports our main empirical results. As indicated above, we use a semi-log specification, and the dependent variable is the growth rate of Alberta's taxable personal income. The key variable of interest in Table 2 is the estimated coefficient of the provincial statutory marginal top PIT rate, which measures the taxable income semi-elasticity. For ease of comparison with the results of those of similar previous studies, we also compute the equivalent taxable income elasticity with respect to the net-of-tax rate. In our analysis, we use standard errors that are robust to heteroscedasticity and autocorrelation. Note also that the dependent variable is the growth rate of real per capita total taxable income (or the first difference of the log of the variable). All the control variables also enter the empirical model as first differences.

Column 1 begins by presenting estimation results based on a simple Ordinary Least Square (OLS) estimation method. In addition to the provincial statutory marginal top PIT rate, we include the oil price and a dummy variable for the 1988 major federal PIT reform as explanatory variables. All three explanatory variables are statistically significant with their respective expected signs. The coefficient of the top PIT rate is -0.722, and it is statistically significant at the five percent level. This result implies that a one percentage point reduction in the top PIT rate is associated with an increase in taxable income by about 0.72 percent. An important implication of such a result is that taxpayers exhibit positive behavioural responses to tax rate cuts.

Column 2 includes the federal statutory marginal top PIT rate as an additional control variable. As expected, the coefficient of the federal PIT rate is negative, but it is statistically insignificant. More importantly, the coefficient of the provincial PIT rate is negative and statistically significant. The other control variables are also significant with their expected signs.

We account for the effects of horizontal tax competition by including the weighted average (weighted by population) statutory top PIT rate of other provinces as an additional control variable in column 3. The coefficient of this variable is positive as expected, but it is statistically insignificant. More interestingly, the coefficient of the provincial PIT rate continues to be negative and statistically significant. The magnitude of the semi-elasticity estimate is now higher in absolute value.

Table 2: The response of taxable income to PIT rate, 1974-2019

	(1) OLS	(2) OLS	(3) OLS	(4) IV	(5) IV	(6) IV
PIT rate	-0.722**	-0.679***	-0.819**	-0.682*	-0.643***	-0.636***
	(0.326)	(0.232)	(0.395)	(0.379)	(0.184)	(0.186)
Oil price	0.003***	0.003***	0.003***	0.003***	0.001*	0.001*
	0.000	0.000	0.000	0.000	(0.001)	(0.001)
Dummy 1988	0.419***	0.414***	0.420***	0.421***	0.339***	0.338***
	(0.008)	(0.020)	(0.012)	(0.012)	(0.016)	(0.014)
Federal PIT rate		-0.138	-0.106	-0.136	-0.713***	-0.720***
		(0.324)	(0.274)	(0.318)	(0.253)	(0.237)
Other Provinces' PIT rate			0.494	0.392	0.351	0.383
			(0.643)	(0.609)	(0.363)	(0.287)
Unemployment rate					-2.841***	-2.835***
					(0.554)	(0.570)
CIT rate						-0.050
						(0.166)
Constant	0.008***	0.008**	0.007**	0.007**	0.011***	0.011***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)
Implied elasticity with respect to net-of-tax rate	0.625**	0.588***	0.709**	0.591*	0.557***	0.550***
	(0.283)	(0.201)	(0.342)	(0.328)	(0.159)	(0.161)
Over. id. test (p-value)				0.622	0.479	0.459
Observations	45	45	45	45	45	45
Adjusted R^2	0.700	0.693	0.687	0.687	0.782	0.777

Notes: In columns (4) to (6), the PIT rate is instrumented with change in the provincial debt to GDP ratio, the U.S top PIT rate as well as the governing party dummy. Heteroscedasticity and autocorrelation robust standard errors in parentheses. Significance levels are shown by * for 10 percent, ** for 5 percent and *** for 1 percent.

[a] The implied taxable income elasticity with respect to the net-of-tax rate is simply obtained by multiplying the semi-elasticity estimate by (1-PIT rate) using Alberta's mean PIT rate of the sample period, which is 0.1343.

So far, our empirical analysis assumes that the income tax rate is exogenous in the sense that the tax rate does not depend on taxable income. However, one may be concerned with such an assumption as the amount of the province's taxable income may influence the tax rate choices of the government. For example, given a specific revenue requirement, the government can lower the tax rate when the taxable income is higher. Thus, if the PIT rate depends on the tax base, then the tax rate is endogenous. In an empirical analysis, if this problem is not adequately addressed, it can result in biased coefficient estimates. Consequently, in column 4, we treat the top provincial PIT rate as endogenous and employ the two-stage least squares instrumental variable (IV) estimation method to address the potential problem of endogeneity.

In aggregate-data-based studies such as ours, finding appropriate instruments for tax variables is often a significant challenge. Therefore, we follow the approaches of previous studies such as Dahlby and Ferede (2012) and Ferede (2019) and use changes in the debt-to-GDP ratio, a governing party dummy (discussed below), and the US top PIT rate as instruments in column 4. When the public debt-to-GDP ratio increases and governments face fiscal challenges, they often raise the income tax rate on high-income earners to collect more revenue. So, the debt-to-GDP ratio is related to the top PIT rate, and it can be a valid instrument. Further, since the US is Canada's biggest trading partner and closest neighbour, its tax policy often influences tax rates in Canada. Thus, we believe the US statutory top marginal PIT can be used as a valid instrument for Alberta's top PIT rate. Similarly, previous political economy studies such as Ferede, et al. (2015) find that the ideological orientation of the government can influence the tax rate. Consequently, we use the governing party dummy as an additional instrument for the PIT rate. The party dummy for Alberta equals one if the provincial governing party is the New Democratic Party (NDP) and zero otherwise. We check the validity of these instruments using various statistical tools. More specifically, we report the Hansen overidentification test probability values (p-value) in all our IV regressions. The null hypothesis in this statistical test is that the instruments are valid. Thus, as we do not reject the null hypothesis, it gives us some assurance that our instruments are valid.

Results of column 4 show that our crucial variable, the coefficient of the top PIT rate, continues to be negative and statistically significant. Compared to the OLS results of column 3, the tax base semi-elasticity estimate obtained using the IV method is lower (in absolute value). This indicates that the tax base semi-elasticity estimate can be biased upwards if the endogeneity of the tax rate is not adequately addressed. Note that the reported overidentification test is insignificant, suggesting that we do not

reject the null hypothesis of valid instruments. Regarding the other control variables, they all exhibit similar signs and statistical significance as those of column 3.

As discussed earlier, Alberta's economy relies greatly on the energy sector, and it is prone to fluctuations in global and North American oil prices. Thus far, we attempt to capture this by controlling the oil price, and this variable has been positive and statistically significant. However, Alberta's economy can also be influenced by fluctuations in economic activities that are not caused by the global oil price. Thus, column 5 uses a more general proxy for the business cycle by including the provincial unemployment rate as an additional control variable. A higher unemployment rate often indicates an economic downturn, and this reduces the provincial taxable income. Thus, we expect the coefficient of the unemployment rate to be negative. Column 5 shows that the coefficient of the unemployment rate is negative and statistically significant as expected. The inclusion of this variable as part of the controls also improved the model's fit, as shown by the increased value of adjusted-R-squared. More importantly, the coefficient of the top PIT rate continues to be negative and statistically significant. However, the magnitude of the tax base semi-elasticity estimate is now lower in absolute value. The coefficient estimates of the other control variables are mostly similar to those of column 4, with the one exception that the coefficient of the federal PIT rate is now statistically significant. The result shows that, like the provincial PIT rate, an increase in the federal PIT rate has a statistically significant negative effect on taxable income.

Finally, column 6 controls for the provincial and federal combined corporate income tax (CIT) rate to capture the potential effect of the corporate income tax system on personal taxable income. Column 6 includes all the relevant control variables, and various statistical tests show the validity of the instruments used in our analysis. Consequently, column 6 represents our primary empirical model, and below we focus on the results of this column. Our key coefficient of the top PIT rate is negative and statistically significant, suggesting the adverse impacts of a higher marginal statutory PIT rate on the province's taxable income. The estimated semi-elasticity of taxable income with respect to the top PIT rate is -0.636. This indicates that a one percentage point cut in Alberta's statutory top marginal personal income tax rate is associated with an increase in the province's taxable income by about 0.64 percent.[13] To facilitate com-

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[13] Note that since we are using total taxable income (rather than taxable income of the top income group) as the dependent variable, we assume that the behavioural responses remain the same as the province gradually cuts the top PIT rate from 15

parison with previous studies, we also computed the equivalent taxable income elasticity with respect to the net-of-tax rate using Alberta's average PIT rate of 0.134 for the sample period. The results show that our taxable income semi-elasticity estimate is equivalent to a taxable income elasticity with respect to the net-of-tax rate of about 0.55.[14] This value is well within the range of estimates obtained by previous similar studies.

Note that the results of column 6 also show that many of the other control variables have statistically significant effects on taxable income. More specifically, the results show that, as expected, the coefficient of the federal marginal top PIT rate is negative and statistically significant. This is unsurprising, as the federal and provincial governments occupy the same tax base. Our result shows that global oil price has positive effects on the taxable income in Alberta. This, too, is not surprising as the energy industry is the leading sector of Alberta's economy. Further, the unemployment rate has statistically significant negative effects on taxable income. Thus, the province's taxable income fluctuates in tandem with the economy. While the coefficient of other provinces' top PIT rate is positive as expected, it is statistically insignificant. On the other hand, the corporate income tax rate coefficient has an unexpected negative sign, although it is statistically insignificant.

How does our key finding compare with those of similar previous studies? Variations in empirical methodologies and the nature of the data used pose a challenge to making a direct comparison. Furthermore, only a very limited number of empirical estimates of taxable income semi-elasticity or elasticity are available in the Canadian setting. However, the taxable income semi-elasticity estimate of this paper is well within the range of values that earlier empirical studies obtained. In this regard, our taxable income semi-elasticity estimate is lower than what Ferede (2019) found for the Canadian federal government PIT system using a similar methodology. This is expected because generally the elasticity of the tax base is greater for individual provinces than for the country as a whole—because people, business activity, and capital are more mobile within the country than between Canada and foreign jurisdictions. Further, our taxable semi-elasticity estimate for Alberta is comparable to the result that Ferede

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percent to 10 percent. One may consider this as a limitation in projecting the revenue effects of changes in tax rates of multiple tax brackets. Nonetheless, the estimated short-run semi-elasticity estimate of taxable income with respect to the top PIT rate suggests that Alberta's short-run Marginal Cost of Public Funds (MCF) in 2019 (the last year of the study period) is about 1.11.

[14] During the sample period under investigation, the average statutory marginal top PIT rate for Alberta is 0.1343. The taxable income elasticity with respect to the net-of-tax rate is simply computed as: -(-0.636) X (1-0.1343) = 0.55.

Table 3: Robustness Checks, 1974-2019

	(1) LIML	(2) Capital gain inclusion rate	(3) Including top threshold	(4) Dummy for 2015	(5) Using net-of-tax rate
PIT rate	-0.552**	-0.552**	-0.893***	-0.787***	
	(0.245)	(0.279)	(0.239)	(0.185)	
Net-of-tax rate					0.553***
					(0.159)
Inclusion rate		0.003			
		(0.049)			
Dummy 2015				0.106***	
				(0.004)	
Threshold income			0.000***		
			0.000		
Constant	0.011***	0.011***	0.010**	0.008*	0.011***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)
Observations	45	45	45	45	45
Adjusted R2	0.775	0.768	0.806	0.809	0.777

Note: The dependent variable is the growth rate of real per capita personal total taxable income. Hetero-scedasticity and autocorrelation robust standard errors in parentheses. Significance levels are shown by * for 10 percent, ** for 5 percent and *** for 1 percent. The robustness check is based on column 6 of table 2, and we use the same instruments. The coefficient estimates of the other control variables are not shown for the sake of brevity.

(2020) obtained for Ontario using a similar empirical approach. However, it is lower than the short-run taxable income semi-elasticity estimate that Dahlby and Ferede (2012) find using data from all the Canadian provinces. Dahlby and Ferede (2018) obtained a long-term semi-elasticity estimate of -2.89 for Alberta. Thus, according to our main result, this long-term value is attained in about five years. Further, our computed taxable income elasticity of 0.55 is also within the range of values that Sillamma and Veall (2001) found using individual-based Canadian data. Our elasticity estimate is slightly lower than that of Milligan and Smart (2019). However,

their focus is the tax rate sensitivity of the taxable income of only the top tax bracket, not total taxable income.

Sensitivity analysis

This section checks the robustness of our key result. We assess the sensitivity of the results to changes in the estimation methods, specifications, and use of additional control variables. Table 3 shows the results of the sensitivity analysis. The robustness check is based on our primary empirical model of column 6 of table 2. As before, we use heteroscedasticity and autocorrelation robust standard errors in the analysis. While all the relevant control variables are included in the estimation, we only report the coefficient estimates of the key variables of interest for the sake of brevity.

Our principal empirical analysis relies on the two-stage least squares (2SLS) instrumental variable estimation method to address the endogeneity of the PIT rate. However, previous studies indicate that the Limited Information Maximum Likelihood (LIML) estimation method performs better than the 2SLS in the presence of the potential problem of weak instruments. Thus, in column 1, we use the LIML instead of the 2SLS. The result shows that the top PIT rate coefficient is still negative and statistically significant, suggesting that weak instruments do not influence our finding. The estimated taxable income semi-elasticity is slightly lower than what we obtain using the 2SLS method.

Currently in Canada, half of the eligible capital gains is included as taxable income under the PIT system. The capital gains inclusion rate has changed quite a few times during the period under investigation. When the capital gains inclusion rate increases, a higher portion of the eligible capital gains will be subject to the PIT system, and this increases taxable income. In column 2, we control for the capital gains inclusion rate to check the robustness of our key finding. Again, the top PIT rate coefficient is negative and statistically significant, suggesting the robustness of our main result. The coefficient of capital gains inclusion rate is positive as expected; however, it is statistically insignificant.

Our empirical analysis focuses on investigating the sensitivity of total taxable income to changes in the top PIT rate that is applicable to the top income tax bracket. However, the threshold income level for the top income tax bracket regularly changes. Thus, one may wonder whether the paper's main finding stands if the threshold income for the top income tax bracket is included as part of the control variables. We check the robustness of our result by including the real threshold income for the top income tax bracket in column 3. The coefficient of the top PIT rate is again negative and statistically significant. The numerical magnitude of the

taxable income semi-elasticity is now higher in absolute value. Further, the coefficient of the threshold income is positive and significant.

The Canadian federal government increased its top PIT rate in 2016. However, the tax rate hike was announced earlier, in late 2015. For this reason, total taxable income in the country (including Alberta) showed a significant jump in 2015 as many taxpayers attempted to avoid the tax increase by bringing their taxable income forward to 2015. Therefore, we check the robustness of our main result by including a dummy variable for the year 2015 to capture this event in column 4. As expected, the coefficient of the dummy variable for the year is positive and statistically significant. Perhaps more importantly, the coefficient of the top PIT rate continues to be negative and statistically significant, indicating the robustness of our key result.

As discussed above, the regression results reported in table 2 include computed taxable income elasticity with respect to the net-of-tax rate to facilitate comparison with previous studies. However, an alternative approach may be to estimate the taxable income elasticity directly by using the log of the net of the tax rate rather than the top PIT rate. We do this robustness check in column 5. The results suggest that, as expected, the taxable income elasticity with respect to the net-of-tax rate is positive and statistically significant. The magnitude of the coefficient estimate is also the same as that reported in column 6 of table 2. This gives us some additional assurance that our finding is robust to the use of the alternative specification.

In sum, the sensitivity analysis indicates our principal finding that Alberta's total taxable income is sensitive to changes in the province's top marginal PIT rate is robust to using a different estimation method, alternative specifications, and the inclusion of additional control variables. The magnitude of the estimated taxable income semi-elasticity is stable across various robustness checks. In the next section, we use this key coefficient estimate to investigate the revenue effects of changing Alberta's top PIT rate.

3. Revenue Effects of Returning to the Flat Tax System

An important objective of this paper is to assess the revenue implications of returning to the flat income tax system in Alberta. Therefore, in this section, we conduct a simulation analysis using our uniquely estimated semi-elasticity of the personal income tax base with respect to the top marginal PIT rate as reported in table 2. More specifically, if Alberta's provincial government gradually cuts its top statutory marginal PIT rate from the current 15 percent to 10 percent, how will its revenue be affected?

Appendix 2 provides a detailed discussion of the analytical framework for the simulation analysis and the various underlying assumptions related to the simulation. Our simulation exercise makes different assumptions. First, consistent with previous tax reform experiences, we assume that the provincial government will move gradually and complete the tax reform over four years. That is, the government is assumed to cut the PIT rates by one percentage point each year for the first three years. In the final year of the reform, the PIT rate is reduced by two percentage points. Thus, beginning from the fourth year of the reform, the government relies on a flat tax system with a single provincial PIT rate of 10 percent—the tax rate that was in effect before the 2015 tax rate increase.[15] We assume that the tax reform begins in 2022. As taxable income data for 2021 are not available, we use extrapolation from the 2017 value using the growth rate of the province's PIT revenue.[16] Tax reform in Alberta would also indirectly affect the PIT revenue of the federal government as both governments occupy the same tax base. However, our simulation analysis focuses only on Alberta's personal income tax revenue. Further, the simulation analysis abstracts from the potential revenue effects of the PIT revenue on the province's other revenue sources. For these reasons, one would expect

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[15] The assumption is that Alberta's provincial government cuts the statutory top marginal PIT rate from 15 percent to 14 percent in the first year, from 14 percent to 13 percent in the second year, from 13 percent to 12 percent in the third year of the reform, and in the fourth and final year of the reform the tax rate is cut from 12 percent to 10 percent resulting in a five percentage points cumulative tax rate cut.

[16] The annual growth rates of the provincial PIT revenue were 10.2 percent (in 2018), -5.3 percent (in 2019), -2.7 percent (in 2020), and 6.5 percent (in 2021).

Table 4: Revenue Effects of Alberta's Return to the Flat Income Tax (in $ millions)

	2022	2023	2024	2025	2026
Static effects	-136	-387	-809	-2096	-2251
Behavioural response	120	257	414	740	704
Dynamic effects	-16	-130	-396	-1356	-1547

Source: Author's calculations. The tax base semi-elasticity estimate reported in column 6 of table 2 and the gradual five percentage points cut in Alberta's PIT rate is used to compute the behavioural responses of the tax rate cut. See the text and appendix 2 for a discussion of the computation.

that our simulation analysis may underestimate the positive PIT revenue effects of the tax reform.

Table 4 shows the potential revenue impact of returning to the single-rate PIT system in Alberta. In any year, the amount of tax revenue that the provincial government collects depends on taxable income and the applicable tax rates. If the total taxable income remains unchanged, the provincial government collects less revenue when it cuts the tax rate. This is commonly referred to in the literature as the *direct revenue effect* of tax rate cuts. Such a revenue estimation approach, which ignores taxpayers' behavioural responses associated with tax rate changes, is also known as a *static estimation*. The first row of table 4 shows our static revenue estimation of the effect of the PIT rate cut in Alberta. The negative figures indicate that the tax rate cuts reduce the provincial government's PIT revenue. The analysis suggests that if Alberta's provincial government gradually cuts its top PIT rate from 15 percent to 10 percent (over four years), then it would collect about $136 million less in PIT revenue in the first year of the reform. This revenue loss grows to about $2.1 billion when the tax reform is complete (and the top marginal PIT rate is eventually reduced from 15 percent to 10 percent) in 2025. Note that the static revenue estimation results are simply the mechanical effects, being obtained by multiplying the reductions in the PIT rates by the applicable taxable income.[17] The revenue losses associated with the tax reform also grow over time as the tax base increases.

A common criticism of a static revenue estimation is that it tends to overestimate the revenue loss associated with tax rate cuts since it ignores

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[17] See HM Revenue and Customs (2012) and Ferede (2019) for a similar tax revenue simulation approach.

taxpayers' behavioural responses. In the context of this study, this limitation must be addressed properly because the empirical analysis of the previous section shows that tax rate cuts have positive effects on taxable income. When the statutory top marginal PIT rate is reduced, the taxable income increases due to the positive impact of the rate cut on taxpayers' behavioural responses, and this increases the tax revenue that the provincial government can collect. In table 4, this positive revenue effect associated with the PIT rate cut is shown in the second row. The simulation results suggest that in the first year of the tax reform, the provincial government's PIT revenue would increase by $120 million due to the positive behavioural responses of taxpayers. The revenue gain stemming from the positive behavioural responses from taxpayers grows to $740 million when the tax reform is complete in 2025. This is possible due to an increase in the province's economic performance and lower tax avoidance and evasion activities associated with the lower tax rate. The PIT rate cut can boost the province's economy in many ways. First, lower PIT rate can encourage more corporate head offices to move to the province which in turn increases jobs in the corporate sector. Second, a reduction in the PIT rate can cause more in-migration of skilled workers to the province and the province can also benefit from a higher level of entrepreneurial activities. Note that the PIT revenue increase associated with the tax rate cut expands over time as the tax base grows in tandem with greater economic activity.

The preceding discussion highlights the fact that revenue projections associated with any tax reform should incorporate taxpayers' behavioural responses to provide a more reliable assessment of medium- and longer-term budgetary implications. Such a revenue estimation is what is commonly known as dynamic revenue estimation (or dynamic scoring). Dynamic estimation includes both the direct negative revenue effects caused by PIT rate cuts and the positive revenue effects associated with the behavioural responses of taxpayers and the effect of these responses on economic activity. In table 4, the third row shows the dynamic revenue estimation as the sum of the negative static estimations (static effects) and the positive revenue effects associated with the taxpayers' behavioural responses.

The dynamic revenue simulation analysis shows that the revenue loss associated with the PIT rate cut is significantly less than what the static estimation suggests. Table 4 indicates that the net tax revenue loss associated with the PIT rate cut is only $16 million in the first year. Similarly, at the end of the fourth year of the tax reform (i.e., in 2025), the net revenue loss for the Alberta government would be about $1.36 billion.[18] This is

[18] This estimated revenue loss is comparable to the projection of Lafleur et al. (2015) about the province's PIT revenue yield that would occur when the provincial

equivalent to a drop in PIT revenue by only about 9 percent compared to the baseline scenario of no tax reform. One may view this revenue loss as modest if we consider the various economic gains that the tax reform can bring to the province. However, some analysts may still be concerned that such a major tax policy reform is not feasible or appropriate given the budgetary pressures facing the province that have been worsened by the Covid-19 pandemic and the decline in the province's non-renewable resource revenue. In this context, the provincial government could undertake a smaller scale tax reform that eliminates only the current top income tax bracket. This would reduce the top PIT rate in Alberta from 15 percent to 14 percent, and this makes Alberta the jurisdiction with the lowest PIT rate of any province.[19] Even this small tax change would help strengthen the Alberta tax advantage. Our dynamic revenue simulation analysis suggests that the provincial government's revenue loss from eliminating the top income tax bracket is $16 million in the first year. The loss rises slightly over time and reaches roughly $20 million after five years. This is roughly equivalent to a reduction of the province's PIT revenue by only 0.13 percent compared to the baseline scenario of no tax reform.

We also show the evolution of the revenue effects of Alberta's possible gradual return to a single-rate PIT system by separating the various effects over an extended period. Figure 2 shows that the static revenue effect of the PIT rate cut (shown by the dotted line) is negative, and the revenue loss associated with the tax rate reduction increases over time as the taxable income expands. This is because as the taxable income increases, the revenue that the government could have collected under the current progressive PIT system also grows. However, this is only one part of the story. As discussed previously, the tax rate cut encourages more economic activity in the province, which expands taxable income. This positive behavioural response by taxpayers serves to broaden the tax base, which boosts the provincial government's revenue. The dashed line shows this positive behavioural effect in figure 2. Thus, owing to the positive behavioural responses from taxpayers to a lower tax rate, the net revenue loss associated with Alberta's possible return to a flat income tax system is less than what static estimation suggests. The solid line shows this net revenue effect of the tax rate cut obtained through dynamic revenue estimation in figure 2.

government eliminated the flat tax system and replaced it with a five-bracket progressive tax system in 2015.

[19] Currently Saskatchewan's top statutory marginal PIT rate of 14.5 percent is the lowest of any province.

Figure 2: Simulated Revenue Effects of Alberta's Gradual Return to a Flat Tax System
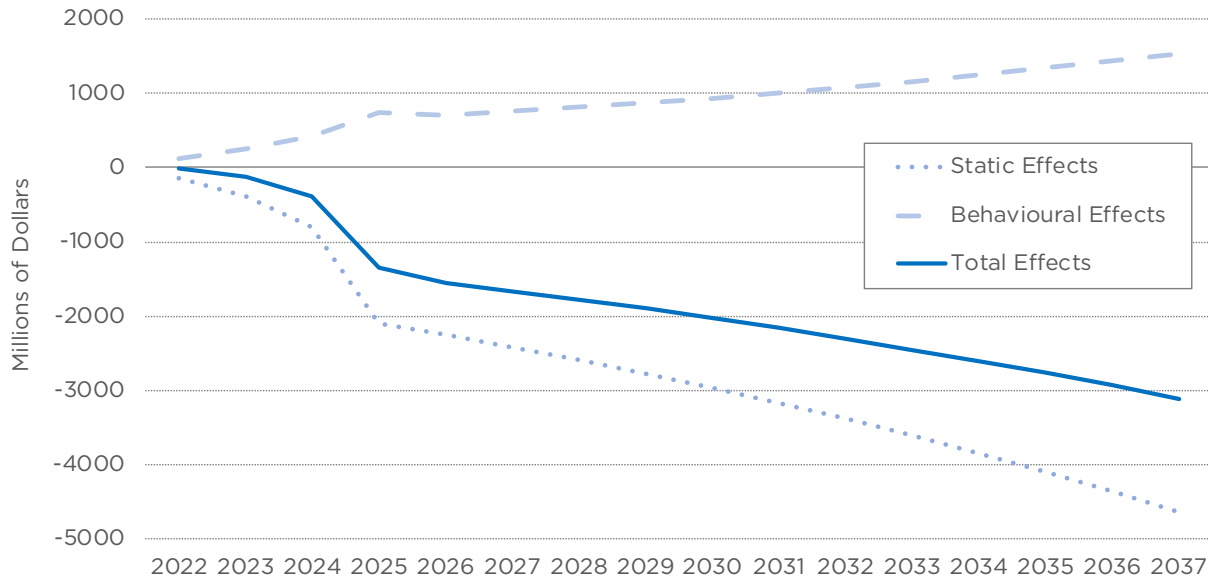
Source: Author's computation. See the text for the method of computation.

Figure 3: Alberta's Total PIT Revenue Projections, 2022-2037
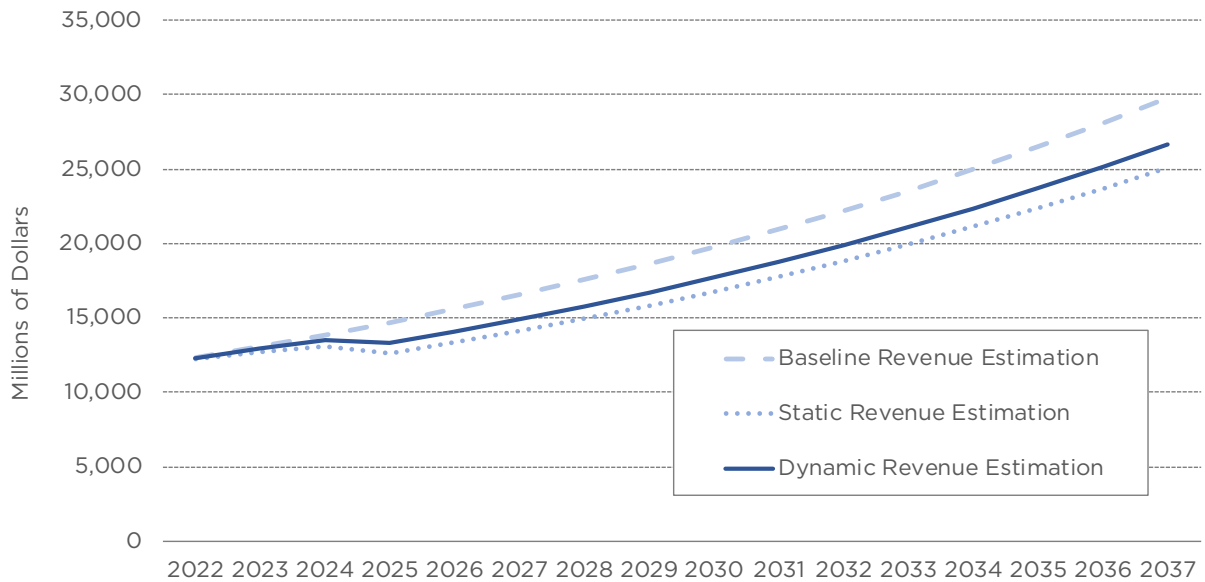
Source: Author's computation. See the text for the method of calculation.

We shed some additional light on the revenue implications of Alberta's possible return to the flat tax system by projecting the province's total income tax revenue with and without the top statutory marginal tax rate cut. We provide PIT revenue projection for the province from 2022 to 2037. Figure 3 shows the revenue projections under three alternative scenarios: baseline, static, and dynamic revenue estimations.

The revenue projections rely on some key assumptions. First, for the baseline revenue estimation shown by the dashed line in figure 3, we assume that Alberta's total personal income tax revenue would grow at an annual rate of 6.0 percent in the absence of any PIT reform. This growth rate value corresponds to the province's yearly average PIT revenue growth rate between 2001 and 2014—the period during which the single-rate PIT system was in effect. Thus, in our baseline revenue estimation, we assume that Alberta's total PIT revenue would grow annually by 6 percent beginning from its 2021 level.

The second alternative revenue projection considers the gradual reduction of the top marginal PIT rate from the current 15 percent to 10 percent, ignoring taxpayers' behavioural responses to the tax rate cut. Such a revenue projection is often referred to in the literature as *static revenue estimation*. In Figure 3, we show the static revenue projection with the dotted line. As compared to the baseline scenario, the static revenue projection shows that the province incurs a significant drop in PIT revenue due to the tax rate cut. However, as argued above, static revenue projections are unrealistic because they overestimate the revenue losses from the tax rate cut because of the failure to consider taxpayers' positive behavioural responses.

We also provide a dynamic revenue projection for Alberta by incorporating the positive behavioural responses from taxpayers as estimated in our empirical analysis. The solid line in figure 3 shows the dynamic revenue estimation. The revenue projection based on dynamic revenue estimation is only slightly lower than the baseline estimate. This shows that the revenue loss associated with Alberta's possible return to the flat tax system is modest. This is due to taxpayers' strong positive behavioural responses associated with the tax rate cut. Increased economic activities caused by the tax cut boost taxable income, which helps the government recoup some of the tax revenue loss from lowering rates. Our dynamic revenue simulation suggests that when Alberta's gradual return to the flat tax system is complete in 2025, Alberta's PIT revenue will drop by only 9 percent compared to the baseline scenario of no tax reform.

We shed additional light on the revenue projections by focussing on the first few years after the potential reform. To put the magnitudes of the revenue changes in perspective, table 5 shows our revenue estimations

Table 5: Alberta's Current and Forecast PIT Revenue (in millions of dollars), 2021-2025

Fiscal Year	(1) Government of Alberta Budget Estimate (Target)	(2) Baseline Revenue Estimate	(3) Static Revenue Estimate	(4) Dynamic Revenue Estimate
2021-22	11,647	11,647	11,647	11,647
2022-23	12,439	12,351	12,215	12,335
2023-24	13,258	13,097	12,709	12,966
2024-25	---	13,888	13,079	13,492
2025-26	---	14,727	12,631	13,371

Source: Column 1 comes from Alberta (2021). The PIT revenue figures in columns 2 through 4 are based on the author's computation, as discussed in the text.

along with the government of Alberta's PIT revenue estimate (or target) for the first few years. In this regard, we use revenue estimates from the provincial government's recent budget document. The document, *Fiscal Plan: Protecting Lives and Livelihoods 2021-2024* (Alberta, 2021), shows the PIT revenue estimate for 2021-22 and the revenue targets for only 2022-23 and 2023-24.

In our analysis, since the tax reform begins in 2022 (or fiscal year 2022-23), the PIT revenue figures are the same across all the columns for the fiscal year 2021-22. As discussed before, the baseline revenue estimation of column 2 assumes no tax rate change and the revenue figures in this column are close to the PIT revenue estimate by the provincial government. The revenue estimation results in columns 3 and 4 assume the gradual PIT reform. While column 3 ignores taxpayers' behavioural responses, column 4 incorporates taxpayers' behavioural responses as measured by our taxable income semi-elasticity estimate.

The key policy implication of our empirical analysis is that gradually returning to the previous single-rate income tax system can help strengthen the Alberta tax advantage. This income tax reform would cause a modest tax revenue loss for the province. However, Alberta can benefit from improved overall tax competitiveness as it encourages more economic activity. If returning to the flat tax system becomes more challenging due to the current budgetary pressures and ongoing shifts in global energy markets, eliminating the current top income tax bracket could be

considered as an alternative reform to strengthen Alberta's tax advantage. This paper's policy recommendation is broadly consistent with the analysis of previous studies such as Bazel and Mintz (2013), among others, which call for a change in Alberta's tax mix by introducing a harmonized sales tax in the province.[20] Such a policy suggestion is important because the absence of a provincial sales tax accounts for more than half of Alberta's tax advantage (Alberta, 2021).

It is important to highlight some of the caveats related to our simulation analysis. As in any revenue projection exercise, the results of the simulation analysis depend on the assumed values of the crucial parameters. Variations in these parameters can yield different results. Further, although our principal dynamic revenue projection explicitly incorporates taxpayers' behavioural responses, it may still overestimate the revenue loss for the province for two main reasons. First, when the tax rate cut encourages more economic activity in the province, the positive macroeconomic feedback effects can raise the government's revenues from other sources.[21] Our analysis does not consider this element. Second, since the provincial and the federal governments occupy the same personal income tax base, the federal government may collect more revenue when Alberta's PIT base expands due to the province's tax reform. Our analysis ignores these potential indirect positive revenue effects for the province. Therefore, even the dynamic revenue estimate may slightly overestimate the provincial government's revenue loss associated with the PIT rate cut.

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[20] Many economists have advocated the adoption of a sales tax in Alberta for various reasons. The motivations for adopting a sales tax include reducing the size of the provincial deficit, financing a cut in the province's personal income tax rate, or as a stable revenue source.

[21] One may wonder whether the reduction in the PIT rate will shift some of the tax revenue from the corporate income tax to the personal income tax if individuals shift income from corporations to personal income because of the PIT rate reduction. However, this is unlikely to happen as the current provincial corporate income tax rate of 8 percent is already lower than the post-reform 10 percent PIT rate.

4. Conclusion

Many theoretical and empirical studies show that high-income tax rates have adverse incentive effects on individuals and businesses and harm overall economic activity. Yet governments wanting to collect more revenue often change tax policy by raising income tax rates. The 2015 PIT reform that Alberta's newly elected NDP government embarked on was one such policy reform. This tax reform essentially replaced the province's flat income tax system with a progressive rate schedule. As part of this tax reform, the province's income tax rate on high-income earners rose from 10 percent to 15 percent. Recognizing the potentially harmful economic effects of the tax increase, many commentators and analysts expressed their concern that the tax reform eroded Alberta's tax advantage and called for a return to the previous flat tax system. However, the effects on revenue and the budgetary implications of the provincial government returning to a 10 percent flat rate have not been thoroughly investigated before.

This paper has examined the revenue effects of Alberta's possible return to the previous single-rate PIT system that was in effect before 2015. In addition to assessing the proposed tax rate change's direct revenue implications, the analysis explicitly incorporates the potential taxpayers' behavioural responses. Using annual time series data from 1974 to 2019, we have estimated the total personal taxable income semi-elasticity with respect to the top marginal PIT rate for Alberta. We found a taxable income semi-elasticity of about -0.64, which suggests that a one percentage point reduction in the statutory marginal top PIT rate is associated with an increase in Alberta's total personal taxable income of 0.64 percent. This estimate also corresponds to a taxable income elasticity with respect to the net-of-tax rate of about 0.55. The empirical estimate of this key parameter is robust to different sensitivity checks.

We also conducted a simulation analysis of the dynamic revenue effects of Alberta's possible return to the flat tax system using our crucial taxable income semi-elasticity estimate. The simulation assumes a gradual four-year tax reform that replaces the province's current progressive income tax system, which has five income tax brackets, with a single rate tax of 10 percent. For high-income earners, such reform reduces the statutory marginal top PIT rate from 15 percent to 10 percent. Our analysis suggests

that this five percentage-point cut in the PIT rate would cause the provincial government to collect about $16 million less in PIT revenue in the first year. Further, at the end of the fourth year of the tax reform, the provincial government's revenue loss would be about $1.36 billion. This is equivalent to a drop in Alberta's PIT revenue by about 9 percent compared to the baseline scenario of no tax reform. However, after considering the many positive economic benefits that the tax rate cut can bring, this revenue loss is relatively modest.

Nevertheless, some analysts may still be concerned that such a significant tax policy reform is not feasible or appropriate given the province's budgetary pressures, which have been worsened by the Covid-19 pandemic and the decline in its non-renewable resource revenue. In this context, the provincial government could undertake a smaller-scale tax reform that would abolish only the current top income tax bracket. Such a minor tax reform would reduce the top PIT rate in Alberta from 15 percent to 14 percent, which would make Alberta the jurisdiction with the lowest PIT rate of any province. Thus, even this minimal income tax rate change would help strengthen the Alberta tax advantage. This paper's analysis suggests that the provincial government's revenue loss from eliminating the top income tax bracket would be $16 million in the first year. The loss would rise slightly over time and reach roughly $20 million after five years. This corresponds to a revenue loss of only 0.13 percent compared to the baseline scenario of no tax reform.

Thus, this paper's empirical analysis suggests that reducing the personal income tax rate would significantly strengthen Alberta's tax advantage, which would also encourage more economic activities in the province with relatively marginal revenue loss.

Appendix 1: Alberta's Government Revenue Sources

Table A1: Shares of Alberta's Provincial Government Revenue Sources (in percent) selected years

Fiscal Year	2017-18	2018-19	2019-20	Period Average (1974-75 to 2019-20)
Personal income tax revenue	25.4	26.6	29.4	21.5
Corporate income tax revenue	8.1	10.9	10.7	9.2
Federal Transfers	16.8	16.8	22.3	13
Non-renewable resource revenue	11.7	12.2	15.5	24.7
Other own-source revenue	37.9	33.4	22	31.7

Source: Kneebone and Wilkins (2021).

Appendix 2: Analytical Framework

This appendix describes the analytical framework that is used to simulate the tax revenue impacts of reducing Alberta's statutory top statutory marginal personal income tax (PIT) rate from the current 15 percent to 10 percent. Thus, our focus is to investigate the revenue effects of cutting the income tax rate on high-income earners in Alberta. The simulation methodology draws heavily on previous similar studies such as Ferede (2020). See also Diamond and Saez (2011) and Veall (2012).

At present, Alberta's provincial government and the federal government rely on a progressive personal income tax system with multiple income tax brackets. Suppose for the sake of analytical tractability, we group the various income tax brackets into two (i.e., the top income tax bracket and all other lower tax brackets). This approach effectively means that, in any year t, the province's total personal income tax base (B_t) is given as the sum of the taxable income of the top income tax bracket (B_t^T) and the taxable income from the remaining lower income tax brackets (B_t^L). In the context of Alberta, the province's total PIT base can be expressed as:

$$B_t = B_t^T(\tau_t^T; Z) + B_t^L(\tau_t^L; Z), \qquad\qquad (2.1)$$

where τ_t^T is the statutory top marginal PIT rate, and τ_t^L denotes the applicable statutory marginal PIT rates for all other remaining lower income tax brackets. In the above equation, Z denotes the various factors that can impact the taxable income of the province.

In any year, the provincial government's personal income tax revenue is obtained by applying the relevant statutory marginal PIT rate on the taxable income. Thus, using Eq. (2.1), the government's total personal income tax revenue in year t (R_t) is computed as:

$$Revenue = R_t = \tau_t^T B_t^T(\tau_t^T; Z) + \tau_t^L B_t^L(\tau_t^L; Z). \qquad (2.2)$$

Consider a gradual personal income tax reform for Alberta that moves the current five-bracket personal income tax system to a single tax rate of 10 percent—the flat rate that was in effect before the 2015 tax hike. Consistent with the practice of Alberta's previous similar tax reforms, we assume that the provincial government completes the PIT reform in four years. That is, we assume a one percentage point cut in the PIT rate each year for the first three years and a two percentage-point cut in the fourth

year (the final year of the reform). More specifically, in the first year, the PIT rate will be reduced to 14 percent, in the second year to 13 percent, in the third year to 12 percent, and in the fourth year to 10 percent. Also, note that such tax reform is equivalent to reducing the current five income tax brackets to just one bracket by abolishing each tax bracket with corresponding PIT rates of above 10 percent. Thus, Alberta's gradual tax reform eliminates each top income tax bracket annually, leaving all other income tax brackets and applicable tax rates unchanged. This means each year's tax rate cut affects only those individuals whose taxable income falls in that year's top income tax bracket.

Based on the empirical results of this paper, as well as those of previous related studies, taxpayers generally exhibit positive behavioural responses to tax rate cuts. Consequently, we expect the taxable income in the top income tax bracket B_t^T will change in response to the top PIT rate cut. However, as argued above, we expect the taxable income in the other remaining tax brackets B_t^L to remain unchanged. Using Eq. (2.2), one can show the revenue effects of Alberta's gradual reduction in the top tax rate as:

$$\Delta R_t = B_t^T \Delta \tau_t^T + (\tau_t^T B_t \varepsilon \Delta \tau_t^T) \qquad (2.3)$$

where Δ denotes change, ΔR_t is change in the provincial government's total PIT revenue, $\varepsilon = \Delta \ln(B_t)/\Delta \tau_t^T$ is the semi-elasticity of the province's total taxable income with respect to the top PIT rate, and all other variables are as defined above.

Eq. (2.3) shows that a cut in the top marginal PIT rate can have two opposite effects on Alberta's PIT revenue. First, a reduction in the top PIT rate means the government is applying a lower multiplying factor on the taxable income and this has a direct or mechanical effect of reducing the tax revenue. In Eq. (2.3), the direct effect is indicated by the expression $B_t^T \Delta \tau_t^T$. Note that this direct revenue effect of the PIT rate cut is negative, and it is simply obtained by multiplying the change in the tax rate by the relevant taxable income. As this direct effect assumes that the taxable income remains unchanged when the tax rate is cut, it is often referred to as a *static effect* of the tax rate change. Second, it is known that tax cuts encourage more economic activities and reduce tax evasion and avoidance. These positive taxpayers' behavioural responses associated with the tax rate cut raise the taxable income, which increases the tax revenue. This is the *behavioural effect*, and it is shown in Eq (2.3) by the expression $(\tau_t^T B_t \varepsilon \Delta \tau_t^T)$. Thus, the positive revenue effect of the tax rate cut depends on how responsive the taxpayers are to the tax cut as captured by the semi-elasticity of taxable income to the top PIT rate (ε). The result of this paper indicates that the tax base semi-elasticity estimate, ε, is negative, implying that the tax rate cut will cause positive behavioural responses of

taxpayers. Therefore, the total revenue effect of the tax rate reduction is the sum of the static and behavioural effects. Since we explicitly account for taxpayers' behavioural responses, our simulation exercise is consistent with what is commonly known as dynamic revenue estimation.

As our revenue simulation focuses on the taxable income of high-income earners, we need to make further assumptions on the income distribution of this group of taxpayers. Following Diamond and Saez (2011) and Veall (2012), we assume that the taxable income of those individuals whose income falls in the top tax bracket satisfies a pareto distribution. That is, the ratio of the average taxable income of the top income tax bracket (b^T) to the threshold income level for the top income tax bracket (b^*) satisfies $\frac{b^T}{b^*} = \frac{c}{c-1}$, where c >1 is the pareto parameter. Suppose the average marginal PIT rate for all taxpayers is denoted by τ_{ave}, the initial total taxable income by B_0, the number of taxpayers in the top tax bracket by N_T, the initial threshold income level for the top income tax bracket by b_0^*, the growth rate of the taxable income of the top tax bracket by γ_1, and the growth rate of total taxable income by γ_2. Further, we assume that the threshold income for the top income tax bracket is indexed to inflation (i.e., it grows at the rate of the inflation rate (π) as is commonly done at the provincial and federal levels in the country. Then, using Eq. (2.3) and the various assumptions discussed above, one can obtain the dynamic revenue effects of the tax rate cuts in year *t* as:

$$\Delta R_t = N_T b_0^* (1 + \gamma_1)^t \left[\frac{c}{c-1} - \frac{(1+\pi)^t}{(1+\gamma_1)^t} \right] \Delta \tau_t^T + \{ \tau_{ave} \varepsilon B_0 (1 + \gamma_2)^t \} \Delta \tau_t^T.$$

(2.4)

Note that in Eq. (2.4), the direct static effect of tax rate changes on the government's revenue is given by the first expression of the right-hand side of the equation. This *static effect* is negative for tax rate cuts. On the other hand, the second term in Eq. (2.4) denotes the *behavioural effect* of tax rate cuts on revenue. Since ε is negative, the behavioural effect of tax rate cuts on provincial government revenue is positive. Thus, the net revenue effect of the tax rate cuts, as given by Eq. (2.4), is not clear and it depends on the relative strength of the static and the behavioural effects. If the static effect is greater than the behavioural effect, tax rate cuts reduce the provincial government's revenue. If, on the other hand, the behavioural effect outweighs the static effect, the provincial government can collect more tax revenue despite the tax rate cut.

The investigation of the revenue effect of the Alberta government's potential cut in the top marginal PIT rate is conducted through a simulation exercise based on Eq. (2.4). The equation requires us to make additional assumptions about key parameters that are relevant to shed light on the net revenue effect of the tax rate cut. In this regard, using high-income

tax filers data from Statistics Canada, we estimate the average values of the pareto parameter c for the period 1989 to 2018 as 1.73, 1.96, 1.96, and 2.08 for the highest, for the second-highest, third-highest, and fourth-highest tax brackets, respectively.[22] Further, we use the same database to estimate the number of taxpayers (N_T) for the year 2018 (the last year where data is available). These estimates are 31,405, 43,962, 81,643, and 157,030, for the highest, the second-highest, the third-highest, and the fourth-highest tax brackets, respectively.

Often income tax bracket thresholds are indexed to the inflation rate. Therefore, in our simulation analysis, we assume that the inflation rate (π) is 2 percent. This is consistent with the inflation target of the Bank of Canada, and it is close to the provincial inflation rate for the period 2001-2014. Further, the annual growth rate of Alberta's total taxable income (γ_2) is assumed to be 7.36 percent, and this corresponds to the total taxable income growth rate of the province from 2001 to 2014 (the period in which the flat-rate PIT system was in effect). We choose this period as there were no provincial and federal income tax rate changes over this period, and we assume that the tax reform is a move to the 10 percent flat tax income rate that was prevailing during this period. Similarly, the taxable incomes of the different tax brackets (γ_1) are assumed to be about 0.05.[23] We use threshold income levels for the relevant income tax brackets (b_0^*) that are consistent with the current PIT system of the province. Thus, the threshold income levels for the four tax brackets are $131,221, $157,465, $209,953, and $314,929. We also compute that the taxable income-weighted average tax rate (τ_{ave}) is 0.113.

In sum, our main simulation analysis is based on Eq. (2.4). This equation shows that any realistic assessment of the revenue effect of tax reforms needs to incorporate the behavioural responses of taxpayers. Consequently, we use our estimated taxable income semi-elasticity estimate (ε)

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[22] Alberta's highest income tax bracket corresponds to the province's top 1 percent of tax filers. Similarly, the second and third-highest tax brackets correspond to the top 5 percent of tax filers. Finally, the fourth-highest tax bracket corresponds to the top 10 percent income earners of the province. We compute estimates of c using the average and threshold incomes of these high-income groups. Our definition of income is market income inclusive of capital gains. We use the 1989 to 2018 period (i.e., the period after the major federal tax reform of 1988) average values of c for parameter stability as this estimate varies each year. See Veall (2012) for a discussion of the importance of this crucial parameter.

[23] The specific growth rates of taxable income (computed based on the 2001 to 2014 average growth rates of the average income of the top 1 percent, 5 percent, and 10 percent income earners. Accordingly, the assumed growth rates are for the highest tax bracket (0.051), for the second and third highest tax brackets (0.05), and for the fourth highest tax bracket (0.0486).

of -0.636 and the other relevant parameters discussed above to estimate the revenue effects of Alberta's possible return to the flat personal income tax system beginning from the year 2022.

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Acknowledgments

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