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The Dynamics of Fiscal Adjustment in Alberta

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EXECUTIVE SUMMARY

This study looks at how Alberta's provincial governments have responded to budgetary imbalances, focusing on the connection between program spending, tax revenue and the volatility of non-renewable resource revenues. The study uses annual time series data from 1973 to 2023 to identify the fiscal responses to changes in the budget's deficit-to-GDP ratio.

Alberta primarily adjusts to fiscal imbalances by cutting spending rather than by increasing revenue. For example, a one percentage point increase in the deficit-to-GDP ratio leads to a 0.24 percentage point reduction in program spending and a 0.06 percentage point increase in tax revenue in the following year. These results suggest that approximately 80 per cent of short-term fiscal adjustments fall on the budget's spending side.

The results also show asymmetries in Alberta's fiscal responses. When deficits arise, governments tend to raise tax revenue but are less inclined to cut spending. Conversely, when surpluses occur, governments increase program spending but do not lower taxes. Thus, while deficits lead to modest adjustments, surpluses create upward pressure on spending and undermine long-term fiscal balance. The province's heavy reliance on resource revenues exacerbates this situation, as volatile oil prices directly influence fiscal outcomes. For example, when oil prices are expected to decline, governments are more likely to cut program spending; however, when prices are forecast to rise, there is no reduction in spending even when there is a deficit.

These are significant findings given Alberta's unique fiscal situation. Unlike other provinces, Alberta relies extensively on non-renewable resource revenues, which puts the budget at the mercy of sharp fluctuations. This dependence makes Alberta's budgetary balance among the most volatile in Canada and leaves the province in a state of chronic fiscal vulnerability and long-term sustainability challenges.

From a policy perspective, the results stress the need for structural reforms to strengthen Alberta's fiscal sustainability. The deficit and surplus responses mean governments must use restraint during periods of fiscal strength. Without such restraint, temporary windfalls from oil revenues translate into higher spending commitments that are unsustainable because those revenues inevitably will decline. It would be far better to align spending with stable, recurring sources of revenue and to save resource windfalls in the province's Heritage Savings Trust Fund to lessen fiscal volatility over time.

This study's findings highlight both the opportunities and the risks of a resource-dependent fiscal model. To get off the boom-and-bust roller-coaster, Alberta should make its fiscal policies counter-cyclical by restraining spending growth during booms and reducing the province's dependence on unstable non-renewable revenues during busts.

1. INTRODUCTION

Alberta is a resource-based economy, and the non-renewable resource revenue coming from the energy sector plays a significant role in the provincial government's budget. As oil prices are inherently volatile, the government's coffers are vulnerable to oil price shocks.[1] Thus, due to the excessive reliance on the unstable non-renewable resource revenue, Alberta's overall budgetary balance exhibits more significant swings than any other province in Canada (Ferede and Dahlby 2023). When governments run budget deficits and face fiscal challenges, sooner or later they need to raise revenue, cut spending, or both to achieve long-term fiscal sustainability. This is particularly true in an economic environment where interest rates exceed economic growth rates. Thus, governments' short-term fiscal responses to budgetary imbalances can impact long-term fiscal sustainability. How have Alberta's provincial governments historically responded to budgetary imbalances? Did successive Alberta governments engage in fiscal adjustments when they faced budget deficits due to various shocks? Are there asymmetries in the provincial government's responses to budgetary imbalances?

Previous studies examine how governments respond to budget deficits and engage in fiscal adjustments. In an influential paper, Bohn (1991) shows that it is possible to study the dynamic fiscal adjustment of governments by explicitly considering their intertemporal budget constraints. His time series-based empirical approach enables one to examine how the various budgetary components respond to deficits and how the different spending and revenue categories interact over time. Bohn (1991) uses his seminal theoretical framework to investigate how the U.S. federal government responds to its budget deficit. This theoretical framework is also adopted in other studies such as Buettner and Wildasin (2006), Buettner (2009), Solé-Ollé and Sorribas-Navarro (2012), Bessho and Ogawa (2015), Jaimes (2020) and Ferede and Dahlby (2023) to examine the dynamic fiscal adjustments of various levels of governments.

While some previous empirical studies use data from other countries to investigate the dynamic fiscal adjustments to budgetary imbalances, the Canadian context lacks similar studies. A recent study by Ferede and Dahlby (2023) is an exception to this. Using an empirical methodology identical to ours, the authors examine the fiscal responses of Canadian provincial governments to changes in budget deficits using panel data from the 10 provinces. They find that provincial governments respond to increases in budget deficits by cutting program spending and raising their own-source revenue.

Due to differences in the structures of their economies, revenue sources and spending priorities, one may not expect all Canadian provinces to respond to budget deficits the same way. Thus, it is essential to rely on province-specific time series analysis to provide a more realistic assessment of how individual provinces, such as Alberta, engage in fiscal adjustment in response to budgetary imbalances. Kneebone and McKenzie (1997) provide one of the earliest studies on Alberta's budgetary responses to fiscal shocks. They find that while Alberta's current provincial expenditure does not respond to past unanticipated revenue and spending shocks, past revenue increases are associated with a decrease in the current revenue. The authors use the seemingly unrelated regression method, investigating only total revenue and total spending without looking into the various components and how these fiscal variables respond to deficits.

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[1] According to the Alberta government's own estimate, for every one US dollar decrease in the West Texas Intermediate (WTI) oil price — the benchmark price for Alberta's oil — the provincial revenue falls by about $630 million. See Government of Alberta (2023).

One of Alberta's most prominent and recurrent fiscal challenges is the volatility of non-renewable resource revenue and its adverse impacts on the province's overall budgetary position and long-term fiscal sustainability. By examining the long-term projections of the various budgetary components, Tombe (2018) investigates Alberta's long-term fiscal sustainability. He concludes that, under the current conditions, Alberta's fiscal policies are unsustainable. To achieve long-term fiscal sustainability, the author recommends that the province explore new and additional revenues and restrain its program spending.

Ferede (2018) also investigates how Alberta's provincial governments respond to increases and decreases in non-renewable resource revenue using annual time series data. The study finds that while Alberta's program spending responds positively to increases in non-renewable resource revenue, decreases in this revenue source seem to have no statistically significant effects on program spending. This suggests that non-renewable resource revenue has asymmetric effects on program spending. As the author focuses on non-renewable resource revenue, he does not examine how Alberta's provincial governments respond to budgetary imbalances.

Therefore, the main objective of this paper is to empirically investigate the previously mentioned public policy questions using annual time series data for Alberta over the period 1973–2023. To this end, we use a dynamic fiscal adjustment empirical methodology that Bohn (1991) initially proposed. We begin our analysis by estimating a vector error correction model and investigating how the province's various budgetary components respond to deficits. According to our empirical results, Alberta responds to deficits by reducing program spending and increasing tax revenue, with no significant impact on the remaining budgetary components.

This study's findings indicate that for every one percentage point rise in the province's current deficit-to-GDP ratio, Alberta's governments have decreased program spending by 0.24 percentage points and raised tax revenue by about 0.06 percentage points in the subsequent year. These results suggest that approximately 80 per cent of the immediate fiscal adjustments to budgetary imbalances manifest in the spending side of the provincial government budget.

Due to various political and social pressures, one may expect that the provincial government's fiscal responses to deficits may differ from those to surpluses. We investigate this issue and find evidence of asymmetric fiscal responses to budgetary imbalances. The results show that when Alberta's provincial governments run surpluses, they raise program spending. However, when deficits occur, provincial governments do not respond by cutting program spending. Similarly, the results suggest that Alberta's provincial governments raise tax revenue in response to deficits but do not cut their tax revenue when surpluses occur. We also find that when oil prices are predicted to decrease, the government responds to the deficit by cutting its program spending in the next year. However, if oil prices are expected to increase, the government does not cut its spending even though it faces a deficit.

An important policy implication of our study is that since Alberta frequently faces significant swings in its overall budgetary situations, if the provincial governments cannot cut their program spending when deficits occur, they need to restrain their program spending when the province's fortunes improve and surpluses occur. Another solution to stabilize Alberta's budgetary position is to better align government spending with a more consistent and reliable part of total government revenue by saving any excess revenue into the Heritage Savings Trust Fund. Such policy actions can help the province easily withstand budgetary risks and achieve long-term fiscal sustainability.

The remainder of the paper is organized as follows. In section 2, we specify the empirical methodology and discuss the data. The paper's main empirical results are presented and discussed in section 3. Section 4 concludes.

2. MODEL SPECIFICATION AND DATA

2.1. MODEL SPECIFICATION

This study focuses on investigating how budgetary imbalances impact the various fiscal components. To this end, our empirical specification is based on the dynamic fiscal adjustment theoretical framework that Bohn (1991) proposed. An essential feature of this empirical model is that it is based on an explicit consideration of the government's intertemporal budget constraint and can be used to investigate how governments respond to deficits. Consequently, earlier similar studies such as Buettner and Wildasin (2006), Buettner (2009), Solé-Ollé and Sorribas-Navarro (2012), Bessho and Ogawa (2015), Ferede and Dahbly (2023) and Jaimes (2020) use this theoretical framework to examine the dynamic fiscal adjustment of various levels of governments.

Following Bohn (1991) and other similar previous studies, we begin by categorizing the various components of Alberta's budget. Broadly speaking, the provincial government has three main revenue categories: tax revenue (TR_t), other own-source revenue (OR_t) and federal grants (FG_t).[2] Note that while the tax revenue (TR) variable includes personal income tax, corporate income tax and consumption tax revenues, the province's revenues from all other sources are categorized as other own-source revenue (OR). The provincial government uses its tax revenue, other own-source revenue and federal grants to finance its program spending (PS_t) and debt service payments (DS_t). Thus, in any given year, the provincial government's current overall deficit (BD_t) can then be expressed by the intertemporal budget constraint as:

$$BD_t = PS_t + DS_t - TR_t - OR_t - FG_t \qquad (1)$$

where the subscript t denotes the fiscal year. Bohn (1991) explains that when the deficit (BD_t) is stationary, Eq. (1) has a vector error correction representation of the following form:[3]

$$\Delta Z_t = \Pi_0 \mathrm{BD}_{t-1} + \Pi_1 \Delta \mathrm{Z}_{t-1} + \Pi_2 \Delta \mathrm{Z}_{t-2} + \Pi_3 \Delta \mathrm{Z}_{t-3} + \cdots + \Pi_p \Delta \mathrm{Z}_{t-p} + \varepsilon_t \qquad (2)$$

where Δ denotes first-difference, Π denotes a vector of coefficient estimates, BD_{t-1} is the one-period lagged deficit (which is simply the error correction term in the model), Z is a vector of the budgetary components PS, DS, TR, OR and FG, p shows the lag length and ε_t is the error term.

Note that since we have five fiscal variables in addition to the deficit, Eq. (2) represents a system of five equations corresponding to each fiscal variable. Thus, Π_0 is a (5x1) vector of the coefficients of the lagged deficit and Π_p is a (5x5) matrix of coefficient estimates of the five fiscal variables. In other words, Eq. (2) shows that each budgetary component can be estimated on the lagged value of the deficit and the lagged values of all the fiscal variables in the budget constraint.

Eq. (2) is basically an error correction model where the lagged deficit is the error correction term. Since the model contains a system of five separate equations with the same explanatory variables, joint estimation of the model does not improve its efficiency. Thus, we can estimate the five equations separately with ordinary least squares (OLS), using robust standard errors as in Bohn (1991) and other previous studies.

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[2] During the sample period, Alberta did not receive equalization grants. Therefore, the federal grant component of the provincial budget is largely exogenous to the province's fiscal policies.

[3] For the sake of brevity, we do not discuss the detailed process of transforming the budget constraint, as indicated in Eq. (1), into its error correction model representation. Interested readers are referred to Bohn (1991) for a more detailed discussion of the model.

2.2. DATA

The main source for our dataset is the online database of Finances of the Nation (2024), which provides data on the various budgetary components of the different Canadian provincial governments. We limit our sample to 1973–2023 as a complete dataset is available for various relevant variables of interest during this period. Note also that we express all budgetary components as a ratio of GDP, which is common in the literature. Moreover, various government policies and reports often focus on such a measure. We show the basic summary statistics for the various variables of interest in Table 1.

Table 1. Summary Statistics, 1973–2023

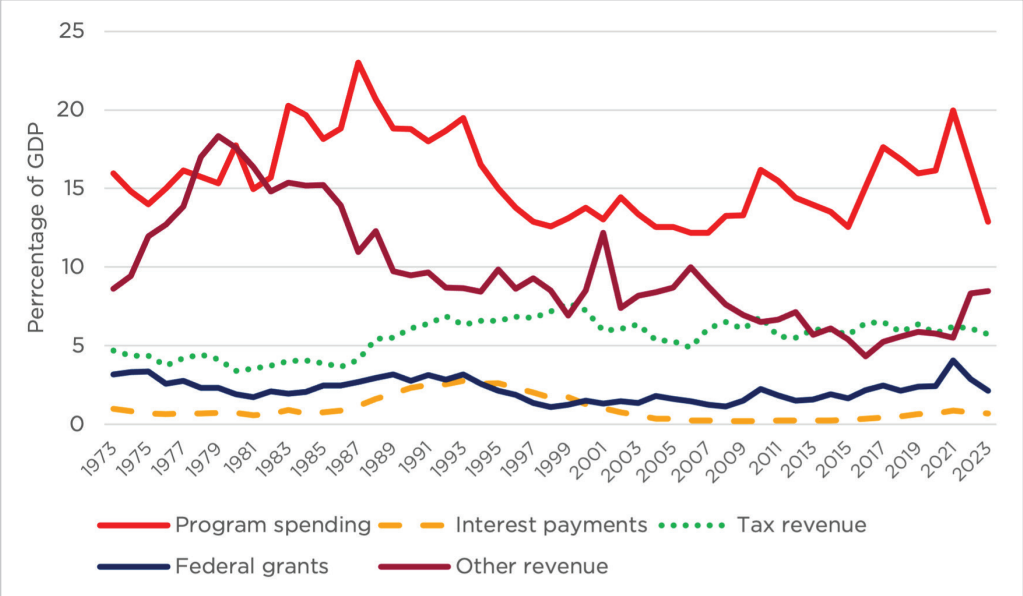
Variable	Obs.	Mean	Std. Dev.	Minimum	Maximum
Budget components in levels					
Program spending (PS_t)	51	15.71	2.62	12.16	23.00
Debt service (DS_t)	51	0.97	0.77	0.19	2.76
Tax revenue (TR_t)	51	5.55	1.13	3.40	7.71
Federal grants (FG_t)	51	2.18	0.68	1.10	4.07
Other revenue (OR_t)	51	9.69	3.60	4.31	18.34
Budget deficit (BD_t)	51	-0.74	3.20	-8.75	6.49
Budget components in first-differences					
Program spending (ΔPS_t)	50	-0.06	1.78	-3.54	4.53
Debt service (ΔDS_t)	50	-0.01	0.19	-0.45	0.45
Tax revenue (ΔTR_t)	50	0.02	0.54	-1.28	1.33
Federal grants (ΔFG_t)	50	-0.02	0.45	-1.19	1.65
Other revenue (ΔOR_t)	50	0.00	1.50	-4.77	3.67

Note: All fiscal variables are as a ratio of GDP in per cent and Δ denotes first-difference or change.

We decompose Alberta's provincial expenditure into program spending and debt service payments. The revenue side of the government budget is also categorized into three broad groups: tax revenue, other own-source revenue and federal grants. Tax revenue comprises personal income tax, corporate income tax and consumption tax revenues, while all other provincial revenue sources are grouped as other revenue (OR).

Table 1 shows there is a lot of variation in the province's various budgetary components during the sample period. The variation is particularly pronounced in the other own-source revenue, which includes the non-renewable resource revenue that the province collects from the energy sector. Alberta has a resource-based economy and fluctuations in energy prices significantly affect non-renewable resource revenue and other components of the government's budget. To visualize how the various components of the provincial budget evolve during the sample period, we plot the relevant spending and revenue categories in Figure 1.

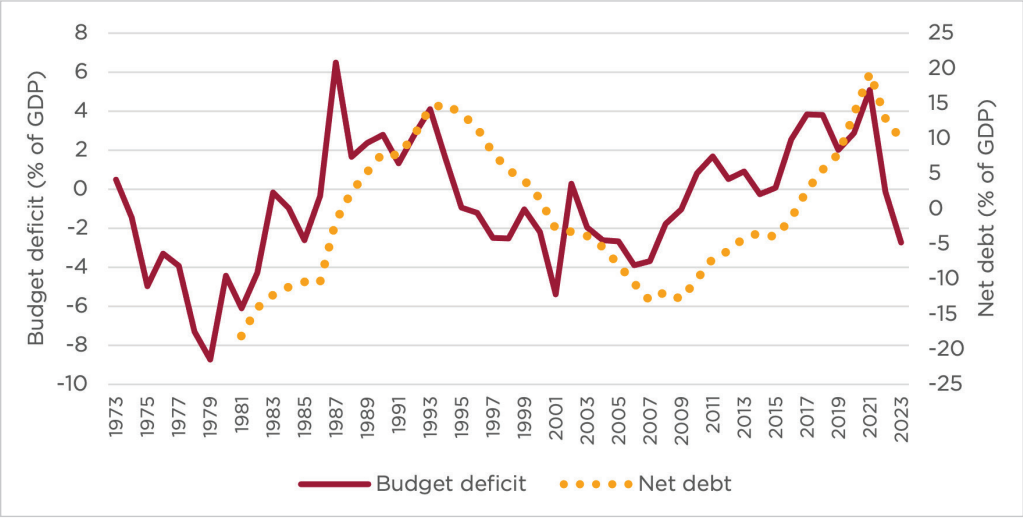
Figure 1. Evolution of Components of Alberta's Budget, 1973–2023



Source: Finances of the Nation (2024)

Looking at the budget's revenue side, the other revenue (OR) component (which includes non-renewable resource revenue) is the largest during most of the sample period. It also shows the most fluctuation. While the federal grant (FG) to the province is relatively stable (as a share of GDP) during the period under consideration, the tax revenue (TR) shows some change primarily due to fluctuations in the economy and the impact this has on tax bases. When we turn to the budget's spending side, program spending (PS) (as a share of GDP) shows a lot of variations due to government policy choices and other shocks. Due to a significant dependence on non-renewable resource revenue, Alberta generally has less public debt than other Canadian provinces. As a result, the interest payment associated with the debt (DS) part of the provincial government expenditure is usually low. Perhaps one can glean information about the overall fiscal position of the province from Figure 2.

Figure 2. Alberta's Budget Deficit and Net Debt (as a percentage share of GDP), 1973–2023



Source: Finances of the Nation (2024)

Note that negative values of the budget deficit (BD) imply that the government is running a surplus. Similarly, the government has net assets when the net debt-to-GDP ratio is negative. We have complete data for the net debt only for the years beginning from 1981. Figure 2 indicates that the fluctuations in the overall budget balance are directly associated with the province's net debt. The variations in the budget balance are mainly driven by changes in global energy prices and their associated impact on the province's revenue sources and program spending that are not well-aligned to a stable component of the provincial revenue. Government policies also significantly impact the observed evolution of the province's budget balance. For instance, between 1993 and 2003, the Ralph Klein government introduced the *Deficit Elimination Act* and the *Balanced Budget and Debt Retirement Act* to reduce the government's deficit and pay off the province's debt. As Figure 2 shows, such provincial fiscal rules resulted in the province moving from deficit to surplus and put the province's net debt on a downward trend. However, in post-2010 years, the budget balance returned to a deficit territory and the province's net debt rose.

3. EMPIRICAL RESULTS AND DISCUSSIONS

3.1. UNIT ROOT TESTS

In a time series analysis such as ours, as is common in the literature, the first task is to check the time series properties of the various fiscal variables. This is crucial because our theoretical framework depends on the deficit's stationarity, which is our key variable of interest. In the literature, one can use different types of unit root tests. In Table A1, we report unit root tests using the Phillips-Perron unit root test and the efficient unit root test proposed by Elliott, Rothenberg and Stock (1996), and the Dickey-Fuller test statistic using a generalized least-squares (GLS) method (DF-GLS). The unit root tests have a null hypothesis that the variable is non-stationary or I (1).

The unit root test results presented in Table A1 show that the budget deficit is stationary. The other remaining fiscal variables are non-stationary or I(1) in levels, but stationary in their first-differences. Thus, as Bohn (1991) explains, the error correction model specified in Eq. (2) is appropriate in our case since it satisfies the required time series properties.

3.2. SHORT-TERM FISCAL EFFECTS OF BUDGET DEFICITS

This section estimates and discusses our error correction model based on the empirical specifications presented before. The empirical model first requires specifying an appropriate lag length for estimation. To this end, we employ the widely used Akaike information criterion (AIC) to choose the relevant lag length for our data. The AIC suggests that the appropriate lag length in our case is two. Thus, we use two lags in our empirical model of the differenced fiscal variables or error correction model. As indicated in Table A1 in the Appendix, our main empirical model provides many coefficient estimates associated with the five separate equations in the error correction model. However, we are particularly interested in the coefficient estimate of the error correction term since it shows how the various fiscal variables respond to the deficit. Thus, in Table 2, we report the error correction term's coefficient estimates (the lagged deficit) and focus our discussion on these crucial coefficient estimates.

Note that in our empirical model, in addition to the fiscal variables, we include various control variables to account for economic activities and main changes in the province's political and fiscal environments. In this regard, as in Bohn (1991) and Buettner and Wildasin (2006), we include lagged per capita GDP to account for the effects of fluctuations in economic activities on the various fiscal variables.

Previous studies such as Kneebone and McKenzie (2001) and Dahlby and Ferede (2016) show that the governing party's ideological orientation has important implications for fiscal policy choices. During most of the period under investigation, Alberta had right-leaning governments. The only exception was from 2015 to 2019 when the left-leaning NDP government was in power. To account for this possible change in the ideological orientation of the governing party and its possible effects on fiscal policy decisions in the province, we include the NDP dummy, which is equal to one in the years in which the NDP was in power and zero otherwise.

During the period under investigation, one of Alberta's most significant fiscal policy shifts occurred when Klein became the premier in 1993. The Klein government focused on eliminating the province's deficit and debt by legislating various fiscal rules. To achieve these goals, the government significantly slashed program spending and because of these policy changes, the province achieved a debt-free status in the fiscal year 2004/05. To account for such dramatic fiscal changes, we include a Klein dummy, which is equal to one for 1994–1997 (where significant policy shifts occurred) and zero otherwise.

We now turn our attention to investigating the deficit's effects on various budgetary components. Our vector error correction model in Table A1 provides many parameters. However, the crucial parameters are the coefficient estimates of the error correction term (lagged deficit) in the five separate equations. We report the error correction term coefficient estimates in Table 2. For brevity, the coefficient estimates of all other variables in the model are not reported.

Table 2. Short-term Fiscal Responses to the Budget Deficit, 1973–2023

	(1)	(2)	(3)	(4)	(5)
	Dependent variables				
	Program spending (ΔPS_t)	**Debt service** (ΔDS_t)	**Tax revenue** (ΔTR_t)	**Other own-revenue** (ΔOR_t)	**Federal grants** (ΔFG_t)
Lagged budget deficit (BD_{t-1})	-0.242***	-0.003	0.059**	0.030	0.028
	(0.056)	(0.004)	(0.026)	(0.078)	(0.026)
Adjusted R^2	0.703	0.403	0.417	0.121	0.421
	Joint significance tests				
F-test on ΔPS (p-value)	0.000	0.305	0.084	0.001	0.377
F-test on ΔOR (p-value)	0.600	0.536	0.169	0.533	0.052
F-test on ΔTR (p-value)	0.090	0.860	0.000	0.920	0.565

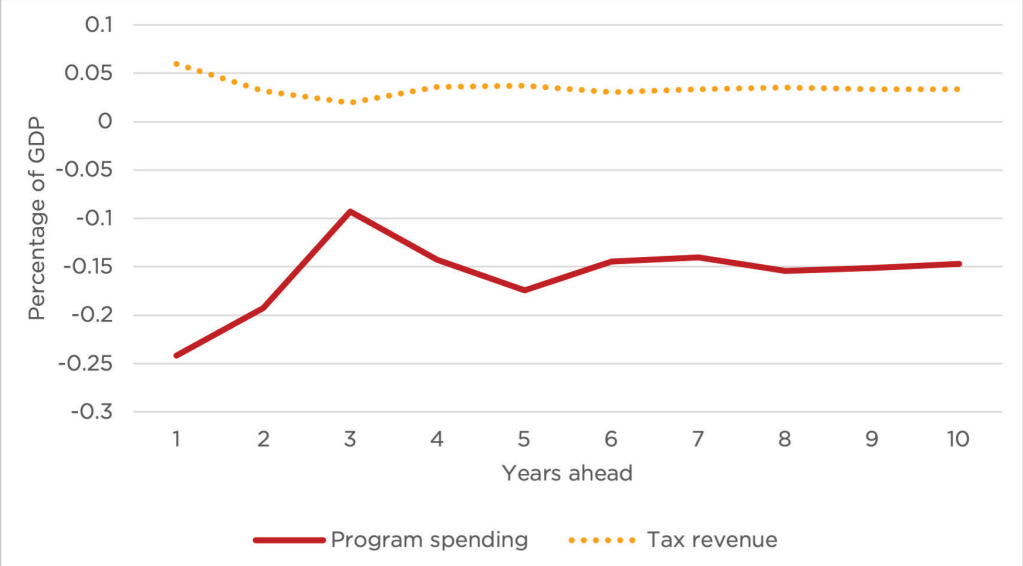
Note: Autocorrelation and heteroscedasticity robust standard errors in parentheses. Significance levels are shown by *** for one per cent, ** for five per cent and * for 10 per cent. The joint significance tests check the statistical significance of the coefficients of lagged values of program spending (PS), other own-source revenue (OR) and tax revenue (TR) in the various equations. The total number of observations for the estimation is 48.

The empirical results show that the deficit has negative effects on government expenditures and positive effects on the various revenues, suggesting convergence towards the intertemporal budget constraint. Column (1) shows that the error correction term has a statistically significant negative effect on program spending. The result implies that in response to a one percentage point increase in the deficit-to-GDP ratio, program spending falls by about 0.24 percentage

points the following year.[4] Similarly, column (3) indicates that a one percentage point increase in the deficit-to-GDP ratio is associated with about a 0.06 percentage point rise in the tax revenue-to-GDP ratio. These results imply that about 80 per cent of Alberta's short-term fiscal responses to budgetary imbalances appear on the spending side of the budget. Also note that, as shown at the bottom of column (3) of Table 2, the lagged coefficients of program spending are jointly statistically significant in the tax revenue equation. This is consistent with what is known as the spend-tax hypothesis, which states that increases in program spending lead to tax increases.

While the previous discussion focuses on how the various budgetary components respond to the deficit in the following year, one may expect the fiscal adjustment to the deficit to continue beyond the immediate year. To shed light on such possibilities, we plot the cumulated responses to the budgetary imbalances over some period after the event occurs. We restrict our discussion to the responses of program spending and tax revenue as the effects of the deficit on the other fiscal variables are statistically insignificant.

Figure 3. Responses of Program Spending and Tax Revenue to a Budget Deficit



Note: The vertical axes show changes in budgetary components as a share of GDP; years ahead are shown in the horizontal axis.

Figure 3 shows the responses of program spending and tax revenue in the years after a deficit occurs. The figure indicates that Alberta provincial governments responded by cutting program spending and raising the tax revenue in the year after a deficit occurred. While the reduction in program spending following a deficit appears to continue in subsequent years, the responses of the tax revenue beyond the first year are not statistically different from zero. Thus, the empirical estimates suggest that the Alberta government's fiscal adjustments to a deficit mainly happen on the spending side of the budget.

[4] Note also that since we use one budgetary imbalance variable and did not make a distinction between budget deficits and surpluses, the results also suggest that when the provincial government runs a surplus (which is negative values for the deficit variable), it responds by raising spending and cutting tax revenue. We discuss the possibility of asymmetric fiscal responses to the budgetary imbalances in another section.

3.3. ASYMMETRIC FISCAL RESPONSES TO BUDGETARY IMBALANCES

So far, our discussion assumes that budgetary imbalances have symmetrical effects on the budget's various components. However, one may expect that the provincial government's fiscal responses to deficits may differ from those to surpluses for various reasons. For instance, when the government runs a large surplus, there may be political and social pressures on the government to increase its program spending. On the other hand, in the event of deficits, it may be politically difficult for the government to engage in significant austerity measures by cutting program spending. To investigate such possible asymmetric fiscal responses to the budget imbalance, we need to modify the original specification of Eq. (2). A relatively more straightforward and common way of assessing the asymmetric fiscal responses to budgetary imbalances is to use a nonlinear transformation and separate the error correction term (the lagged deficit) into positive and negative values.[5] Recall that a negative value of the error correction term () implies a surplus, whereas a positive value () represents a deficit. Thus, our key variable of interest, the error correction term, can be decomposed into:

$$BD_{t-1}^{+} = \begin{Bmatrix} BD_{t-1} & if\ BD_{t-1} > 0 \\ 0 & otherwise \end{Bmatrix} \quad (3)$$

$$BD_{t-1}^{-} = \begin{Bmatrix} BD_{t-1} & if\ BD_{t-1} < 0 \\ 0 & otherwise \end{Bmatrix} \quad (4)$$

where the various symbols are as defined previously. The main error correction model indicated in Eq. (2) can then be respecified by replacing the error correction term with BD_{t-1}^{-} and BD_{t-1}^{+} as follows:

$$\Delta Z_t = \Pi_s \mathrm{BD}_{t-1}^{-} + \Pi_d \mathrm{BD}_{t-1}^{+} + \Pi_1 \Delta Z_{t-1} + \Pi_2 \Delta Z_{t-2} + \Pi_3 \Delta Z_{t-3} + \cdots + \Pi_p \Delta Z_{t-p} + \varepsilon_t \quad (5)$$

where Π_s and Π_d denote the coefficients of the lagged budget surplus and deficit, respectively. All other variables are as defined before. We estimate Eq. (5), and the results are shown in Table 3. For the sake of brevity, we report only the key coefficients of interest and the complete estimation results are presented in Table A2 in the Appendix. Even if we report the results for all five fiscal variables, we limit our discussion to program spending and tax revenue, as exogenous factors largely drive the other budgetary components.

Table 3. Short-term Asymmetric Fiscal Responses to the Budget Imbalance, 1973–2023

	(1)	(2)	(3)	(4)	(5)
Explanatory variable	**Program spending** (ΔPS)	**Debt service** (ΔDS)	**Tax revenue** (ΔTR)	**Other revenue** (ΔOR)	**Grants** (ΔGR)
Lagged budget deficit ()	-0.039	0.051***	0.133***	0.092	0.065
	(0.119)	(0.014)	(0.042)	(0.210)	(0.057)
Lagged budget surplus ()	-0.347***	-0.031***	0.021	-0.003	0.008
	(0.056)	(0.010)	(0.033)	(0.041)	(0.016)
	Test of symmetry ($\Pi_s = \Pi_d$)				
Chi-squared (1) statistic	7.20***	14.80***	3.80*	0.21	1.16

Note: Δ denotes first-differences. Autocorrelation and heteroscedasticity robust standard errors in parentheses. Significance levels are shown by *** for one per cent, ** for five per cent and * for 10 per cent.

[5] During the sample period under investigation, Alberta experienced surpluses and deficits 60 per cent and 40 per cent of the time, respectively.

As reported in the last row of Table 3, we first test whether the government's fiscal responses to budget imbalances are symmetrical. The null hypothesis is that the lagged deficit and lagged surplus coefficients are equal, i.e., $\Pi_s = \Pi_d$. As shown in columns (1) through (3), in the program spending, debt service payment and tax revenue equations, the null hypothesis of symmetry is rejected, suggesting that these fiscal variables respond to budgetary imbalances asymmetrically. However, in columns (4) and (5), we do not reject the null hypothesis of symmetry.

Column (1) suggests that a deficit and a surplus have different impacts on Alberta's program spending. The results indicate that program spending increases significantly when the government experiences a surplus. According to our estimate, a one percentage point rise in the surplus is associated with an increase in program spending by about 0.35 percentage points. On the other hand, when a deficit occurs, the government does not respond by cutting its program spending. If Alberta's deficits and surpluses principally occur due to increases and decreases in the province's non-renewable resource revenue, our result is broadly consistent with the findings of Ferede (2018). Hill and Palacios (2024b) also noted that Alberta's fiscal risk emanates from the government's decision, which raises spending when the resource revenue increases. However, it is reluctant to adjust spending downwards when resource revenue falls.

When a deficit occurs, the government needs to cut its spending, raise revenue or both to achieve fiscal sustainability.[6] Our empirical estimates shown in column (3) indicate that Alberta's provincial governments respond to a deficit by raising tax revenue. However, the governments do not seem to cut their tax revenue when a surplus occurs, suggesting the presence of an asymmetric tax revenue response to budgetary imbalances.

In sum, our empirical analysis shows there is historical evidence that program spending and tax revenue, two of the main budgetary components of Alberta's provincial governments, exhibit asymmetric fiscal responses to budgetary imbalances.

3.4. SHORT-TERM FISCAL ADJUSTMENT AND OIL PRICE EXPECTATIONS

Alberta's energy sector plays a crucial role in the province's economy and the non-renewable resource revenue from this sector accounts for a significant part of the government's revenue. Consequently, fluctuations in global oil prices can impact the budget and the government's fiscal decisions in many ways. For instance, when the West Texas Intermediate (WTI) oil price, which is the benchmark price for Alberta's oil, is predicted to rise, the government will expect its revenue to increase, and it may not have the incentive to engage in fiscal adjustment even when it recorded a deficit in the previous year. Thus, the budgetary responses of Alberta's governments to deficits may well depend on the expectations about the future path of oil prices and the associated non-renewable resource revenue.

To investigate these issues, in this section, we re-estimate the main empirical model by decomposing the deficit variable into oil price rising and falling regimes. For our analysis, we use the real price of WTI in Canadian dollars. A problematic issue in this regard is obtaining relevant oil price forecasts for the entire sample period. As Ellwanger and Snudden (2023) indicate, there are many ways of statistically forecasting real oil prices with their respective limitations. In our analysis, we assume that, in any year, the one-year-ahead actual real oil price corresponds

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[6] This is especially true if the interest rate is greater than the economic growth rate. On the other hand, in a less common fiscal environment where the interest is lower than the economic growth rate, the government can continue borrowing without endangering its fiscal sustainability. See Blanchard (2019). However, even in such a scenario where the interest rate is lower than the economic growth rate, Dahlby, Ferede and Fuss (2022) show that debt-financed government spending can still have significant fiscal costs.

to the forecast oil price. Such an assumption is broadly aligned with Ellwanger and Snudden's (2023) findings. Thus, we define a dummy variable, *OD*, as equal to one if the one-year-ahead real oil price is greater than the current real oil price and zero otherwise. Then, our main error correction model shown in Eq. (2) can be re-specified as follows:

$$\Delta Z_t = \Pi_h * \mathrm{OD} * BD_{t-1} + \Pi_l * (1 - \mathrm{OD}) * BD_{t-1} + \Pi_1 \Delta Z_{t-1} + \Pi_2 \Delta Z_{t-2} + \Pi_3 \Delta Z_{t-3} + \cdots + \Pi_p \Delta Z_{t-p} + \varepsilon_t \quad (6)$$

where Π_h and Π_l denote the coefficients of the lagged budget deficit in high and low real oil price regimes, respectively, and the other variables in Eq. (6) are as defined previously. We present the empirical estimates in Table 4. For brevity, we show the coefficients of the key variables of interest and the detailed results are reported in Table A3 in the Appendix.

Table 4. Short-term Fiscal Responses and Oil Price Forecasts, 1973–2023

		(1)	(2)	(3)	(4)	(5)
		Dependent variables				
Regimes	**Explanatory variable**	**Program spending** (ΔPSt)	**Debt service** (ΔDSt)	**Tax revenue** (ΔTRt)	**Other own-revenue** (ΔORt)	**Federal grants** (ΔFGt)
Higher oil price	Lagged budget deficit	-0.106	-0.000	0.006	-0.020	0.055
		(0.077)	(0.011)	(0.046)	(0.124)	(0.040)
Lower oil price	Lagged budget deficit	-0.274***	-0.003	0.072***	0.042	0.021
		(0.053)	(0.003)	(0.027)	(0.098)	(0.021)
		Test of symmetry ($\Pi_h = \Pi_l$)				
	Chi-squared (1) statistic	8.09***	0.08	2.63	0.12	1.87
	Adjusted R^2	0.716	0.385	0.436	0.098	0.417

Note: Δ denotes change. Autocorrelation and heteroscedasticity robust standard errors in parentheses. Significance levels are shown by *** for one per cent, ** for five per cent and * for 10 per cent.

As Table 4 shows, we first conduct a statistical test to determine whether there are asymmetrical responses to the deficit depending on the expectation of higher or lower oil prices in the subsequent year. The null hypothesis of symmetry is rejected only in the program spending equation shown in column (1). In all the other cases, there is no evidence of asymmetric responses. Thus, our analysis below focuses on results reported in column (1).

Column (1) shows that the coefficient of the lagged budget deficit is, as expected, negative in both higher and lower oil price regimes. However, the coefficient estimate is statistically significant only in the lower oil price regime. This suggests that when the government expects oil prices to be higher in subsequent years, it does not cut its program spending in response to the deficit. On the other hand, when the oil price is expected to be lower next year, the provincial governments respond to deficits by cutting program spending. This result is also broadly consistent with earlier studies, such as Ferede (2018). Thus, there is evidence that Alberta provincial governments show some restraint in their program spending when oil prices are predicted to decline but not when oil prices are expected to be higher. Such a policy choice can

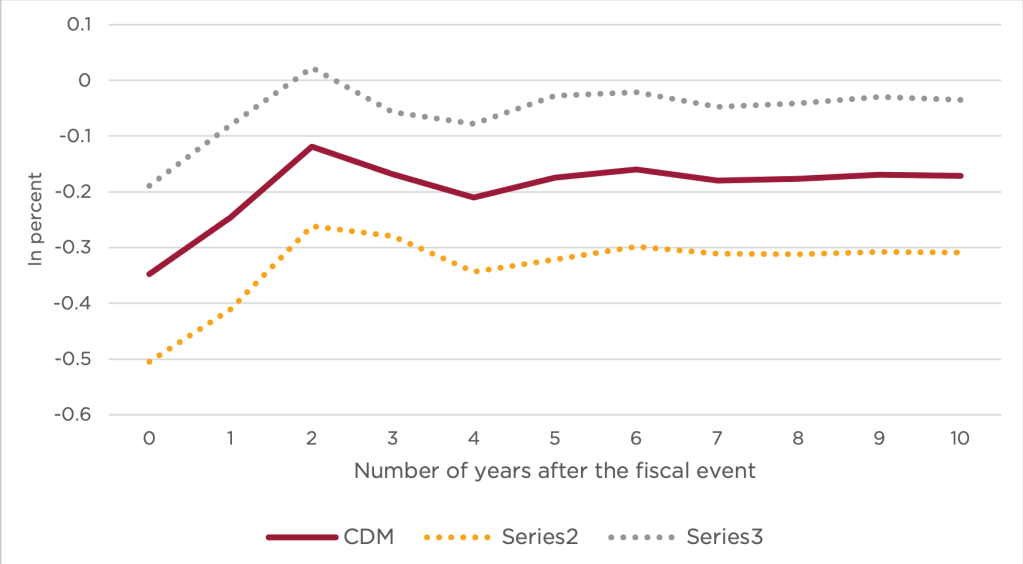
expose the province's spending on programs and services that Albertans rely on to the vagaries of volatile global oil prices. An important policy implication of these results is that it may be better to align the province's program spending to a sustainable part of its revenue so that vital public programs and services can be sustainably and predictably provided. See Hill and Palacios (2024a) for similar policy recommendations and justifications.

3.5. ASYMMETRIC FISCAL RESPONSES AND LONG-TERM IMPLICATIONS

In the previous section, we presented empirical evidence which suggests that Alberta provincial governments respond to budgetary imbalances asymmetrically. Given these asymmetric responses, it would be interesting to assess the long-term fiscal implications for the province. Thus, we shed some light on this crucial issue in this section.

Our empirical analysis presented in the previous section reveals that while a surplus causes an increase in program spending in the following year, no statistically significant spending responses occur when there is a deficit. An important question is whether this fiscal response is temporary or long-lasting. In Figure 4, we plot the cumulative responses of program spending to a budget surplus.[7]

Figure 4. Effects of Budget Surplus on Program Spending



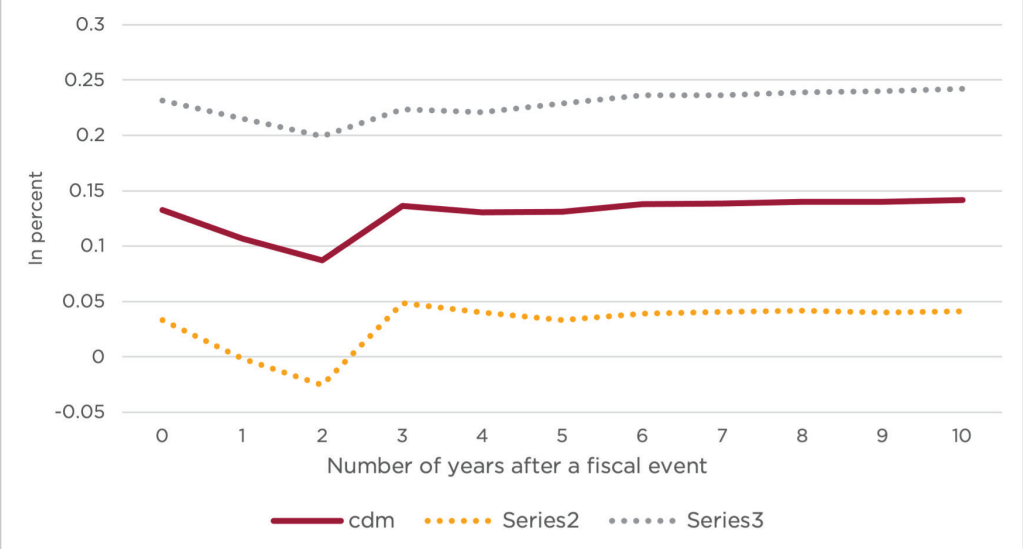
Note: The horizontal axis shows the years after the fiscal event. A negative value of the budget deficit implies a budget surplus. Thus, negative values in the above figure denote increases in program spending.

In the figure, the solid line shows the cumulative dynamic multipliers from our empirical model. The dotted lines indicate the 95 per cent confidence intervals. Note that since negative values of the deficit imply a surplus, the negative values in the above figure denote increases in program spending. Figure 4 shows that a surplus causes an increase in program spending in the following years. The elevated spending appears to be lasting longer and this effect is statistically significant. The rise in program spending adversely impacts the budget balance in future years and this is particularly important since we find that the provincial governments do not cut spending in the face of deficits.

[7] The figure shows the cumulative dynamic multipliers from our empirical model presented in Table 3.

Similarly, our empirical analysis shows that provincial governments increase tax revenue the following year when a deficit occurs, but the government does not appear to cut tax revenue when a surplus occurs. Thus, in Figure 5, we also plot the cumulative responses of tax revenue following a deficit.

Figure 5. Effects of Budget Deficit on Tax Revenue

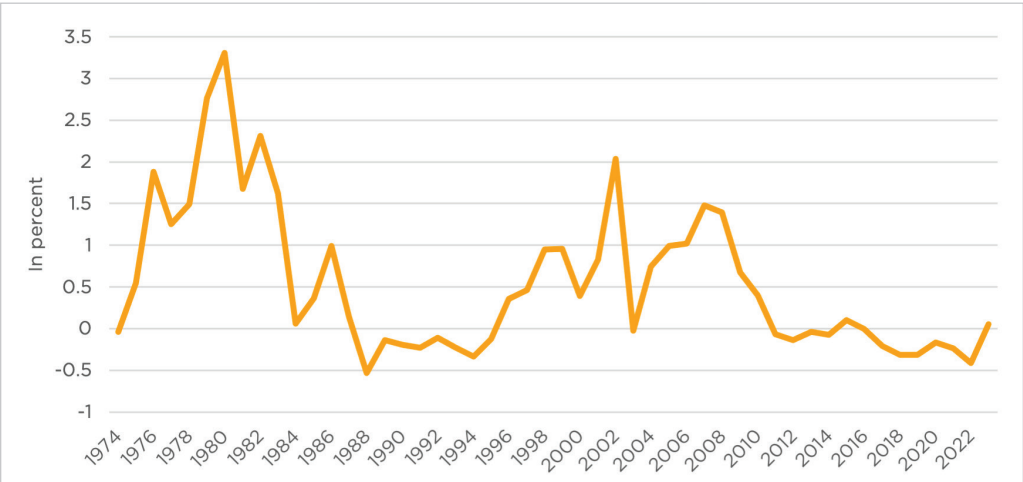


Note: The horizontal axis shows the years after the fiscal event.

The figure shows that Alberta's provincial governments tend to raise tax revenue following a deficit in the previous year and this increase in tax revenue seems to last for a longer period, although the magnitude of the response is lower than the spending response.

The variation in the asymmetrical responses of the various budgetary components has an important impact on the provincial government's overall budget balance. In Figure 6, we show the impact of the asymmetrical fiscal responses on the deficit (broken line).

Figure 6. Impacts of Asymmetric Fiscal Responses on the Budget Deficit (as a percentage of GDP)



Note: A negative value of the budget deficit implies a budget surplus.

Note that the implied asymmetric responses for each year are computed using the statistically significant coefficient estimates from our empirical results reported in Table 3. As before, negative values of the deficit represent surpluses. During the period under consideration, Alberta provincial governments run surpluses 60 per cent of the time. Our results show that a surplus causes an increase in program spending in the following year, which causes a decline in the budget balance. Ultimately, this can cause an increase in the province's net debt or a reduction in its net financial assets. Thus, the asymmetric fiscal responses adversely impact the government's overall budget balance and can harm the province's fiscal sustainability in the long term.

An essential policy implication of this study is that Alberta provincial governments should restrain their program spending when they face surpluses (for instance, when global oil prices increase and the associated non-renewable resource revenue from the sector increases). From the province's long-term fiscal sustainability perspective, it may be better to invest in a fiscal stabilization fund or the Alberta Heritage Savings Trust Fund when the province runs surpluses. This also helps the province withstand the budgetary impacts of the volatile resource revenue on which it heavily depends. For instance, Hill and Palacios (2023, 2024a, b) suggest that by basing the provincial budget on the average resource revenue from the past two decades — and directing any excess revenue into the Heritage Savings Trust Fund — the government could achieve greater fiscal stability.

4. CONCLUSIONS

This paper investigates the dynamic fiscal adjustment of Alberta's provincial governments to budgetary imbalances using annual time series data over the past half-century. Our analysis reveals that the governments respond to budgetary imbalances by adjusting their program spending and tax revenue with no significant change in the other budget components. Historical evidence shows that the provincial government responded to budgetary imbalances asymmetrically. More specifically, according to our empirical estimates, Alberta's provincial governments respond to a surplus by raising program spending with no significant adjustments on the revenue side of the budget. On the other hand, when the provincial governments face deficits, they raise tax revenue but do not adjust their program spending. Since the increase in tax revenue during a deficit is generally lower than the required financial needs, some of the deficit is financed through borrowing. We also find evidence that the government's program spending responses to the deficit depend on whether oil prices are predicted to increase or decrease.

A crucial policy implication arising from our study is that given Alberta's frequent encounters with substantial fluctuations in its overall budgetary positions, if provincial governments cannot reduce program spending during times of deficits, they must exercise restraint in such spending when the province's fortunes improve and surpluses emerge. Another potential way to stabilize Alberta's finances is to better align government spending with a more consistent and reliable part of total government revenue by excluding temporary resource revenue windfalls. Implementing such policy measures can bolster the province's resilience against budgetary risks and foster long-term fiscal sustainability.

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APPENDIX: ADDITIONAL RESULTS

Table A1. Unit Root Tests

	Levels		First-differences	
	Phillips-Perron (Z_τ)	DF-GLS	Phillips-Perron (Z_τ)	DF-GLS
PS_t	-2.249	-2.686	-6.921***	-5.914***
DS_t	-1.318	-2.665	-3.948***	-1.977*
TR_t	-1.699	-1.904	-7.776***	-4.733***
OR_t	-1.488	-1.974	-7.523***	-4.673***
FG_t	-2.596	-2.204	-7.977***	-5.081***
BD_t	-2.779*	-2.449**		

Note: Significance levels are shown by *** for one per cent, ** for five per cent and * for 10 per cent. The lag length for the DF-GLS unit root test is chosen by the Schwarz Information Criterion (SIC). All the unit root tests include a constant term but no trend, as in previous literature on dynamic fiscal adjustment. However, including a trend will not change the results qualitatively.

Table A2. Short-term Fiscal Responses to the Budget Deficit, 1973–2023 (Error correction model)

	(1)	(2)	(3)	(4)	(5)
	Dependent variables				
	ΔPS_t	ΔDS_t	ΔTR_t	ΔOR_t	ΔFG_t
BD_{t-1}	-0.242***	-0.003	0.059**	0.030	0.028
	(0.056)	(0.004)	(0.026)	(0.078)	(0.026)
ΔPS_{t-1}	-0.084	-0.021	-0.022	0.301***	-0.004
	(0.097)	(0.014)	(0.022)	(0.082)	(0.018)
ΔPS_{t-2}	-0.353***	-0.005	0.035	-0.083	0.041
	(0.033)	(0.009)	(0.023)	(0.067)	(0.031)
ΔDS_{t-1}	-0.942	0.271***	1.021***	-2.469***	-0.156
	(0.630)	(0.082)	(0.324)	(0.496)	(0.271)
ΔDS_{t-2}	-0.108	0.399***	-0.143	2.071	-0.268
	(0.628)	(0.149)	(0.218)	(1.287)	(0.214)
ΔTR_{t-1}	0.076	-0.003	-0.283***	0.212	-0.052
	(0.157)	(0.022)	(0.067)	(0.538)	(0.095)
ΔTR_{t-2}	0.367*	-0.016	-0.130**	0.029	0.071
	(0.190)	(0.030)	(0.059)	(0.190)	(0.074)
ΔFG_{t-1}	0.763**	0.033	-0.463***	0.226	-0.370***
	(0.304)	(0.038)	(0.137)	(0.233)	(0.109)
ΔFG_{t-2}	0.543	0.055	-0.592***	0.063	-0.309*
	(0.454)	(0.045)	(0.160)	(0.448)	(0.163)
ΔOR_{t-1}	0.017	-0.020	-0.032	-0.084	-0.030
	(0.056)	(0.021)	(0.041)	(0.324)	(0.039)
ΔOR_{t-2}	-0.055	0.004	0.042	-0.007	-0.074**
	(0.063)	(0.008)	(0.032)	(0.194)	(0.031)
Δy_{t-1}	-14.773***	-0.472**	-2.637***	7.803**	-3.136***
	(1.630)	(0.202)	(0.707)	(3.276)	(0.945)
NDP dummy	0.865***	0.007	-0.391**	0.521	-0.055
	(0.211)	(0.032)	(0.171)	(0.516)	(0.132)
Klein dummy	-0.944***	-0.191***	-0.225	0.264	-0.579***
	(0.288)	(0.033)	(0.140)	(0.313)	(0.142)
Constant	-0.002	0.021	0.187***	-0.243	0.081
	(0.115)	(0.018)	(0.072)	(0.281)	(0.078)
Observations	48	48	48	48	48
Adjusted R^2	0.703	0.403	0.417	0.121	0.421
F-test on ΔPS (p-value)	0.000	0.305	0.084	0.001	0.377
F-test on ΔOR (p-value)	0.600	0.536	0.169	0.533	0.052
F-test on ΔTR (p-value)	0.090	0.860	0.000	0.920	0.565

Note: y denotes the log of real per capita GDP. Autocorrelation and heteroscedasticity robust standard errors in parentheses. Significance levels are shown by *** for one per cent, ** for five per cent and * for 10 per cent.

Table A2. Short-term Asymmetric Fiscal Responses to the Budget Imbalance, 1973–2023

	(1)	(2)	(3)	(4)	(5)
	Dependent variables				
	ΔPS_t	ΔDS_t	ΔTR_t	ΔOR_t	ΔFG_t
Lagged budget deficit ()	-0.039	0.051***	0.133***	0.092	0.065
	(0.119)	(0.014)	(0.042)	(0.210)	(0.057)
Lagged budget surplus ()	-0.347***	-0.031***	0.021	-0.003	0.008
	(0.056)	(0.010)	(0.033)	(0.041)	(0.016)
ΔPS_{t-1}	-0.120*	-0.030***	-0.035*	0.290***	-0.011
	(0.072)	(0.008)	(0.021)	(0.089)	(0.011)
ΔPS_{t-2}	-0.374***	-0.011	0.027	-0.089	0.037
	(0.028)	(0.010)	(0.023)	(0.065)	(0.040)
ΔDS_{t-1}	-1.619**	0.090	0.777***	-2.677***	-0.280
	(0.769)	(0.070)	(0.274)	(0.653)	(0.309)
ΔDS_{t-2}	-0.195	0.376***	-0.174	2.044	-0.283**
	(0.630)	(0.140)	(0.219)	(1.337)	(0.118)
ΔTR_{t-1}	0.179	0.024	-0.246***	0.244	-0.033
	(0.172)	(0.023)	(0.062)	(0.568)	(0.077)
ΔTR_{t-2}	0.390**	-0.010	-0.122***	0.035	0.075
	(0.163)	(0.021)	(0.043)	(0.197)	(0.071)
ΔFG_{t-1}	0.720**	0.022	-0.478***	0.213	-0.378***
	(0.326)	(0.038)	(0.114)	(0.253)	(0.088)
ΔFG_{t-2}	0.672	0.089*	-0.546***	0.103	-0.286*
	(0.455)	(0.053)	(0.158)	(0.418)	(0.162)
ΔOR_{t-1}	0.003	-0.024*	-0.037	-0.088	-0.032
	(0.046)	(0.013)	(0.037)	(0.323)	(0.028)
ΔOR_{t-2}	-0.089*	-0.005	0.030	-0.017	-0.080***
	(0.049)	(0.007)	(0.031)	(0.176)	(0.023)
Δy_{t-1}	-15.853***	-0.760***	-3.027***	7.470**	-3.333***
	(2.082)	(0.291)	(0.736)	(3.786)	(1.146)
NDP dummy	0.753***	-0.023	-0.432***	0.487	-0.075
	(0.231)	(0.040)	(0.141)	(0.579)	(0.140)
Klein dummy	-0.952***	-0.193***	-0.227**	0.261	-0.580***
	(0.364)	(0.038)	(0.111)	(0.319)	(0.142)
Constant	-0.363**	-0.075**	0.057	-0.354	0.015
	(0.144)	(0.036)	(0.059)	(0.233)	(0.038)
Observations	48	48	48	48	48
Adjusted R^2	0.718	0.545	0.433	0.097	0.416
	Test of symmetry ($\Pi_s = \Pi_d$)				
Chi-squared (1) statistic	7.20***	14.80***	3.80*	0.21	1.16

Note: y denotes the log of real per capita GDP. Autocorrelation and heteroscedasticity robust standard errors in parentheses. Significance levels are shown by *** for one per cent, ** for five per cent and * for 10 per cent.

Table A3. Short-term Fiscal Responses and Oil Price Forecasts, 1973–2023.

	(1)	(2)	(3)	(4)	(5)
	Dependent variables				
	ΔPS_t	ΔDS_t	ΔTR_t	ΔOR_t	ΔFG_t
Oil price rising ($OilDummy * BD_{t-1}$)	-0.106	-0.000	0.006	-0.020	0.055
	(0.077)	(0.011)	(0.046)	(0.124)	(0.040)
Oil price falling ($(1\text{-}OilDummy) * BD_{t-1}$)	-0.274***	-0.003	0.072***	0.042	0.021
	(0.053)	(0.003)	(0.027)	(0.098)	(0.021)
ΔPS_{t-1}	-0.097	-0.021	-0.017	0.306***	-0.007
	(0.102)	(0.014)	(0.026)	(0.093)	(0.011)
ΔPS_{t-2}	-0.383***	-0.005	0.047*	-0.071	0.035
	(0.054)	(0.008)	(0.026)	(0.067)	(0.036)
ΔDS_{t-1}	-1.252*	0.265***	1.143***	-2.355***	-0.217
	(0.642)	(0.070)	(0.289)	(0.650)	(0.212)
ΔDS_{t-2}	-0.521	0.392**	0.020	2.223**	-0.349***
	(0.841)	(0.164)	(0.312)	(1.029)	(0.101)
ΔTR_{t-1}	0.200	-0.001	-0.332***	0.167	-0.027
	(0.213)	(0.024)	(0.105)	(0.404)	(0.056)
ΔTR_{t-2}	0.465**	-0.014	-0.169**	-0.007	0.091
	(0.216)	(0.029)	(0.084)	(0.165)	(0.081)
ΔFG_{t-1}	0.795***	0.034	-0.476***	0.214	-0.364***
	(0.298)	(0.038)	(0.150)	(0.250)	(0.086)
ΔFG_{t-2}	0.555	0.056	-0.597***	0.059	-0.307*
	(0.520)	(0.047)	(0.171)	(0.465)	(0.185)
ΔOR_{t-1}	0.141	-0.018	-0.081*	-0.129	-0.005
	(0.086)	(0.016)	(0.044)	(0.213)	(0.041)
ΔOR_{t-2}	0.001	0.005	0.020	-0.027	-0.063**
	(0.070)	(0.008)	(0.042)	(0.149)	(0.029)
Δy_{t-1}	-14.969***	-0.476**	-2.560***	7.875**	-3.174***
	(1.474)	(0.198)	(0.510)	(3.292)	(0.929)
NDP dummy	0.757***	0.005	-0.349**	0.561	-0.076
	(0.191)	(0.037)	(0.175)	(0.474)	(0.127)
Klein dummy	-1.274***	-0.197***	-0.095	0.385	-0.644***
	(0.332)	(0.039)	(0.163)	(0.265)	(0.152)
Constant	0.090	0.023	0.151*	-0.277	0.100
	(0.114)	(0.022)	(0.080)	(0.235)	(0.074)
Chi-squared (1) statistic	8.09***	0.08	2.63	0.12	1.87
Observations	48	48	48	48	48
Adjusted R^2	0.716	0.385	0.436	0.098	0.417

Note: y denotes the log of real per capita GDP. Autocorrelation and heteroscedasticity robust standard errors in parentheses. Significance levels are shown by *** for one per cent, ** for five per cent and * for 10 per cent.

The oil dummy is equal to one when the one-year-ahead real oil price is higher than the current real oil price; otherwise, it is zero.

About the Authors

Ergete Ferede received his BA and M.Sc. degrees from Addis Ababa University (Ethiopia) and his PhD from the University of Alberta. He is professor of economics at MacEwan University where he has served since 2006. Prior to joining MacEwan University, he taught at Addis Ababa University, the University of Alberta and the University of Windsor. He has been teaching various economics courses and his teaching interests include public finance, macroeconomics, and money and banking. Dr. Ferede has been actively engaged in research with a particular focus on tax policies, fiscal federalism and economic growth. His research has been published in *National Tax Journal*, *International Tax and Public Finance*, *Small Business Economics*, *Public Finance Review* and other journals. He is currently serving as a senior fellow of the Fraser Institute.

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