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Discretionary Tax Changes and the Macroeconomic Activity: New Narrative Evidence from Australia

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Keywords

narrative approach, tax multiplier, Australia

JEL Classification

E32, E62, H20, N17

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1 Introduction

While many have attempted to estimate the effects of discretionary tax policies across different countries, there has been a dearth of research focusing on this important yet long-neglected topic within commodity exporting economies such as Australia.

The recent literature has tackled the identification problem in two ways. One popular method follows Blanchard and Perotti (2002)[1] who use external information on the elasticity of revenue to output to estimate cyclically adjusted tax revenues. For Australia, Perotti (2005) finds that a shock to net taxes equal to -1 percentage point of GDP decrease the output by 0.55 per cent after one year and a maximum effect on GDP for Australia of around -0.89 percent.

The second method, following Romer and Romer (2010), utilises written records from official budget sources to construct a narrative measure of exogenous policy changes, which are uncorrelated with other macroeconomic shocks. This approach has been employed for identifying exogenous tax policy shocks in various countries.[2] Romer and Romer (2010) and Cloyne (2013) find large and persistent effects on GDP in the UK and the US. Following a cut in tax revenues corresponding to one percent of GDP, GDP rises by around three percent over three years. Despite its widespread application, there remains a lack of consensus regarding the magnitude of tax policy effects. However, this methodology has not yet been applied to the Australian context.

This paper contributes new empirical evidence to this debate. I construct a narrative time series dataset of legislated tax changes in Australia from 1983Q4 to 2018Q4, an exercise that is particularly suitable for Australia. The main conclusion is that one percent decrease in tax revenue will increase the output by 0.76% at peak after three quarters, which is approximately 2.7 in dollar to dollar terms after scaling the elasticity estimates by average tax revenue to GDP ratio.[3] Compared to Romer and Romer (2010) and Cloyne (2013), the effects on GDP is large but transitory, providing a clear divergence from the established results. In doing so, I provide some of the first estimates for Australia. This paper also provides a detailed new dataset for further study.

The suitability of the narrative approach for Australia can be attributed to two primary factors. First, the country's extensive history with tax policy is marked by a comprehensive range of amendments, encompassing changes in superannuation, oil excise rates, and personal income tax rates. This historical depth provides a rich basis

[1]See Corsetti et al. (2012b) , Monacelli and Perotti (2010) and Ilzetzki et al. (2013) for the effects of government spending shocks in Australia. See Ramey (2019) and Ramey (2016) for a detailed survey.

[2]Examples include Canada by Hussain and Liu (2019), Germany by Christofzik et al. (2022), Spain by Gil et al. (2019), the UK by Cloyne (2013), and the US by Romer and Romer (2010).

[3]Ramey (2019) reported that converting elasticities to multipliers using sample averages can make the multipliers excessively counter-cyclical. Additionally, the cumulative multipliers introduced by Mountford and Uhlig (2009) do not fully account for the impact of the government budget, which complicates the computation of the tax multiplier. Therefore, in this paper, I focus primarily on estimating the elasticities between tax revenue and macroeconomic variables.

for narrative analysis. Second, the adoption of a budgeting framework in Australia that mirrors the practices of the UK provides additional support for this approach. In this system, tax policy is centralised within the Commonwealth government, with key announcements typically made on Budget night.[4] This process is augmented by detailed revenue forecasts accompanying each tax amendment, coupled with political debate for the motivations behind each legislative change. These components collectively underscore the suitability of a narrative approach in the Australian context, enabling a detailed and nuanced analysis of fiscal policy dynamics.

I adopt the identification strategy outlined by Cloyne (2013) to isolate tax policy changes in Australia from 1983Q4 to 2018Q4 that are not reactive to other macroeconomic shocks. Following the frameworks of Romer and Romer (2010) and Cloyne (2013), these tax changes are classified as 'exogenous', in contrast to those considered 'endogenous' to broader economic dynamics. The detail can be found in a companion paper, Ge (2024).[5]

In categorising 752 discretionary tax changes, I primarily use the stated motivation of policymakers, which generates comparable categories to those in Cloyne (2013). The 'exogenous' category contains tax acts intended to improve long-run economic growth, ideological changes aimed at improving social outcomes, and tax administration measures to enhance the fairness of the tax system. The 'endogenous' changes are actions taken to reduce budget deficits, finance government spending programs, and mitigate the negative effects of other macroeconomic shocks.

Having constructed a quarterly series of 'exogenous' tax changes, I follow Mertens and Ravn (2014) to treat the unanticipated exogenous tax changes as external instruments for structural tax shocks to estimate the effects of tax changes in Australia. In line with existing literature, my results should be interpreted as the average effects of exogenous tax changes.

2 Constructing the Narrative Time Series Dataset for Australia

2.1 Sources of Data

The foundation of the narrative analysis lies in an extensive examination of budgetary documents from both the executive and legislative branches of the Australian government.

From the executive side, the primary focus is on documents provided by the Australian

[4]In the Australian economic calendar, prior to 1993, the fiscal pronouncement, commonly referred to as the Budget, was traditionally delivered on the first Tuesday night of August. Post-1993, this convention has been modified, with the Treasurer presenting the budgetary overview on the second Tuesday of May.

[5]The companion paper is available at https://www.dropbox.com/scl/fi/dff24zi7bm419ike0dphb/Narrativepaper.pdf?rlkey=oxi28ixtrfti6863ah7r5a6cf&st=2jhg1gy1&dl=0.

Treasury. Key sources include the annual *Budget Economic and Fiscal Outlook Report*, the *Mid-Year Economic and Fiscal Outlook Report*, and the *Final Outcome Budget Report*.[6] These documents are instrumental in revealing the motivations driving significant tax policy changes at the time of their announcement.

On the legislative front, two pivotal sources are utilised. The *Hansard*, a transcript of parliamentary debates, is critical for understanding the underlying rationales and justifications for major tax reforms.[7] Additionally, the *Explanatory Memorandum* accompanying each government bill provides a detailed chronology, projected revenue implications, and fiscal impacts of proposed tax changes.[8]

Supplementary sources, including Australian Federal Election Speeches [9] and Media Releases from the Treasury are consulted to capture the political intent and offer additional insights into the factors shaping legislated tax changes.[10]

2.2 Identification of Legislated Tax Changes

The initial task involves pinpointing all legislated tax amendments spanning 1983-2018. This process requires thorough examination of bills archived in the Federal Register of Legislation.[11] In the Australian legislative process, each Bill is presented in the House of Representatives, accompanied by an *Explanatory Memoranda* that clarify the Bill's provisions for Parliament members. Following the 1984 amendments to the Acts Interpretation Act 1901, these memoranda are required to outline the Bill's primary objectives and fiscal impacts (Australia Parliament. House of Representatives et al., 2018). Once a Bill receives approval from both the Senate and the House of Representatives and is granted Royal Assent by the Governor-General, it becomes an Act of Parliament.[12]

2.3 Classification of Exogenous Tax Changes

The next phase involves discerning the motivations behind each tax change. Drawing inspiration from Cloyne (2013) and Romer and Romer (2010), I analyze policymakers' explicit statements to deduce their stated intentions. Principal sources for this analysis include the Budget Speech, the *Explanatory Memorandum*, and *Budget Paper No.2 Budget Measures*. Further insights are gleaned from Australian Federal Election Speeches,

[6] An archive of these budget-related documents is available at https://archive.budget.gov.au.

[7] A comprehensive record is housed at https://www.aph.gov.au/Parliamentary_Business/Hansard.

[8] The collection can be accessed at https://www.legislation.gov.au.

[9] The Election speeches are archived at https://electionspeeches.moadoph.gov.au.

[10] These Media Releases from the Treasury are available at https://treasury.gov.au/media-release.

[11] Details on legislated tax amendments are available at https://www.legislation.gov.au.

[12] A detailed explanation of the legislative process is available in the House of Representatives Practice at https://www.aph.gov.au/About_Parliament/House_of_Representatives/Powers_practice_and_procedure/Practice7/HTML/Chapter10/Billsthe_parliamentary_process.

discussions recorded in the *Hansard*, and Treasury media releases.

This paper focuses on the identification of exogenous tax changes, which are enacted for reasons unrelated to current or anticipated economic conditions. In the online Appendix A, a detailed explanation of the identification strategies and an in-depth discussion of the characteristics of endogenous tax changes are provided.

2.3.1 Exogenous Tax Changes

According to Romer and Romer (2010), exogenous tax changes are those not motivated by past or anticipated macroeconomic conditions. They are typically enacted for reasons unrelated to immediate economic circumstances and do not correlate predictably with factors likely to influence output in the near future.

Exogenous tax changes are further divided into three categories:

1. **Long-run Growth-oriented Changes:** These changes aim to enhance long-term economic growth. An example is the Tax Laws Amendment (Personal Income Tax Deduction) Act 2005, which targeted long-term economic expansion without addressing immediate economic conditions.

2. **Ideological Changes:** These are motivated by philosophical or societal goals, such as the Excise Tariff Amendment (Tobacco) Bill 2016, which increased tobacco excise for public health objectives.

3. **Tax Integrity Measures:** Focused on improving the fairness of the tax system, these amendments often target tax compliance by large entities. The Treasury Laws Amendment (GST Integrity) Bill 2017, aiming to enhance tax system transparency, is an example.

This study's classification system draws parallels and distinctions from the frameworks of Romer and Romer (2010) and Cloyne (2013), aligning the "spending-driven" and "counter-cyclical" categories with Romer and Romer (2010), while the "deficit-driven" category mirrors Cloyne (2013). The exogenous categorizations of long-run growth and ideological changes correspond with Cloyne (2013), and our tax integrity measures align with "ideological" category.

2.4 Measuring the Size and Timing of Tax Changes

When formulating the dataset, it is critical to distinguish between the announcement and implementation dates of tax changes. These dates, sourced from the *Explanatory Memorandum*, serve distinct functions: the announcement date marks the policy's public introduction, while the implementation date indicates when the tax change becomes effective. The interval between these events is termed the 'implementation lag'.

Following Mertens and Ravn (2012), tax actions are categorised as either anticipated or unanticipated based on this lag. Changes with a lag shorter than 90 days are considered unanticipated, while those with a longer duration are categorized as anticipated.

For assessing the magnitude of tax changes, the 'full year' revenue estimate method, inspired by Cloyne (2013), is employed. Since the enactment of the *Charter of Budget Honesty Act 1998*, the Australian Treasury has provided revenue projections for four fiscal years. The stability of these forward estimates for most tax changes allows the use of the farthest year's projection as a representative 'full year' measure.

In determining the timing of revenue impacts, a methodology aligned with Romer and Romer (2010) is used. It assumes that tax changes are effective in the latter half of a quarter. If a change is legislated before a quarter's midpoint, its revenue effects are attributed to the current quarter. If legislated after the midpoint, the effects are allocated to the subsequent quarter.

3 Properties of Exogenous Tax Changes

This section describes the property of narratively identified exogenous and unanticipated tax changes, which is later used in the empirical analysis.

3.1 Properties of Exogenous Tax Changes

Drawing from narrative sources, I identified 752 legislated tax actions, of which 631 qualify as 'exogenous'. Adapting the methodology of Romer and Romer (2010), I express the estimated revenue effects as a fraction of the annualized nominal GDP for the quarter of their respective implementation, as presented in Figure 1.

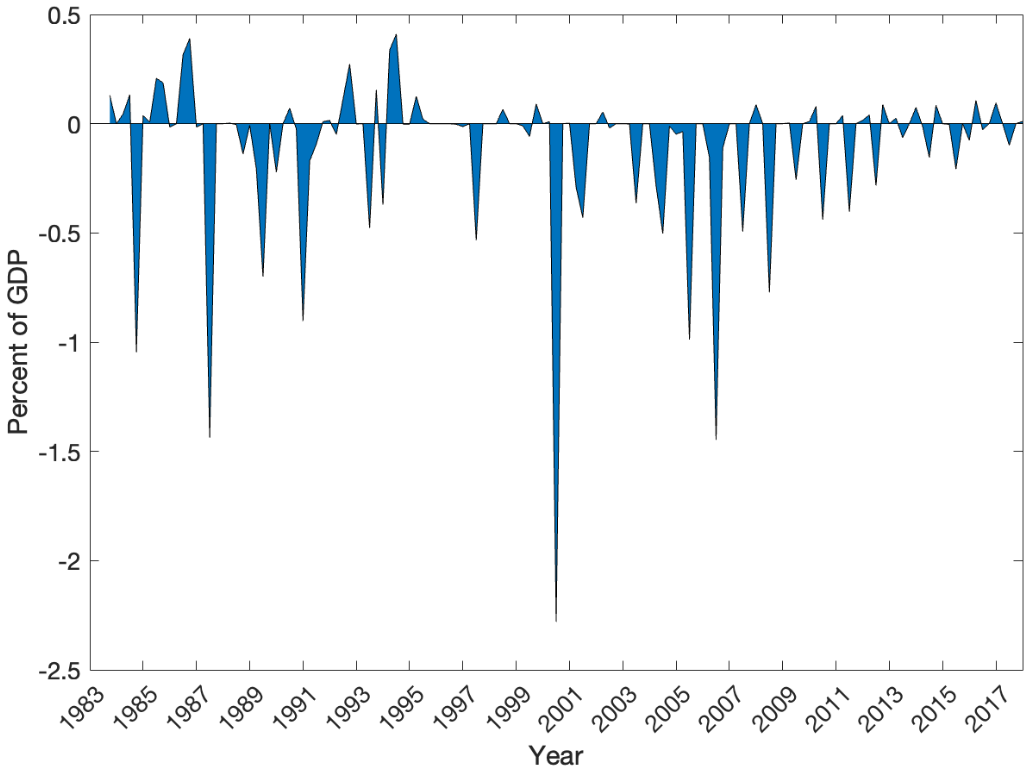


Figure 1: Exogenous Tax Policy Changes in Australia from 1983Q4 to 2018Q4

The nature of exogenous tax changes is evident, akin to patterns observed in Romer and Romer (2010) and Cloyne (2013). A majority of the quarterly observations in the series register as zero, underscoring the discrete nature of legislated tax reforms. The series spans from 1983 to 2018 and displays exogenous tax actions distributed throughout this period. As seen in prior studies, tax reductions are more frequent, with the series averaging a change of -0.0917%. Notably, the most pronounced reduction corresponding to the A New Tax System (Goods and Services Tax) Act 1999.

Figure 2 organises the exogenous tax changes into three categories. Foremost among these are measures targeting Australia's long-term economic growth. Notable initiatives in this grouping encompass the Personal Income Tax Cuts Act of 1999, integral facets of the 1985 Tax System Reform, and a series of five personal income tax cuts spanning the commodity price surge from 2003 to 2007.

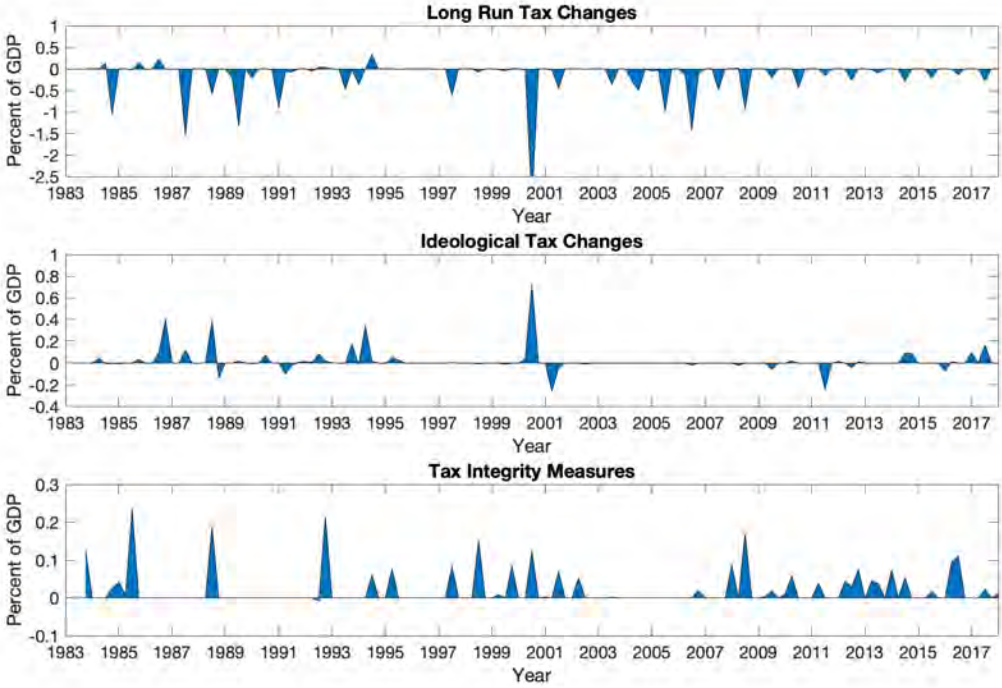


Figure 2: Components of Exogenous Tax Changes from 1983Q4 to 2018Q4

Second, the 1980s witnessed a surge in ideological tax changes, predominantly in the form of increase in oil excises. This period was characterised by heightened concerns over energy security, which led to the introduction of tax measures like the Excise Tariff Amendment Bills of 1987 and 1988. Furthermore, public health considerations also drove the imposition of excises on alcohol and tobacco products through out the sample period. These fiscal measures reflect a broader governmental objective to improve societal health outcomes.

Lastly, to enhance the integrity of the tax system and reduce tax evasion and avoidance practices, various legislative measures were instituted. The most significant among these were the Tax Integrity Act of 2018 and the Multinational Tax Avoidance Bill of 2017, both of which sought to ensure a fair and transparent taxation system.

3.2 Properties of Unanticipated Tax Changes

Figure 3 delineates narrative estimates of unanticipated tax modifications in Australia spanning from 1983 to 2018. Constituting a specialized subset of a broader array of exogenous tax variations, this quarterly series specifically focuses on tax policies characterized by an implementation lag of fewer than 90 days. Adhering to the framework established by Mertens and Ravn (2014), these unanticipated tax alterations serve as external instruments for isolating structural tax shocks in the context of the Australian economy for the ensuing empirical investigation.

Based on the narrative analysis, 359 out of a total of 752 legislated tax changes qualify as unanticipated. On average, these unanticipated tax changes represent -0.04% of Australia's GDP, with a standard deviation of 0.29%. Among these, the two most significant unanticipated tax modifications are the personal income tax cuts of 1984 and 2007, introduced by the Hawke and Rudd-Gillard governments, respectively.

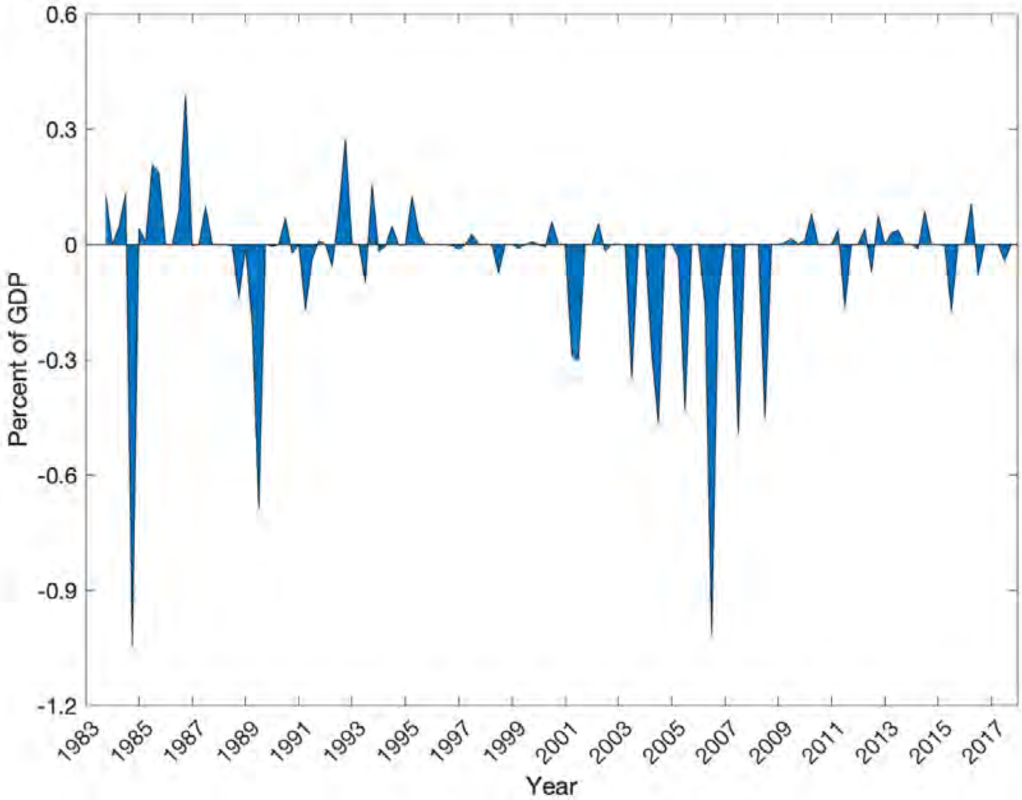


Figure 3: Narrative Measure of Unanticipated Tax Changes in Australia from 1983 to 2018

3.3 Testing the Exogeneity and Relevance of the "Exogenous" Tax Changes

I test the exogeneity of the tax instruments by conducting a Granger causality test using a seven-variable vector autoregression (VAR) model following Toda and Yamamoto (1995) with the narrative tax changes, tax revenue, government spending, output, the inflation rate, interest rates and the real exchange rate. The model includes a constant and five lags of each variable. The details of the Granger Causality tests are discussed in the online Appendix B.

The Granger causality test results in Table 1 show that the exogenous and unanticipated tax changes exhibit p-values of 0.2612 and 0.2496, respectively, implying that these "exogenous" tax series are not predictable from past values of the other macroeconomic variables, thus enhancing the exogeneity of the narrative tax measures. The endogenous series have a p-value of 0.0217, indicating that the "endogenous" tax changes are predictable from past values of the macroeconomic variables.

Table 1: Granger Causality Results - Seven Variable VAR

	F-Statistic	p-Value
Exogenous Series	1.2148	0.2612
Unanticipated Series	1.2300	0.2496
Endogenous Series	1.9074	0.0217

Consequently, I conduct a regression of the real commodity prices against unanticipated tax changes, incorporating four lags and a constant. The findings, shown in Table 2, reveal that the null hypothesis—stating the real commodity price does not Granger-cause the exogenous tax series—is not rejected at a 5% significance level. This result further affirms the tax series' exogeneity.

Table 2: Granger Causality Results - Real Commodity Prices

	F-Statistic	p-Value
Exogenous Series	1.7963	0.1336
Unanticipated Series	0.6026	0.6615

4 LP-IV Methodology

4.1 Methodology

The estimation of dynamic causal effects of Australian tax changes is achieved by using the local projections-IV (LP-IV) method of Stock and Watson (2018), who combine the local projections proposed by Jordà (2005) with the use of instrument variables. Following Mertens and Ravn (2014), I treat the narrative measure of unanticipated exogenous tax changes as an external instrument for structural tax shocks. The causal effect of exogenous tax changes is estimated by a linear regression of

$$Y_{i,t+h} = \Theta_{h,i1} Y_{1,t} + \gamma_h' W_t + u_{i,t+h}^{h\perp} \quad (1)$$

where $Y_{i,t+h}$ represents the forecasted value of the macroeconomic variable of interest for h periods into the future, $\Theta_{h,i1}$ quantifies the dynamic causal impact of changes in tax policy on the variable i. W_t comprises a vector of control variables that includes the lagged values of Y. $u_{i,t+h}^{h\perp}$ encapsulates a series of orthogonal residuals, such as

$\varepsilon^{\perp}_{t+h}, \ldots, \varepsilon^{\perp}_{t+1}, \varepsilon^{\perp}_{2:n,t}, \varepsilon^{\perp}_{t-1}, \varepsilon^{\perp}_{t-2}, \ldots$, where n denotes the total number of variables and $\varepsilon_{1,t}$ is identified as the exogenously determined structural tax shock. The notation '$\perp$' indicates the orthogonal residual resulting from the projection of population data onto W_t; for example, $x^{\perp}_t = x_t - \text{Proj}(x_t|W_t)$ adjusts variable x_t with respect to the controls in W_t. The constant term is omitted for brevity.

Let Z_t be a vector of tax proxies. The assumptions for instrument validity are

Assumption 1. *LP-IV*$^{\perp}$

(i) $E\left(\varepsilon^{\perp}_{1,t} Z^{\perp\prime}_t\right) = \alpha' \neq 0$ (*relevance*)

(ii) $E\left(\varepsilon^{\perp}_{2:n,t} Z^{\perp\prime}_t\right) = 0$ (*contemporaneous exogeneity*)

(iii) $E\left(\varepsilon^{\perp}_{t+j} Z^{\perp\prime}_t\right) = 0$ *for* $j \neq 0$ (*lead-lag exogeneity*)

Assumption (i) implies that the proxy z_t is correlated with the shocks to tax revenue. Assumption (ii) requires z_t to be systematically uncorrelated with other concurrent macroeconomic events. Assumption (iii) implies that z_t is systematically uncorrelated with pastor future shocks other than the tax shock $\varepsilon_{1,t}$. With the scale normalisation $\Theta_{0,11} = 1$, I assume that a unit decrease in $\varepsilon_{1,t}$ decreases $Y_{1,t}$ by one percentage points.

Then $\Theta_{h,i1}$ can be estimated from equation (1) following Stock and Watson (2018):

$$\Theta_{h,i1} = \frac{E\left(Y^{\perp}_{i,t+h} Z^{\perp\prime}_t\right) \text{H} E\left(Z^{\perp}_t Y^{\perp}_{1,t}\right)}{E\left(Y^{\perp}_{1,t} Z^{\perp\prime}_t\right) \text{H} E\left(Z^{\perp}_t Y^{\perp}_{1,t}\right)} \tag{2}$$

where H is any positive semi-definite matrix.

Hence, the policy effect of a one unit intervention in ε_t, h periods ahead is

$$\Theta_{h,i1} = E_t\left(Y_{i,t+h} \mid \varepsilon_{1,t} = 1\right) - E_t\left(Y_{i,t+h} \mid \varepsilon_{1,t} = 0\right) \tag{3}$$

4.2 Data and Specification

The benchmark local projection includes the following variables:

(i) the log of real tax revenue,

(ii) the log of real government spending (sum of government consumption and investment),

(iii) the log of real GDP,

(iv) Inflation (the percentage change of GDP Implicit Price Deflator compared to the same period one year earlier),

(v) the 90-Day Treasury Bill Rate and

(vi) the log of the real exchange rate (an increase is an appreciation).

The first three terms are expressed in per capita terms. The controls W_t includes three lags of each variable and a constant term. Tax Revenue, government spending and GDP are from Australian National Accounts, and are seasonally adjusted by the original sources.[13] Tax revenue is deflated using the GDP deflator and the government spending is defined as the sum of public gross fixed capital formation and government final consumption expenditure. Government spending and GDP per capita are chain volume measures.

The inflation and 90-Day Treasury Bill Rate are expressed in levels and are from the Reserve Bank of Australia. The real exchange rate is the Australian dollar trade-weighted exchange rate index adjusted for relative consumer price levels: see Ellis (2001) for details. My sample runs from 1983Q4 to 2018Q4.

My benchmark specification is an extension of Blanchard and Perotti (2002) and Perotti (2005). Monacelli and Perotti (2010) and Corsetti et al. (2012a) also apply a similar specification to study the effects of fiscal policy on output and the trade balance in the United States.

5 Empirical Results

In this section, I report the response of key macroeconomic variables to a shock corresponding to a 1% decrease in tax revenue with a 68% confidence interval. The impulse responses with 90% and 95% confidence intervals are reported in the Online Appendix E.

5.1 Benchmark Results

Before turning to the main results, I provide formal statistical tests to verify the relevance assumption in Assumption 1. Verifying these assumptions is important to assess whether weak instrument problems may bias our conclusions.

The relevance condition in the LP-IV framework is standard for linear IV models. Using the baseline LP-IV specification, the value for the first stage F-statistics (using a Newey and West (1987) HAC-robust residual covariance matrix with 13 lags) is 1.37 for the unanticipated exogenous tax changes. The values are well below the threshold value of 10 proposed by Stock and Yogo (2002), indicating that the narrative measure of unanticipated tax changes is weakly relevant for tax revenue.[14]

Olea et al. (2021) and Stock and Watson (2012) reported that standard inference might be invalid when the instrument is weak. To this end, I report the Anderson-Rubin confidence interval in my robustness checks showing that the weak instrument has

[13] The details of the data source are reported in Online Appendix F.

[14] As reported in Ramey (2019) and Ramey (2016), most narrative measure of fiscal policies are weak instruments. For example, Ramey (2016) reports that the first stage regression on tax revenue for Romer and Romer (2010) tax shocks is only 1.4. Further, some popular measure of government spending shocks that exclude the Korean War - Ramey (2011) and Ben Zeev and Pappa (2017)- are well below 10.

minimal impact on the statistical significance of the point estimates.

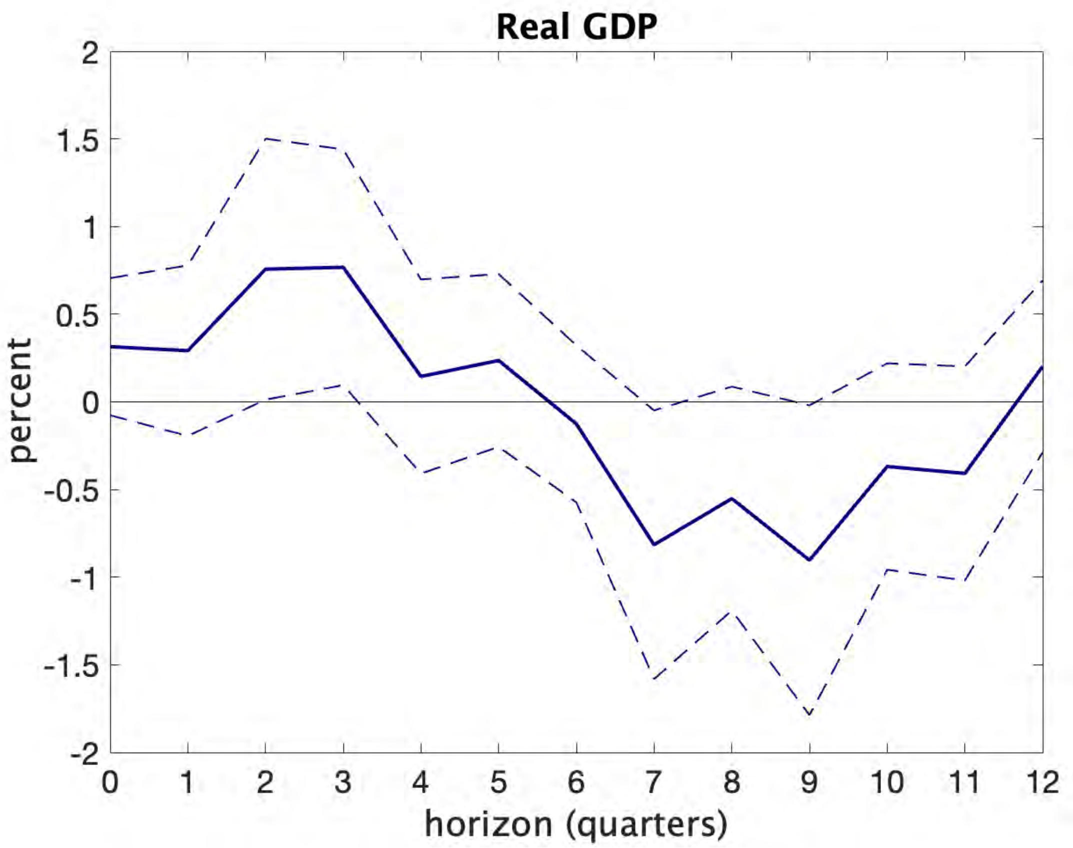


Figure 4: Response of real output per capita to a one percent decrease in tax revenue
Note: The impulse response function is estimated based on a six-variable local projection (LP) $y_t = (T, G, Y, \pi, i, E)_t$ with 3 lags and an intercept. The estimated impulse response function is represented by the solid line, and the dashed line represents the 68% standard confidence interval based on the Newey and West (1987) HAC-robust residual covariance matrix.

Figure 4 presents the output response to a tax revenue shock under the benchmark specifications, where the shock corresponds to a 1% decrease in tax revenue. The figure shows the impulse response function alongside 68% confidence bands, constructed using the standard 2SLS inference procedures with the Newey and West (1987) HAC-robust standard errors.

The response of GDP is both positive and statistically significant at the 10% significance level, peaking at approximately 0.76% after three quarters, before quickly returning to its trend. This result contrasts with the findings of Romer and Romer (2010) and Cloyne (2013), who document positive and persistent effects of tax cuts on output. In the Australian context, however, the evidence suggests that the effects of tax changes are transitory, with no permanent effects on output.

The transitory nature of output responses to tax changes in Australia can be attributed to the specific characteristics of both corporate and personal income tax policies. First, unlike UK and the US, Australia has relied heavily on indirect mechanisms such as bracket creep, with infrequent direct reductions in statutory tax rates. Bracket creep occurs when inflation pushes taxpayers into higher marginal tax brackets without a corresponding increase in real income, effectively raising the average tax burden without explicit policy changes. This phenomenon limits the expansionary effects on aggregate demand, as taxpayers' disposable income does not increase proportionally. Consequently, Australia's infrequent personal income tax cuts, such as the 1989 reforms under the Hawke Government, have had limited success in generating sustained increases in consumption or investment. In contrast, direct tax rate reductions in the United States and the United Kingdom—such as the *Tax Reform Act of 1986*, which lowered the top U.S. marginal income tax rate from 50% to 28%, and the Thatcher government's reforms, which reduced the top U.K. marginal rate from 83% to 40%—provided more substantial and persistent fiscal stimulus. As Dabla-Norris and Lima (2023) highlight, changes in the tax base often lead to smaller and less significant effects on economic activity compared to cuts in tax rates.

Second, corporate tax reforms in Australia have likewise been infrequent, contributing to muted and temporary effects on investment and output. The reduction of the corporate tax rate from 36% to 30% in 2001 represents the most recent significant adjustment. In contrast, the United States and the United Kingdom have pursued more proactive corporate tax policies aimed at fostering long-term economic growth. The U.S. *Tax Reform Act of 1986* reduced the corporate tax rate from 46% to 34%, followed by the *Omnibus Budget Reconciliation Act of 1993*, which introduced targeted incentives such as extended investment tax credits and accelerated depreciation allowances. Similarly, the U.K. reduced corporate tax rates from 52% in 1982 to 33% by 1986, and further to 30% by 1999. These more aggressive tax cuts, combined with fiscal incentives designed to stimulate capital formation, have consistently supported higher levels of private investment and financial inflows. In contrast, the limited scope of corporate tax reforms in Australia has constrained its ability to attract long-term capital, thereby dampening prospects for sustained improvements in productivity, investment, and economic growth.

Figure 5 illustrates the output responses to a tax policy shock, specifically a decrease in tax revenue equivalent to 1% of GDP. The estimated tax multipliers for Australia are derived by multiplying the impulse response from Figure 4, expressed in log terms, by the sample average GDP-to-tax revenue ratio following Blanchard and Perotti (2002), which is approximately 3.59. Figure 5 indicates that tax multipliers in Australia are slightly above 2.7 after three quarters.

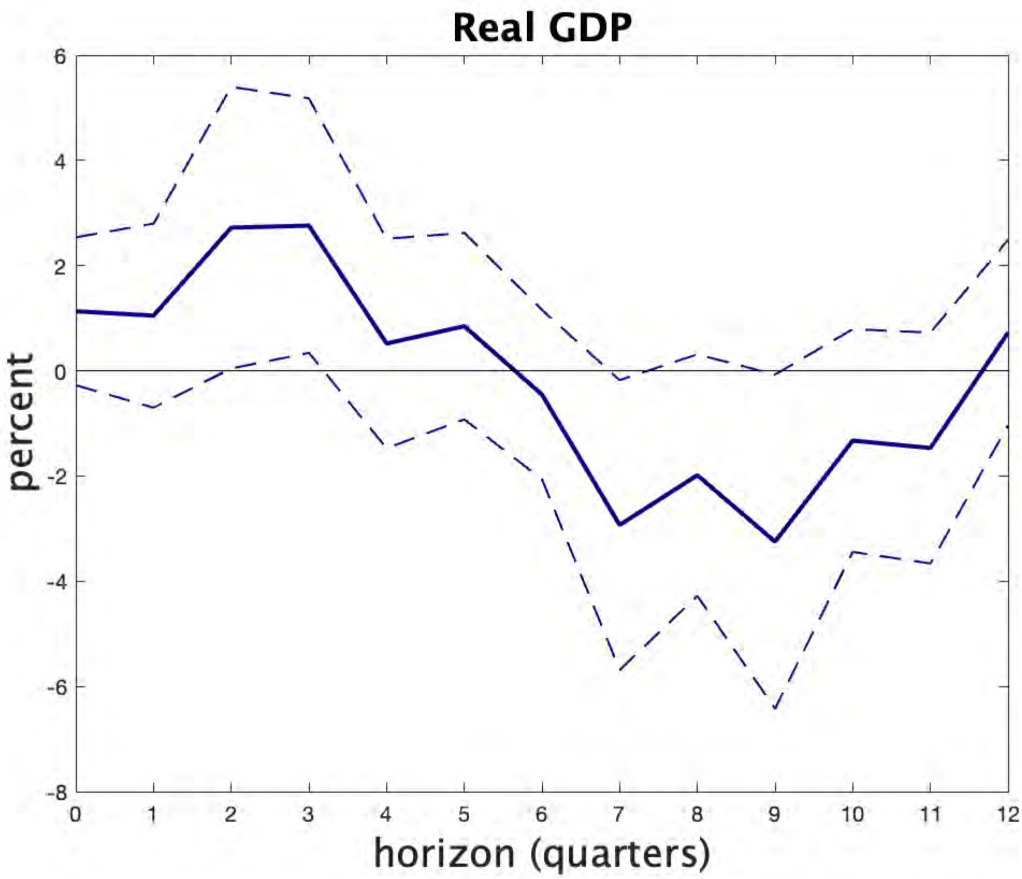
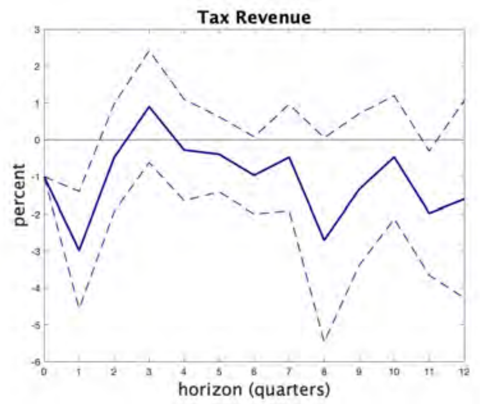


Figure 5: Response of real output per capita to one dollar decreases in taxes

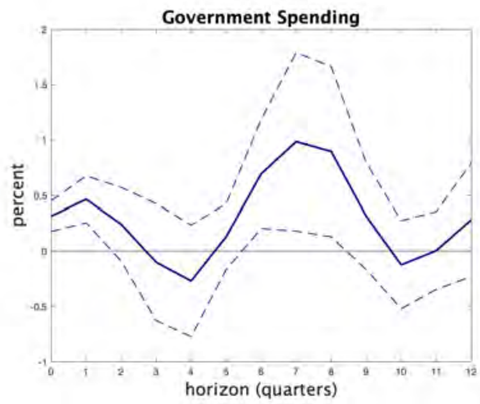
Note: The impulse response function is estimated based on a six variable local projections $y_t = (T, G, Y, \pi, i, E)^t$ with three lags and an intercept. The estimated impulse response function is represented by the solid line and the dashed line represents the 68% standard confidence interval based on a Newey and West (1987) HAC-robust residual covariance matrix.

5.2 Results for Key Variables

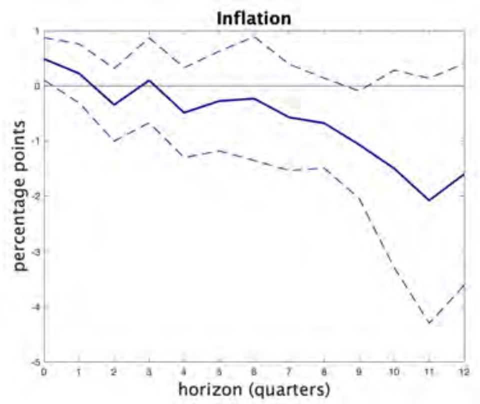
Figure 6 displays the response of key variables of the benchmark specification to a tax revenue shock corresponding to a one percent decrease in tax revenue. For each variable, the figure displays the impulse response and the 68% confidence bands constructed using the HAC-robust residual covariance matrix as proposed by Newey and West (1987).



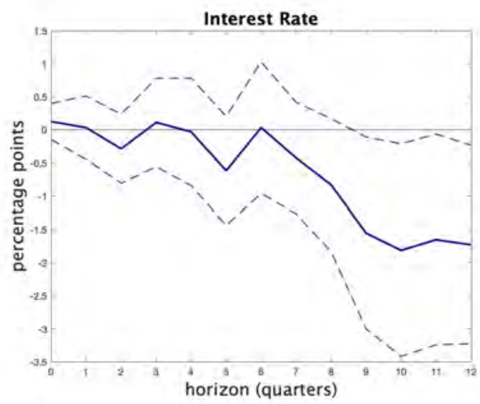
(a) Tax



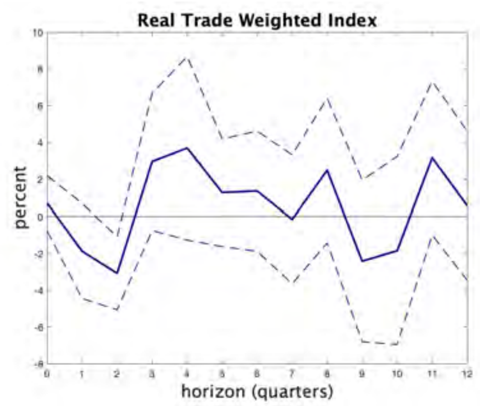
(b) Spending



(c) Inflation



(d) Interest Rate



(e) Real Exchange Rate

Figure 6: Responses of key economic variables to a one percent decrease in tax revenue. Note: All impulse response functions are estimated based on a six-variable local projection (LP) $y_t = (T, G, Y, \pi, i, E)_t$ with 3 lags and an intercept. The estimated impulse response functions are represented by the solid line, and the dashed line represents the 68% standard confidence interval based on Newey and West (1987) HAC-robust residual covariance matrix.

The empirical analysis reveals a transitory decline in tax revenues, with a decrease of approximately three percent observed after one quarter, followed by a rapid reversion to the trend. In contrast, government spending exhibits an immediate positive response, initially increasing by 0.3 percent and reaching a peak of approximately one percent after seven quarters. Inflation experiences a notable surge, rising by 0.48 percentage points shortly after the tax cut, before reverting to its trend level within one quarter. Meanwhile, the interest rate remains unchanged throughout the first year, suggesting that monetary policy remains accommodative in the short run. This stance reflects a strategic decision to allow the tax cuts to exert their full influence on the economy without the countervailing effects of monetary tightening. Additionally, the real exchange rate depreciates temporarily, declining by about three percent after two quarters.

It is important to note that the response of most key macroeconomic variables becomes statistically insignificant after one year. Therefore, the evidence from Australia does not support the hypothesis that tax cuts have a significant and positive long-term impact on macroeconomic equilibrium.

Following Plagborg-Møller and Wolf (2021), I also compare the benchmark results to the estimates from the SVAR using the same set of variables with three lags. The results are discussed in the online Appendix C and D. The main finding from this comparison is that the SVAR estimates are are comparable with those in the LP-IV in the short term.

6 Robustness

In this section, I test the sensitivity of my main finding that change in taxes have large and transitory effects on output. I investigate the sensitivity to various specifications. I also examine the sensitivity of the statistical significance by using the weak instrument robust inference method.

6.1 Control for Global Economic Activity

For commodity-exporting economies like Australia, global economic conditions can have a powerful impact on output. By construction, my narrative tax measure should not be correlated with other determinants of output, and the LP-IV should yield unbiased estimates of the effects of tax changes. As Céspedes and Velasco (2014) and Bjørnland and Thorsrud (2016) explicitly state that there is a positive correlation between global economic activity and tax revenue in commodity-exporting economies, it is crucial to test the robustness of my findings by including an indicator of global economic conditions.

To do so, I control for global economic activity by using the Global Economic Conditions Indicator provided by Baumeister et al. (2022) and estimate a seven-variable local projection. The global economic activity data also starts from 1983Q4. As before, I include three lags.

Figure 7 shows that controlling for global economic conditions has minimal impact on the estimated effects of tax changes. The maximum output effect of a tax decrease of one percent is around 0.73 percent, which is slightly smaller than the estimate from the baseline LP-IV. Moreover the Granger causality shows that there is no evidence of the measure of the narrative tax changes responding to the global economic activity: the p-value for the test of the null hypothesis that global economic activity does not enter the equation for the narrative tax changes is 0.4342.

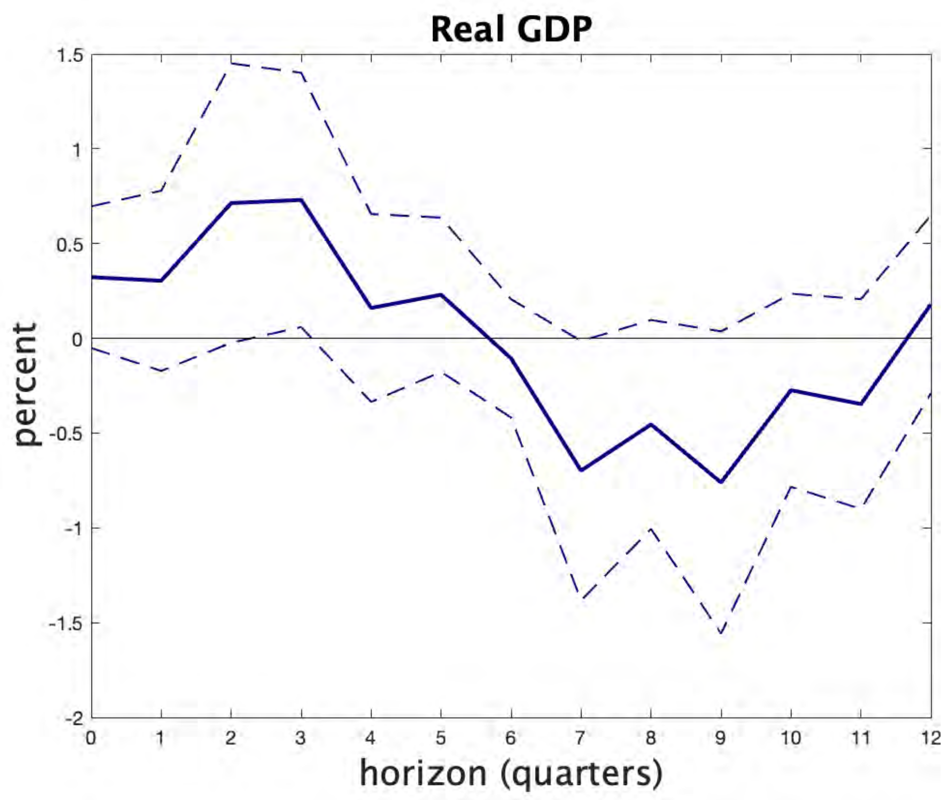


Figure 7: Response of real output per capita to a one percent decrease in tax revenue

Note: The impulse response function is estimated based on a seven-variable local projection (LP) $y_t = (T, G, Y, \pi, i, E, GEN)_t$ with 3 lags and an intercept. The estimated impulse response function is represented by the solid line, and the dashed line represents the 68% standard confidence interval based on Newey and West (1987) HAC-robust residual covariance matrix.

6.2 Controlling for Other Variables

While global economic activity is a prominent omitted variable, it is not the only factor that may influence output and correlate with changes in tax revenue. Other variables, which may coincidentally affect output in small samples, also warrant consideration. To address this, I extend the LP-IV model by sequentially incorporating a set of three additional variables. This expanded specification allows for the inclusion of three lags, providing a more comprehensive analysis.

The additional variables include the logarithm of working hours, which captures business cycle fluctuations and their interaction with fiscal policies; the trade balance as a percentage of GDP, which accounts for the influence of international trade; and a measure of oil supply shocks, as provided by Baumeister and Hamilton (2019).[15]

When controlling for working hours, the GDP response is positive, peaking at approximately 0.68% after three quarters. The maximum output effect of a one percent tax decrease is 0.81% and 0.84% when controlling for the trade balance and oil supply shocks, respectively. In all cases, the impact of tax changes on output remains positive and significant after three quarters.

These results underscore the robustness of the finding that tax cuts have positive and transitory effects on output. The fact that including controls for variables well-known to impact output has little effect on the estimated impact of tax changes provides important indirect evidence that our new measure of fiscal shocks is not correlated with other factors affecting output.

6.3 Weak Instrument Robust Inference

As highlighted by Olea et al. (2021) and Stock and Watson (2012), weak instruments can undermine the reliability of standard inference in local projections instrumental variables (LP-IV) models. When instruments are weak, estimates may be biased, and the associated confidence intervals can be misleading, potentially leading to incorrect conclusions regarding the effects of fiscal policy. Consequently, it is crucial to assess whether the weak instrument issue introduces bias into the baseline results. Addressing this concern is essential to ensure that the inferences drawn from the model accurately reflect the underlying economic relationships. To this end, I construct 68 percent Anderson-Rubin confidence intervals for the impulse response function, as recommended by Olea et al. (2021), to secure valid inference. The Anderson-Rubin approach is particularly valuable because it provides valid inference even in the presence of weak instruments, thereby serving as a critical robustness check.

Figure 8 presents the impulse response function alongside 68 percent standard confidence bands (depicted with blue dashed lines) and the Anderson-Rubin confidence intervals (depicted with red dashed lines). Notably, the standard confidence intervals are entirely bounded by the weak-instrument-robust confidence intervals. This alignment is highly informative, as it suggests that the conclusions derived from the standard LP-IV approach are consistent with those obtained using the more conservative Anderson-Rubin method. This consistency implies that the potential weak instrument problem does not bias the estimated output effect of tax changes, providing reassurance that the standard LP-IV estimates are not compromised by weak identification.

The fact that the standard confidence intervals are bounded within the Anderson-Rubin intervals is significant for several reasons. First, it indicates that the standard

[15] The oil supply shock series was converted from monthly to quarterly by summing the corresponding monthly observations.

inference procedures employed in the LP-IV model are reliable, as the results are corroborated by the more conservative Anderson-Rubin approach. This consistency also implies that the estimated impulse responses are robust to potential weaknesses in instrument strength, which is crucial for the credibility of the empirical findings. The robustness of these results is particularly important for policy implications, as it ensures that the estimated effects of tax changes on output are not due to weak instruments.

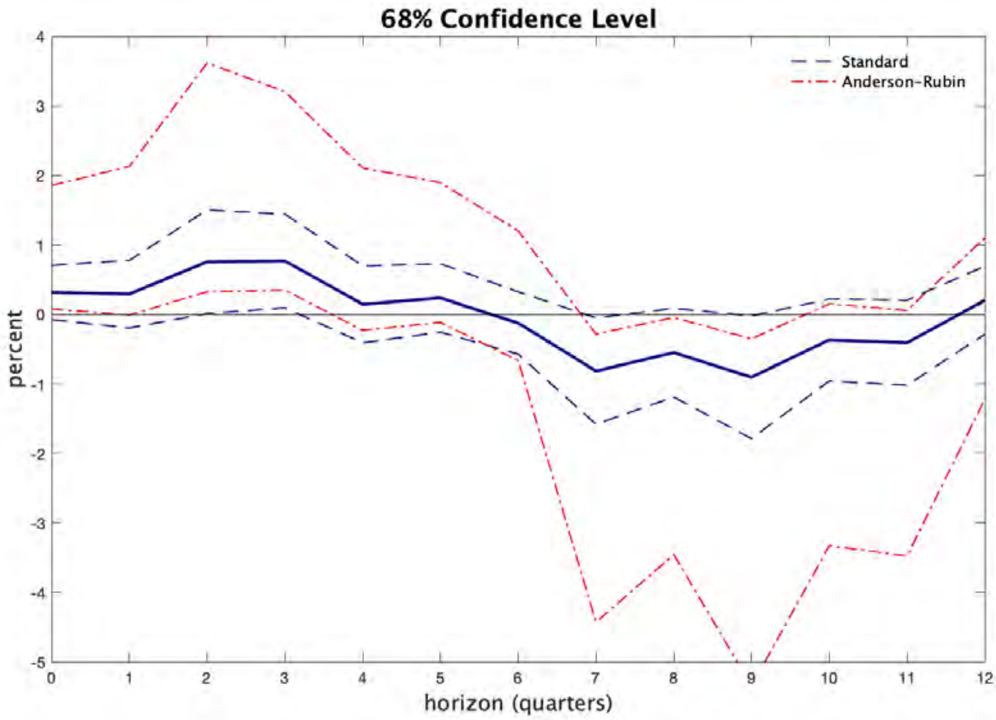


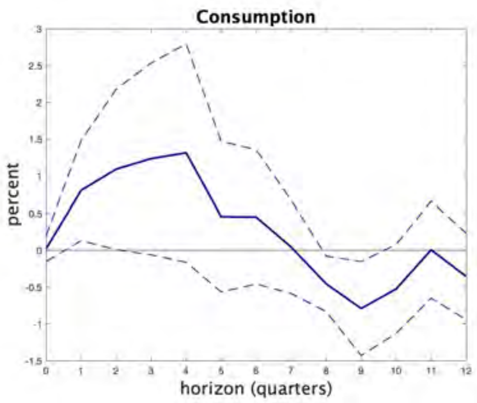
Figure 8: Response of real output per capita to a one percent decrease in tax revenue
Note: The impulse response function is estimated based on a six-variable local projection (LP) $y_t = (T, G, Y, \pi, i, E)_t$with 3 lags and an intercept. The estimated impulse response function is represented by the solid line, and the dashed line represents the 68% standard confidence interval based on Newey and West (1987) HAC-robust residual covariance matrix and the red dashed line represents the 68% Anderson-Rubin confidence interval.

In conclusion, the concordance between the standard and Anderson-Rubin confidence intervals provides compelling evidence that the estimated impulse responses are not significantly affected by the potential weak instrument problem. This robustness check enhances the overall reliability and validity of the results, reinforcing confidence in the empirical findings and their implications for understanding the effects of fiscal policy.

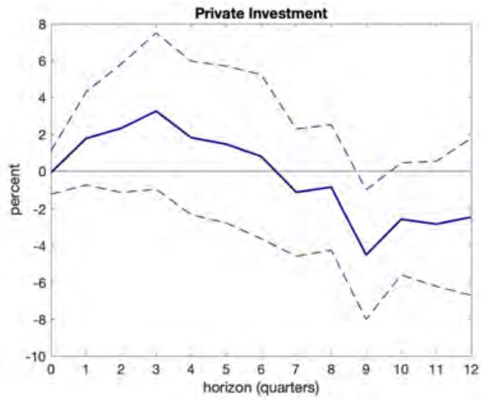
7 The Transmission Mechanism

Recall that I find that tax cuts lead to transitory and positive effects on output. An obvious question arises as to why tax policies have such profound effects. To investigate this, I examined various components of GDP, including consumption, investment, and working hours and trade balance.[16]

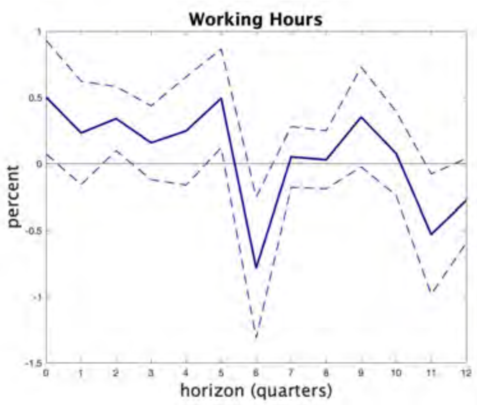
The specification follows the seven-variable local projection model, incorporating tax revenue, government spending, output, inflation, interest rate, and the logarithm of the GDP component. Consistent with previous specifications, I included three lags as control variables and focused on the sample period from 1983Q4 to 2018Q4.



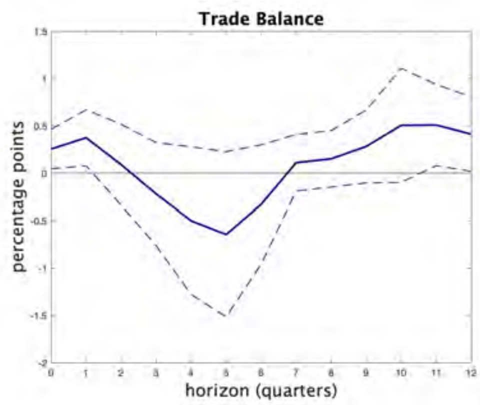
(a) Consumption



(b) Investment



(c) Working Hours



(d) Trade Balance

Note: The impulse response function is estimated based on a seven-variable local projection (LP) $y_t = (T, G, Y, \pi, i, E, \text{components of GDP})_t$ with 3 lags and an intercept. The estimated impulse response function is represented by the solid line, and the dashed line represents the 68% standard confidence interval based on Newey and West (1987) HAC-robust residual covariance matrix.

Figure 9: Responses of consumption, investment, trade balance and working hours to a one percent decrease in revenue.

Results are shown in Figure 9. Figure 9(a) and Figure 9(b) show the response of consumption and investment to an exogenous decrease in tax revenue. The key result is that tax cuts leads to a positive and significant increase in household consumption, but there is no real effects on investment. In response to a tax decrease of one percent,

[16] Consumption and Investment are sourced from the Australian National Accounts, measured in chain volume and seasonally adjusted by the original sources.

consumption increases by 0.8 percent after one quarter and the maximum increase in consumption is approximately 1.3 percent after one year.

Different from the findings in Romer and Romer (2010) and Cloyne (2013), I do not find that tax cuts leads to a substantial increase in investment. One explanation is that tax cuts in Australia do not improve the cash flow and overall economic condition, so the effects on investment remains insignificant for all forecast horizons. Another candidate explanation is that my exogenous tax changes barely include features that affect the monetary incentives for investment. [17]

The strong negative relationship between consumption and tax changes also helps explain the size and persistence of the overall estimated effect on output. Recall that I find a one percent decrease in tax revenue increases GDP by approximately 0.76% after three quarters. A significant portion of this effect appears to be driven by the procyclical behaviour of consumption.The negative correlation between consumption and tax changes further addresses the magnitude and persistence of the overall estimated impact on output. This result underscores that the procyclical behaviour of consumption plays a pivotal role in driving the observed effects on output, thereby highlighting the significance of household behavior in the transmission of tax policy shocks.

Figure 9(c) depicts the response of working hours to an exogenous tax cut. The data reveal an immediate and significant increase of 0.5 percent in working hours following the tax cut, with the effect reaching its maximum at 0.55 percent after five quarters. This response further reinforces the conclusion that the effects on output are primarily attributable to the behaviour of households.

Figure 9(d) illustrates the response of the trade balance to an exogenous tax cut. Initially, the trade balance improves by 0.37 percentage points of GDP, indicating short-run crowding-in of net exports due to the budget deficit in Australia. This improvement can be attributed to the positive wealth effect of personal income tax cuts, consistent with the predictions of recent open economy New Keynesian models.[18] However, after three quarters, the trade deficit worsens, accompanied by a pronounced depreciation of the real exchange rate. As Monacelli and Perotti (2010) explain, this outcome arises because the positive wealth effect from the tax cuts stimulates private consumption, necessitating a depreciation of the exchange rate under the international risk-sharing condition.

My model predicts a negative correlation between the real exchange rate and private consumption in response to a tax policy shock.[19] This may be driven by a bias

[17] Unanticipated exogenous actions include adjustments to investment incentives, such as the immediate expensing provisions introduced in the 2017-18 Budget, the modification of the research and development concession in the 1994-95 Budget, and the corporate tax rate reduction in the 1988-89 Budget, although the latter's magnitude was relatively small. Other changes, like the corporate tax cuts introduced in 2000 and 2016, are classified as anticipated due to the extended implementation lags associated with these measures.

[18] See Monacelli and Perotti (2010) and Gali and Monacelli (2005) for a detailed discussion.

[19] This result aligns with Monacelli and Perotti (2010), who observe a similar depreciation in the real

towards home consumption. When a tax cut occurs, the relative increase in domestic consumption compared to the rest of the world leads to a higher demand for domestically produced tradable goods over imports. Consequently, an appreciation in the terms of trade deteriorates the trade balance and depreciates the exchange rate in the short run.

8 Conclusion

This paper investigates the motivation and macroeconomic effects of tax changes following the floating of the Australian dollar. Despite the complexity of the Budget process, I find that most significant tax changes can be categorized into two main groups: those driven by relative economic conditions and those motivated by factors unrelated to output. The latter, which are more exogenous in nature, provide a suitable basis for estimating the effects of tax changes on output.

The results indicate that tax changes have substantial but transitory effects on output. The baseline specification suggests that a 1% decrease in tax revenue leads to a 0.76% increase in real GDP after three quarters, equivalent to a 2.7% increase following an exogenous tax decrease of one percent of GDP. Robustness checks yield elasticity estimates between taxes and output ranging from 0.64% to 0.84%.

Consistent with the findings of Cloyne (2013) and Romer and Romer (2010), these results should be interpreted as the average effect of a one percent decrease in tax revenue. It is important to note that different types of taxes may have varying impacts on output and other macroeconomic aggregates, presenting an interesting avenue for future research.

However, the precision of my estimates is limited by the weak instrument problem and the broad confidence intervals. When examining more specific questions, such as the response of output to corporate tax changes or the behaviour of the exchange rate following a tax change on tariffs, the estimated effects are essentially zero, with wide confidence intervals.

An important direction for extending this analysis is to explore the role of exchange rate regimes and monetary policy regimes in shaping the macroeconomic effects of tax changes (see, for example, Ramey and Zubairy (2018); Caggiano et al. (2015); Fazzari et al. (2021)). There are compelling reasons to expect that the output response to tax changes may depend on the institutional framework governing monetary policy. Investigating this aspect could provide valuable insights into both the transmission mechanisms of tax changes and the broader properties of the macroeconomy.

exchange rate following an increase in private consumption.

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Online Appendix to Discretionary Tax Changes and the Macroeconomic Activity: New Narrative Evidence from Australia

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October 10, 2024

Contents

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Appendix A Endogenous and All Legislated Tax Changes

This section describes the identification and properties of endogenous and all legislated tax changes in the quarterly narrative time series dataset.

A.1 Endogenous Tax Changes

Endogenous fiscal policies typically aim to counteract macroeconomic shocks that could alter the trajectory of long-run economic growth. For instance, a tax reduction introduced to stimulate the economy in anticipation of a recession is considered endogenous, as it seeks to mitigate non-policy influences on economic dynamics. Such tax amendments are thus classified under the "endogenous" category.

Three distinct sub-categories of endogenous tax changes are identified:

1. **Spending-driven Changes:** These adjustments are initiated primarily to fund specific government programs. An example is the increase in the Medicare levy surcharge in 2013, expressly aimed at financing the Disability Care Australia Fund.

2. **Deficit-driven Changes:** Motivated by concerns over short-term fiscal sustainability, these alterations often respond to deficit issues. The 2014 introduction of the Temporary Budget Repair Levy on high-income earners, a response to deficits stemming from the Global Financial Crisis, is a notable case.

3. **Counter-cyclical Measures:** Aimed at countering non-policy-driven economic fluctuations, these policies are tailored to stabilize standard economic growth patterns. The 2008 National Building and Jobs Plan, formulated to support employment and growth during the Global Financial Crisis, exemplifies this category.

A.2 Properties of Endogenous Tax Changes

Utilising the narrative analysis, this study identifies a total of 121 tax policy changes categorised as "endogenous" tax changes. These modifications are further detailed in Figure A.1. The mean value of these endogenous tax adjustments is computed to be approximately 0.04% of GDP, with an associated standard deviation of 0.22%. Predominantly, these fiscal modifications manifest as increases in taxation.

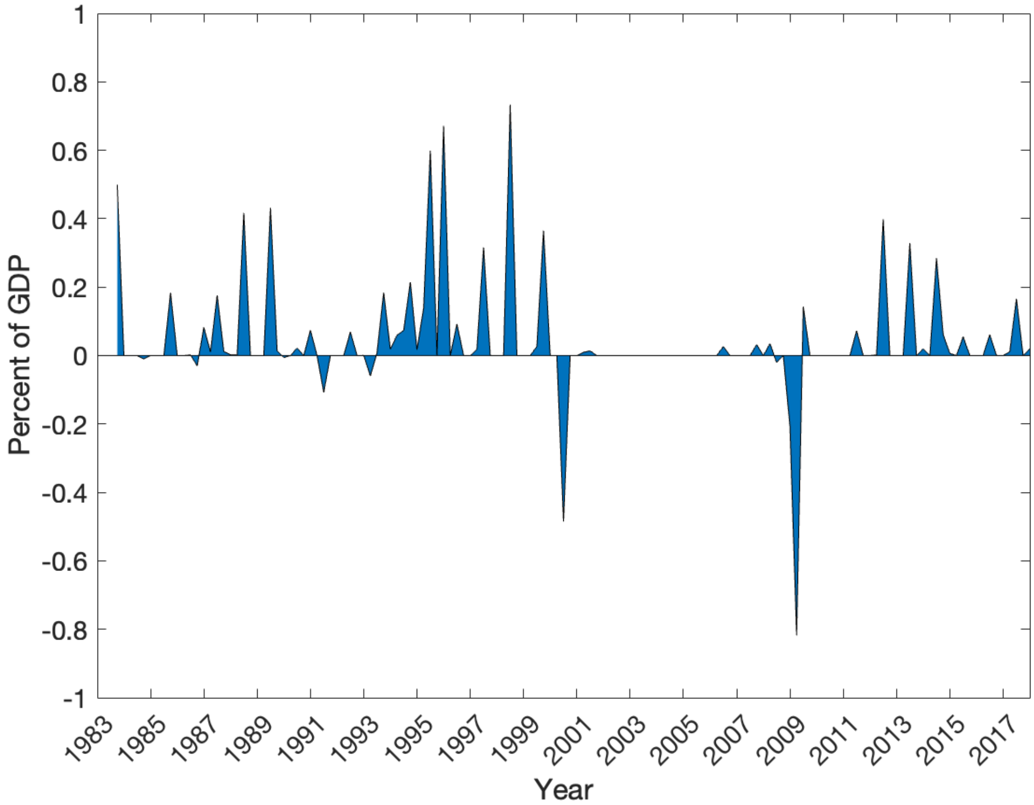


Figure A.1: Narrative Measure of Endogenous Tax Changes in Australia from 1983 to 2018

In analysing the motivations behind endogenous tax policies, Figure A.2 details the nature of these changes. It is observed that all spending-driven tax increases in Australia are aimed at specific objectives. A prominent example is the consistent rise in the Medicare levy since 1983, primarily to fund crucial health programs like Medicare and the National Disability Insurance Scheme. This intent is evident in legislation such as the Income Tax Laws Amendment (Medicare Levy) Act of 1983 and the Medicare Levy Amendment (Disability Care Australia) Bill of 2013. Furthermore, these tax increases have also been deployed for specific objectives, including financing reconstruction efforts following natural disasters and covering the administrative costs of regulatory bodies.

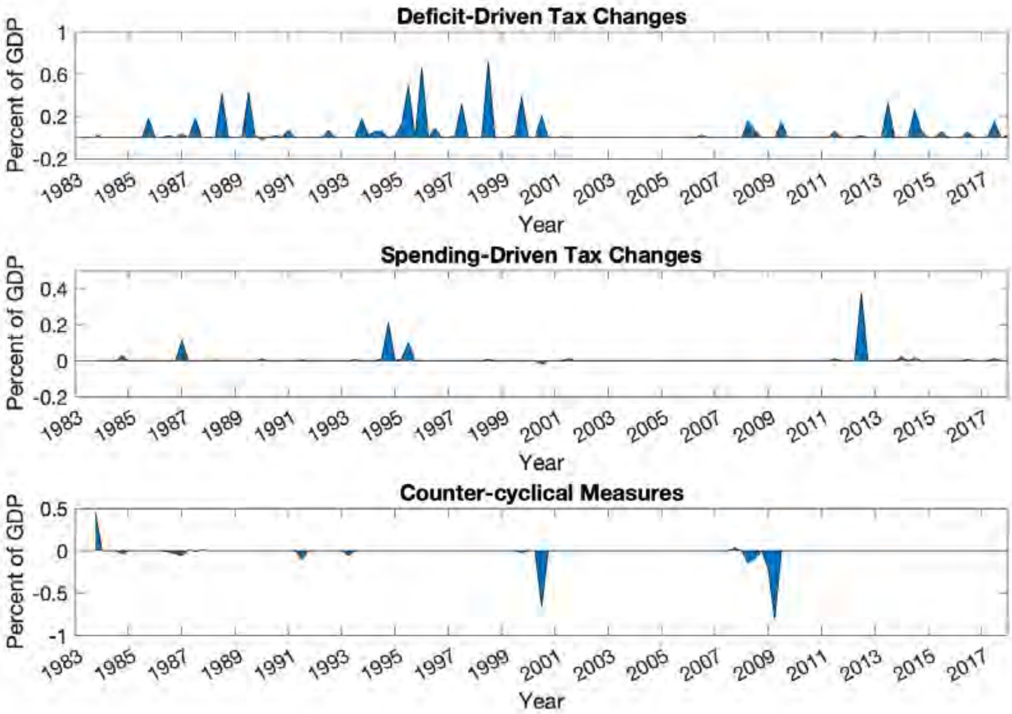


Figure A.2: Decomposition of Endogenous Tax Changes in Australia from 1983 to 2018

Taxes targeting reducing budget deficits have significantly contributed to medium-term deficit reduction. The fiscal consolidation undertaken by the Hawke government following the recessions of the 1990s serves as a primary illustration. This included a 15% tax on superannuation contributions and the removal of the 5/3 depreciation allowance. Likewise, the Morrison government employed Bank Levies and Budget Repair Levies to address the budget deficit following the Global Financial Crisis.

The period from 2000 to 2007 marks a heyday for counter-cyclical tax policy adjustments. A notable exception to this trend was the reduction in personal and corporate income taxes during the Global Financial Crisis, driven by lower expectations of future economic growth.

A significant deviation in Australian endogenous tax policy was observed during the five-year period from 2003 to 2007, marked by an absence of adjustments as indicated in budget documents. This lack of tax modifications is primarily attributed to the improved fiscal balance in Australia, notably supported by windfalls from commodity prices. This scenario highlights the direct influence of external economic factors, such as commodity price fluctuations, on fiscal policy strategies. It illustrates how global economic trends can temporarily influence fiscal policy decisions in a commodity-exporting economy.

A.3 Comparison with All Legislated Tax Changes

Figure A.3 displays the narrative estimates corresponding to the full spectrum of legislated tax policy changes. The mean value of these legislative changes registers at -0.05% of GDP, and is accompanied by a standard deviation of 0.444%. Notably, the time series encapsulating all legislated tax amendments exhibits a remarkable congruence with the exogenous series. The most significant points of divergence between these two series are attributable to the fiscal consolidation initiatives promulgated in the early 1990s and the institution of Medicare Levy during the 1970s and 1980s.[1]

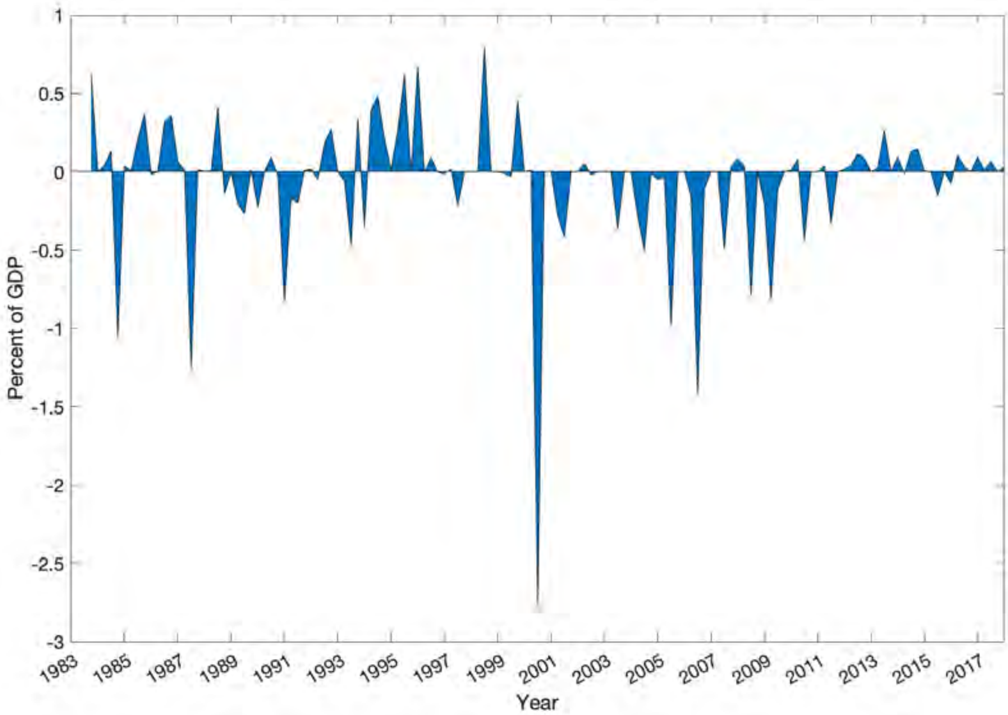


Figure A.3: Narrative Measure of All Tax Changes in Australia from 1983 to 2018

[1]For details on the fiscal consolidation plans, see Alesina et al. (2015).

Appendix B Statistical Tests

This section presents the results of the unit root and cointegration tests and discusses the methodology of Toda and Yamamoto (1995) related to the Granger causality tests described in section 3.5.

To ensure the Granger causality test yields valid F-statistics, it is essential to first test for unit roots and cointegration within the VAR framework. Stock and Watson (1989) emphasize that the presence of unit roots can distort the asymptotic distribution of the F-statistics, leading to non-standard inference. Additionally, Toda and Yamamoto (1995) highlight the necessity of accommodating integrated processes to obtain valid statistical inferences in VAR models. Thus, addressing both unit roots and cointegration is crucial to avoid the pitfalls associated with non-standard F-statistics and ensure robust causality testing.

Unit Root Test

To begin with, the KPSS test was employed to assess whether the time series for (ln) tax revenue (T), (ln) government spending (G), (ln) output (Y), interest rate (i), inflation (π), and the (ln) real exchange rate (E) exhibit unit root characteristics, under the assumption that each series is trend-stationary. The analysis incorporated a specification of a time trend and four lags to accommodate potential serial correlations. The results of the KPSS tests are presented in Table A.1.

Variable Name	Test Statistic	p-value
Tax	0.4048	0.010
Spending	0.4307	0.010
Output	0.4961	0.010
Inflation	0.1881	0.021
Interest Rate	0.3160	0.010
Exchange Rate	0.3816	0.010

Table A.1: KPSS test results for variables used in the VAR

The KPSS test results show that for all six variables, the null hypothesis that the series is trend-stationary is rejected. Hence, these variables are all unit root processes.

Information Criterion

I follow the conventional literature by using AIC, HIC, SQC to determine the lag length of the LP-IV. Table 1 shows the that the AIC and HQC criterion favours a lag order $p = 3$, whereas SIC chooses $p = 1$ for the full sample period.

p	SIC(p)	HQC(p)	AIC(p)
0	-37.7781	-37.8537	-37.9054
1	-52.1554	-52.6833	-53.0453
2	-52.0846	-53.0668	-53.7392
3	-51.8111	-53.2466	-54.2293
4	-50.9729	-52.8617	-54.1547

Table A.2: AIC, SIC and HQC test for a six variable VAR

Cointegration Test

Following the unit root test, it is important to determine whether a long-term relationship exists among the variables. To this end, I conducted a cointegration test with two lags, focusing on a six-variable system $y_t = (T, G, Y, \pi, i, E)_t$. The proposed null hypothesis was that the cointegration rank among the time series is less than or equal to r. The outcomes of both the Trace and Max Eigenvalue tests are presented in Table B.

$\mathbb{H}_0$	LR^{trace}	Critical Value	$LR^{\max}$	Critical Value
$r = 0$	160.4712	92.7173	67.9481	42.2279
$r = 1$	92.5232	67.6430	51.1677	35.7124
$r = 2$	41.3555	46.5743	22.3078	29.0632

Table A.3: Trace and Max-Eigenvalue Tests for Cointegration Rank at the 1% Significance Level

Both Trace and Max-Eigenvalue tests establish the existence of at least two common stochastic trends across tax revenue, government spending, inflation, interest rate, and real exchange rate since the floating of the Australian dollar.

Granger Causality Test

Having established the presence of unit roots and cointegration, I proceed to conduct a Granger causality test using a seven-variable vector autoregression (VAR) model. The model is specified as:

$$Y_t = \begin{pmatrix} \eta_t \\ T_t \\ G_t \\ \pi_t \\ i_t \\ E_t \end{pmatrix},$$

where η_t represents narrative tax changes, T_t denotes tax revenue, G_t represents government spending, π_t signifies the inflation rate, i_t indicates the interest rate, and E_t stands for the exchange rate. The model includes a constant and three lags of each variable.

To address the presence of integrated processes and cointegration, I follow Toda and Yamamoto (1995) by estimating an augmented VAR model with $k + d_{\max}$ lags, where $k = 3$ is the optimal lag length determined by information criteria, and $d_{\max}$ is the maximum order of integration of the series. [2]

Assuming that Y_t are at most I(2) as per Johansen (1995), $d_{\max}$ is set to 2. Thus, the resulting VAR model includes 5 lags.

The VAR model is expressed as follows:

$$Y_t = \alpha + \sum_{i=1}^{k+d_{\max}} A_i Y_{t-i} + \epsilon_t,$$

where α is a vector of constants, Φ_i are the coefficient matrices, and ϵ_t is a vector of error terms.

The presence of cointegration among the variables in Y_t is considered in this framework. Cointegration implies that despite the individual non-stationarity of the series, there exists a long-term equilibrium relationship among them. The Johansen cointegration test is used to determine the number of cointegrating vectors.

The null hypothesis for the Granger causality test is formally stated as:

$$H_0 : A_{T,i} = A_{G,i} = A_{\pi,i} = A_{i,i} = A_{E,i} = 0 \text{ for } i = 1, \ldots, k,$$

which implies that the coefficients of the lagged values of the macroeconomic variables $T_t, G_t, \pi_t, i_t,$ and E_t are jointly zero in the equation for η_t. Under the null hypothesis, the past information of the macroeconomic variables $T_t, G_t, \pi_t, i_t,$ and E_t cannot be used to predict the series η_t.

Appendix C Dynamic Estimates from SVAR-IV

Following the seminal work by Plagborg-Møller and Wolf (2021), this section presents estimates of the output effects resulting from tax changes, derived from structural vector autoregressive (SVAR) models. Specifically, I identify the causal effects of exogenous tax policy interventions by employing a narrative-based measure of unanticipated exogenous tax changes as an external instrument for tax policy shocks, maintaining consistency with the model specifications used in the baseline LP-IV . This approach allows for a robust

[2] I follow the conventional literature by using AIC, HIC, SQC to determine the lag length. The AIC and HQC criterion favours a lag order $p = 3$, whereas SIC chooses $p = 1$ for the sample period.

identification of the impact of tax policy shocks on output.

SVAR-IV Methodology

I define A_{ij} is the ijth element of matrix $A, \text{vec}(A)$ is the vectorization of A, and vech(A) denotes the lower triangular factor of $A.e_j$ is j th column of identity matrix I_n.

Consider the following reduced-form VAR model:

$$Y_t = \sum_{j=1}^{p} A_j Y_{t-j} + u_t \tag{4}$$

where A_j, $j = 1, ..., p$ are $\text{n} \times \text{n}$ coefficient matrices, Y_t is an $\text{n} \times 1$ vector of observable and u_t is an $\text{n} * 1$ vector of reduced-form VAR innovations. The constant and trend are omitted for notional convenience.

A key assumption made for an SVAR model is that the forecast errors in equation (4) are a linear combination of a vector of structural exogenous shocks ε_t, that is

$$u_t = \Theta_0 \varepsilon_t \tag{5}$$

where Θ_0 is $\text{n} * \text{n}$ non-singular matrix. The structural shocks are assumed to be serially and mutually uncorrelated, with

$$\mathbf{E}\left(\varepsilon_t\right) = 0 \text{ and } \mathbf{E}\left[\varepsilon_t \varepsilon_t'\right] = D = \text{diag}\left(\sigma_1^2, \ldots, \sigma_n^2\right) \tag{6}$$

The identification strategy follows exactly Mertens and Ravn (2014) and relies on the tax proxy z_t that satisfies the assumption:

Assumption 1. *(External Instrument):*

$$\mathbf{E}\left[z_t \varepsilon_t^T\right] = \alpha \neq 0. \tag{A.1}$$

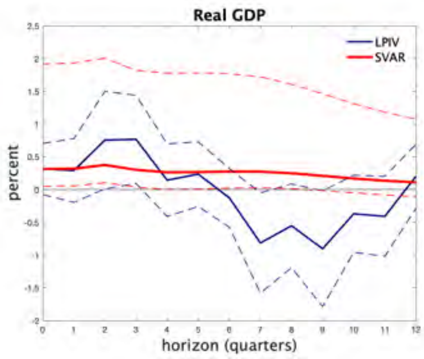
$$\mathbf{E}\left[z_t \varepsilon_t^o\right] = 0, \tag{A.2}$$

(A.1) implies that the unanticipated tax changes z_t is correlated with other type of tax shocks ε_t^T, and (A.2) states that the shock z_t should be orthogonal to other type of shocks ε_t^o in the VAR. When these conditions are hold, the dynamic response to exogenous tax changes are identified with the scale normalisation $\Theta_{0,11} = 1$ following Stock and Watson (2018). The instrument can be used to recover the structural tax shock ε_t^T from reduced form innovations.

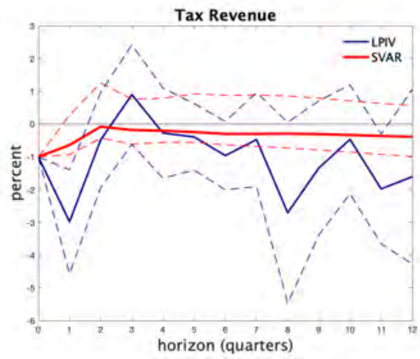
The strength of the instrument is assessed using the Wald statistic $\xi_1 = \frac{T\hat{\Gamma}_{T,1}^2}{\hat{W}_{\Gamma,11}}$, as detailed in Olea et al. (2021), where T denotes the sample size, $\hat{\Gamma}_{T,1}$ represents the sample covariance between the tax instrument and the reduced-form VAR residuals, and $\hat{W}_{\Gamma,11}$ is the corresponding element of the covariance matrix of $\hat{\Gamma}$. The Wald statistic for the tax instrument in Australia, since the floating of the Australian dollar, is 1.5473. Based on the Wald statistic, I conduct inference in the SVAR-IV model using the Anderson-Rubin confidence intervals as suggested by Olea et al. (2021) with a Newey and West (1987) HAC-robust residual covariance matrix.

Figure A.4 shows the response of key variables to a one percent decrease in tax revenue from the SVAR-IV regression with a 68% Anderson-Rubin confidence interval. For comparison, the figure also depicts the LP-IV estimate as the blue line with 68% confidence intervals. As the controls in W_t coincide with the SVAR-IV right-hand side variables, the impact response in the LP-IV and SVAR-IV models is numerically identical at the zero horizon. Beyond this horizon, the results diverge. However, the main finding from Figure A.4 is that the SVAR-IV estimates are not statistically different from those in the LP-IV for most horizons. The SVAR-IV estimates also confirm the finding that tax cuts have significant and transitory effects on output after three quarters, with the maximum effect on output being approximately 0.37 percent after three quarters. Both tax revenue and government spending responses are statistically significant over the same horizon. Although the spending responses are statistically similar to those obtained in the LP-IV, the decrease in tax revenue is notably smaller when using SVAR. Measured by the impulse response function, the SVAR-IV approach yields a tax decrease of -0.63 percent after one quarter, whereas the LP-IV indicates a decrease in tax revenue of three percent.

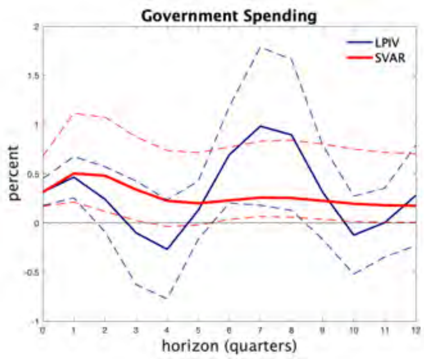
The SVAR-IV estimates also affirm the finding of significant real effects on inflation. The increase in inflation is statistically significant and persists for two quarters before converging back to the trend, while the interest rate responses remain statistically significant using both approaches. However, the SVAR-IV approach indicates that tax cuts lead to persistent and significant appreciation in the exchange rate after five quarters.



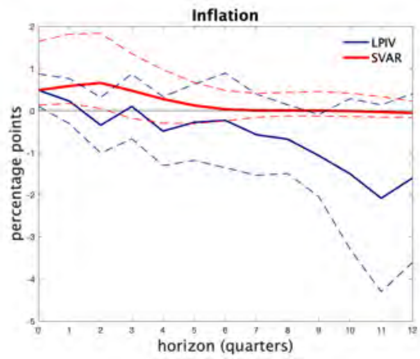
(a) Output



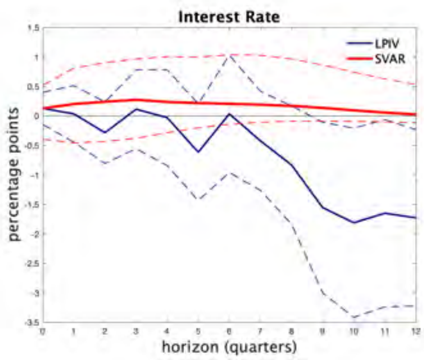
(b) Tax



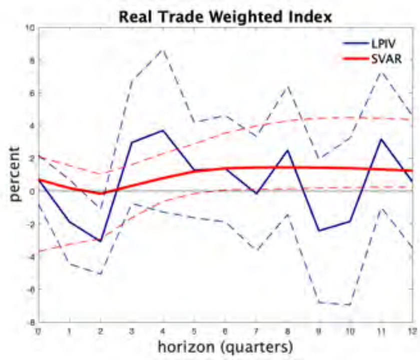
(c) Spending



(d) Inflation



(e) Interest Rate

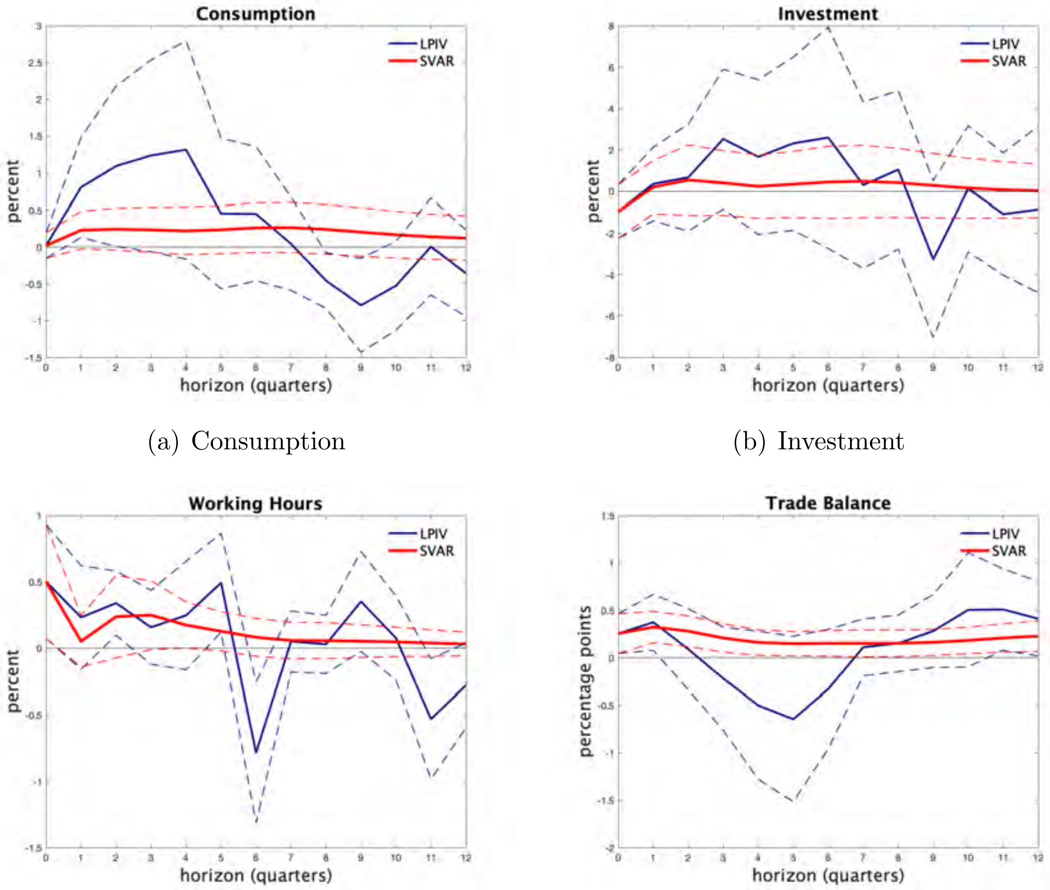


(f) Real Exchange Rate

Figure A.4: Responses of key economic variables to a one percent decrease in tax revenue. Note: The solid red line shows the impulse response function estimated using the SVAR-IV model, as specified in equations (4) and (5), with three lags and a constant. The analysis covers the period from 1983:Q4 to 2018:Q4. For comparison, the solid blue line replicates the LP-IV estimates from Figure 4. The dashed blue lines indicate the 68% confidence intervals for the LP-IV estimates, computed using HAC-robust standard errors as per Newey and West (1987). The dashed red lines represent the 68% Anderson-Rubin confidence intervals for the SVAR-IV estimates proposed by Olea et al. (2021), with a HAC-robust residual covariance matrix following Newey and West (1987).

Figure A.5 compares the aggregate responses from Figure 9 to the estimates from the SVAR-IV model with 68 percent Anderson-Rubin confidence intervals. The main finding from Figure A.5 is that the SVAR-IV estimates are not statistically different from those of the LP-IV for most horizons, particularly for the trade balance and private investment.

Specifically, the response of the trade balance is consistent with the LP-IV estimates and is statistically significant over the same horizon.



(a) Consumption

(b) Investment

(c) Working Hours

(d) Trade Balance

Note: The impulse response function is estimated based on a seven-variable local projection (LP) $y_t = (T, G, Y, \pi, i, E, \text{components of GDP})_t$ with 3 lags and an intercept. The estimated impulse response function is represented by the solid line, and the dashed line represents the 68% standard confidence interval based on Newey and West (1987) HAC-robust residual covariance matrix.

Figure A.5: Aggregate responses to a one percent decrease in tax revenue.

However, a notable difference arises in the response of consumption to tax cuts. Although the consumption response in the SVAR-IV estimates falls within the 68 percent confidence band of the LP-IV estimates, its magnitude is much smaller. The SVAR-IV estimates indicate that a one percent decrease in taxes leads to an increase in consumption of approximately 0.22 percent after two quarters (0.8 percent in the LP-IV model), which lacks statistical significance. One possible explanation for the different response in consumption can be attributed to the response of tax revenue shown in Figure A.4. Recall that there is a larger decrease in tax revenue in the LP-IV estimates, which provides a greater income effect to households.

Appendix D Dynamic Estimates from Cholesky Decomposition

I also applied the internal instrument approach by ordering the unanticipated exogenous tax changes first in the VAR, using the same specification described in Section 4. The results, presented in Figures 3, corroborate our initial findings. Figure A6 shows the estimated response of output and key variables to a one percent decrease in taxes. The estimated effects of tax cuts on macroeconomic variables remain significant and display similar patterns over time. In particular, the responses of tax revenue, government spending, and output are consistent with the estimates from the LP-IV model shown in Figure 6 on page 15. The internal instrument approach indicates that a one percent decrease in tax revenue leads to an increase in GDP of approximately 0.88 percent after two quarters. This further confirms the robustness of my main finding.

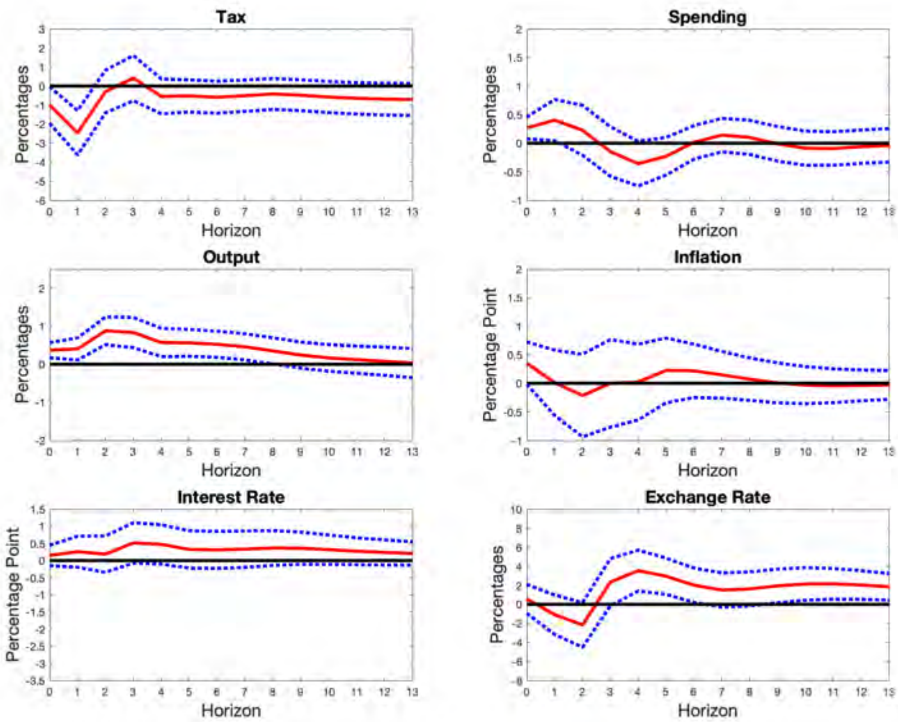
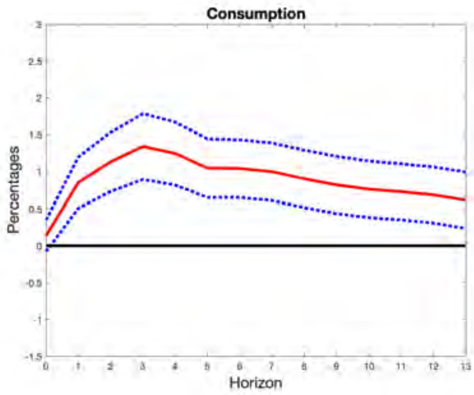
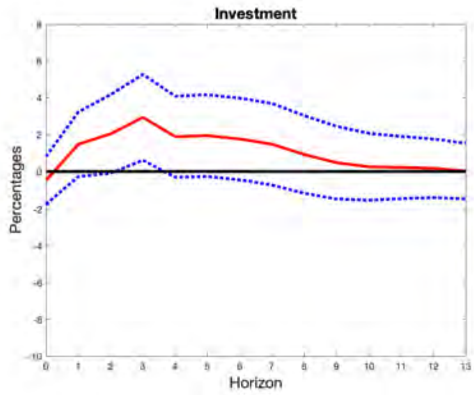


Figure A.6: Aggregate responses to a one percent decrease in tax revenue.
Note: The impulse response function is estimated based on a seven-variable VAR $y_t = (\eta_t, T, G, Y, \pi, i, E)^t$ with three lags and an intercept. The narrative instrument is ordered first in the VAR. The estimated impulse response function is represented by the solid line, and the dashed lines represent the 68% delta method confidence intervals based on the HAC-robust residual covariance matrix by Newey and West (1987).

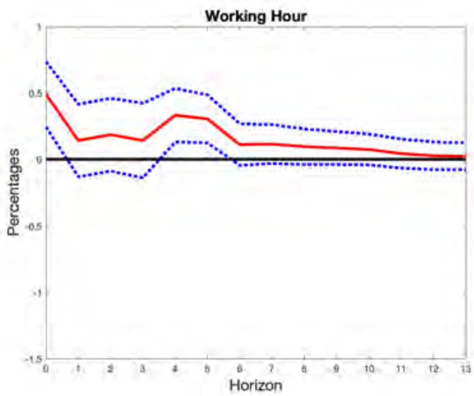
Figure A7 shows the estimated response of consumption, investment, working hours and trade balance to a one percent decrease in taxes. The estimated effects of tax cuts on macroeconomic variables remain significant and display similar patterns to results shown in Figure 9 over time. Notably, estimates from the instrument approach shows that investment increases significantly by 2.93 percent after three quarters.



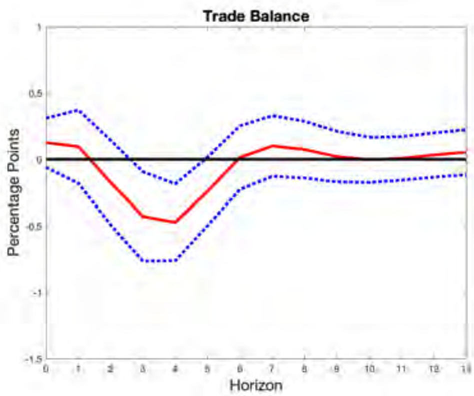
(a) Consumption



(b) Investment



(c) Working Hours



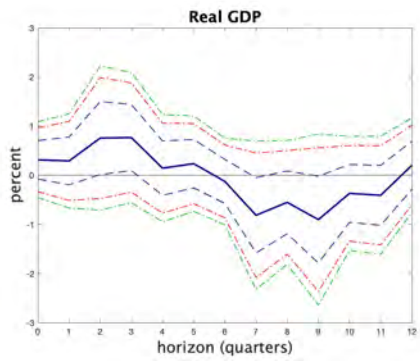
(d) Trade Balance

Figure A.7: Aggregate responses to a one percent decrease in revenue.

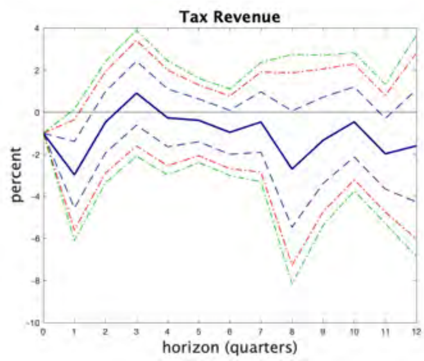
Note: The impulse response function is estimated based on a eight-variable VAR $y_t = (\eta_t, T, G, Y, \pi, i, E, \text{components of GDP})_t$ with three lags and an intercept. The narrative instrument is ordered first in the VAR. The estimated impulse response function is represented by the solid line, and the dashed lines represent the 68% delta method confidence intervals based on the HAC-robust residual covariance matrix by Newey and West (1987).

Appendix E IRFs with 90% and 95% Confidence Intervals

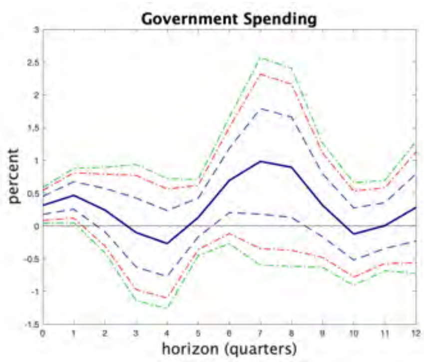
I have reported the impulse responses and included 90 percent, and 95 percent confidence intervals in this Appendix. This addition allows for a more comprehensive assessment of both statistical and economic significance, taking into account the sample size and variability of the estimates.



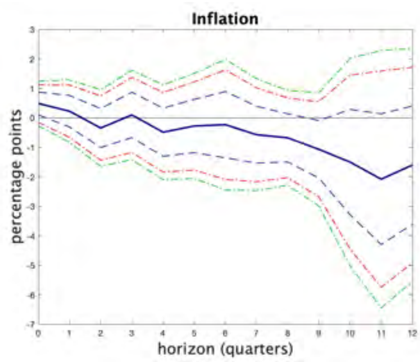
(a) Output



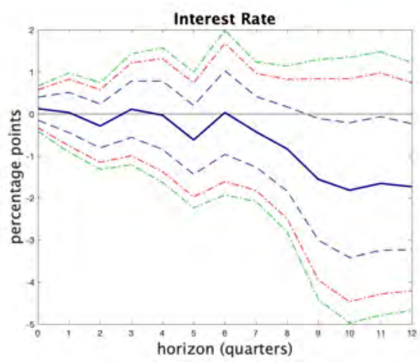
(b) Tax



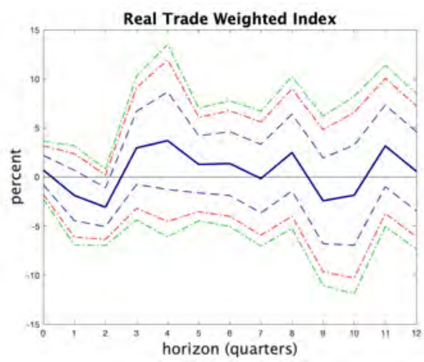
(c) Spending



(d) Inflation

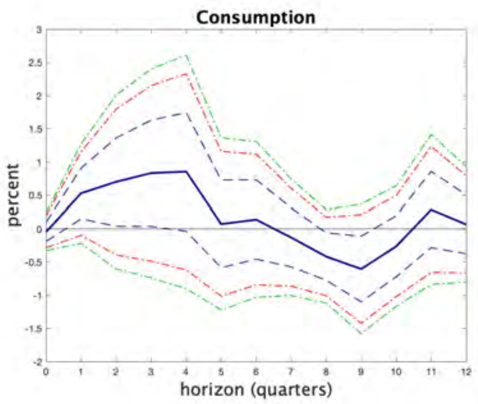


(e) Interest Rate

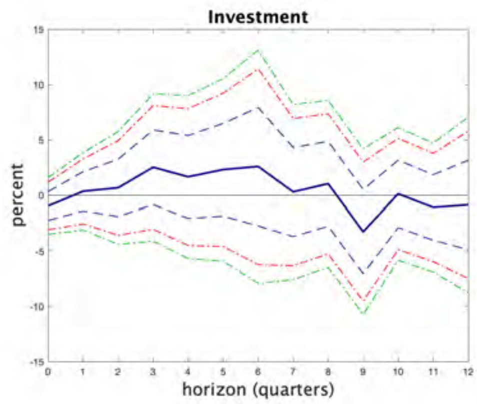


(f) Real Exchange Rate

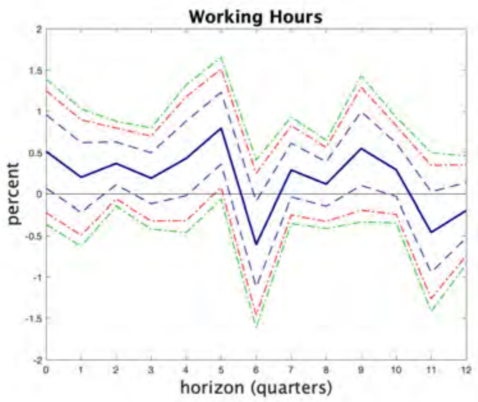
Figure A.8: Responses of key economic variables to a one percent decrease in tax revenue.
Note: The impulse response function is estimated based on a six-variable local projection (LP) $y_t = (T, G, Y, \pi, i, E)_t$ with 3 lags and an intercept. The estimated impulse response function is represented by the solid line, and the blue dashed line represents the 68% standard confidence interval based on a Newey and West (1987) HAC-robust residual covariance matrix. The red dashed line represents the 90% standard confidence interval based and the green dashed line represents the 95% standard confidence interval based on the Newey and West (1987) HAC-robust residual covariance matrix.



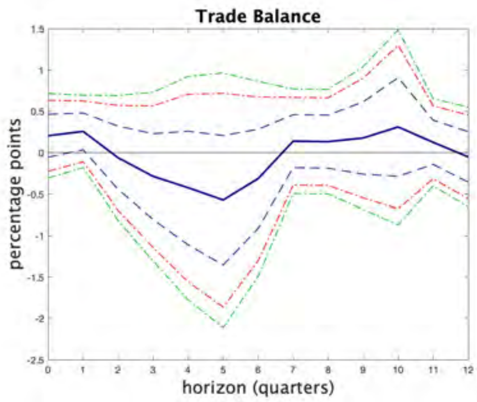
(a) Consumption



(b) Investment



(c) Working Hours



(d) Trade Balance

Note: The impulse response function is estimated based on a seven-variable local projection (LP) $y_t = (T, G, Y, \pi, i, E, \text{components of GDP})_t$ with 3 lags and an intercept. The estimated impulse response function is represented by the solid line, and the dashed line represents the 68% standard confidence interval based on the Newey and West (1987) HAC-robust residual covariance matrix. The red dashed line represents the 90% standard confidence interval and the green dashed line represents the 95% standard confidence interval based on the Newey and West (1987) HAC-robust residual covariance matrix.

Figure A.9: Responses of consumption, investment, trade balance and working hours to a one percent decrease in tax revenue.

Appendix F Data Source

The paper contains seventeen quarterly time series data for Australia covering 1983Q4 to the 2018Q4. These are:

1. Nominal GDP: Seasonally adjusted gross domestic product in current price (ABS Catalogue 5206.001).

2. Real tax revenue per capita(T): Seasonally adjusted total taxes in current price [3] divided by GDP Implicit Price Deflator in Australia,[4] then divided by the size of population.[5] This series enters in log form.

3. Real government spending per capita(G): Sum of seasonally adjusted public gross fixed capital formation and government final consumption expenditure, then divided by the size of population. This series enters in log form.

4. Real GDP per capita(Y): Seasonally adjusted Gross domestic product in chain volume measures (ABS Catalogue 5206.001),then divided by the size of population.. This series enters in log form.

5. Three-month Treasury Bill Rates (i): The monthly series is converted into quarterly frequency by arithmetic averaging.[6]

6. Inflation (π): is measured as the percentage change in the GDP Implicit Price Deflator in Australia compared to the same period one year earlier.

7. Real exchange rate(E), which is the Australian dollar trade-weighted exchange rate index adjusted for relative consumer price levels (see Ellis (2001) for details)[7]. This series enters in log form.

8. Real Consumption per capita (C): Seasonally adjusted household final consumption expenditure (ABS Catalogue 5206.0) divided by the size of population. This series enters in log form.

[3]Data for tax revenue, government spending and output are downloaded from Australia National Accounts available at https://www.abs.gov.au/statistics/economy/national-accounts/australian-national-accounts-national-income-expenditure-and-product/latest-release

[4]The series is reported in the FRED database available at https://fred.stlouisfed.org/series/AUSGDPDEFQISMEI

[5]The size of population for Australia is recorded in the FRED database available at https://fred.stlouisfed.org/series/POPTOTAUA647NWDB

[6]The 90-day Treasury Bill Rates is are downloaded from RBA statistical stables $F1.1$ available at https://www.rba.gov.au/statistics/tables/

[7]Data for real exchange rate and commodity price measured in US dollars are downloaded from RBA statistical stables $I2$ and $F15$ respectively, available at https://www.rba.gov.au/statistics/tables/

9. Real private investment per capita (I) : Seasonally adjusted private gross fixed capital formation (ABS Catalogue 5206.0) divided by the size of population. This series enters in log form.

10. Real Export per capita (EX): Seasonally adjusted export of goods and service (ABS Catalogue 5206.0) divided by the size of population. This series enters in log form.

11. Real Import per capita (IM): Seasonally adjusted export of goods and service (ABS Catalogue 5206.0) divided by the size of population. This series enters in log form.

12. Real public investment per capita: Seasonally adjusted public gross fixed capital formation (ABS Catalogue 5206.0) divided by the size of population. This series enters in log form.

13. Real commodity price (CP): This is the RBA Index of commodity prices measured in US dollars, divided by the GDP Implicit Price Deflator in the United States[8]. The monthly series is converted to a quarterly frequency by arithmetic averaging. This series is expressed in logarithmic form.

14. Trade Balance: Seasonally adjusted balance on international trade in goods (ABS Catalogue 5206.0). This series is expressed as a percentage of nominal GDP.

15. Global Economic Activity Index: Quarterly Global Economic Conditions (GECON) Indicator provided by Baumeister et al. (2022)

16. Oil Supply Shock: Monthly Oil Supply Shock provided by Baumeister and Hamilton (2019)

17. Working hours: Seasonally adjusted average weekly working hours (ABS Catalogue 1364.0.15.003 Modellers' Database).

[8]The GDP Implicit Price Deflator in the United States is downloaded from the FRED database, available at https://fred.stlouisfed.org/series/USAGDPDEFQISMEI

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