The Australian Real-Time Fiscal Database: An Overview and an Illustration of its Use in Analysing Planned and Realised Fiscal Policies*

by

Kevin Lee†, James Morley††, Kalvinder Shields††† and Madeleine Sui-Lay Tan

Abstract

This paper describes a fiscal database for Australia including measures of government spending, revenue, deficits, debt and various sub-aggregates as initially published and subsequently revised. The data vintages are collated from various sources and provide a comprehensive description of the Australian fiscal environment as experienced in real-time. Methods are described which exploit the richness of the real-time datasets and they are illustrated through an analysis of the extent to which stated fiscal plans are realised in practice and through the estimation of fiscal multipliers which draw a distinction between policy responses and policy initiatives. We find predictable differences between plans and actual fiscal policy, consistent with a desire of the government to appear more prudent than in reality, and a larger multiplier for policy initiatives than implementation errors.

Keywords: Real-time, Australian Database, Revisions, Fiscal Policy, Government Spending, Government Revenues

JEL Classification: C32, D84, E32

*†University of Nottingham, UK; ††University of Sydney, Australia, †††University of Melbourne, Australia. Version dated October 2018. Financial support from the ARC (Discovery Grant DP140103029) is gratefully acknowledged. Corresponding author: Kalvinder Shields, Department of Economics, University of Melbourne, Victoria 3010, Australia (k.shields@unimelb.edu.au).

1 Introduction

It is now widely recognised that empirical policy analysis can be seriously misleading if it is conducted using the most recent vintage of available data as opposed to the data that was available at the time decisions were actually made. Revisions in data mean that the measurements of historical outcomes published today may differ substantially from the data on which plans were made and so 'real-time' datasets, containing all the vintages of data that were available in the past, are required to fully understand the plans. A substantial literature has now grown, developing the methods required for the analysis of real-time datasets and their use in prescribing and evaluating policy.[1] However, whilst there have been many studies of the use of real time data in monetary policy reaction functions, there have only been a handful of studies in the area of fiscal policy: there are no papers on fiscal policy in the extensive survey by Croushore (2011) on papers using real time datasets, for example. This has become an important omission as the recent global economic downturn and increasing levels of public debt have directed attention towards the dynamic responsiveness of fiscal policy over the economic cycle. This has raised questions, *inter alia*, on how planned policy adjusts in the face of business cycle conditions, the ways in which expenditure plans are constrained by solvency and other long-horizon considerations, and the ways in which actual expenditure relates to planned expenditure at different points in the business cycle.

One reason why fiscal policy analysis is typically undertaken using only ex post data is due to the lack of datasets that include and maintain a comprehensive set of fiscal variables over a reasonable time span and frequency appropriate for time series analysis. The real time 'ALFRED' database at the Federal Reserve Bank of St Louis contains the most comprehensive set of fiscal variables with a reasonable time dimension and frequency but, of course, covers the US only. The Reserve Bank of Philadelphia's real time database, the OECD's real time database, the ECB-EABCN's EU area-wide real time database, and the recently available Australian Real Time Macroeconomic Database all include some

[1] See, for example, Croushore and Stark (2001) and Croushore and Evans (2006), the October 2009 special issue of the *Journal of Business and Economic Statistics* and the literature on monetary policy decisions (e.g. Orphanides and van Norden, 2002, and Garratt et. al. 2009, among others).

fiscal variables although not in as much detail as that available in ALFRED.[2] For this reason, most empirical studies attempting to look at fiscal policy using real time data have focused on the use of real time measures of output only (see Forni and Momigliano, 2005, for instance) but important results for policy are found in those cases where real-time fiscal datasets are used. For example, important insights have been obtained in assessing the pro- or counter-cyclicality of discretionary fiscal policy on the basis of studies which have constructed their own real-time databases for select fiscal indicators; see, for example, Golinelli and Momigliano (2006), Bernouth et al. (2008), Holm-Hadulla et al. (2012), and Cimadomo (2012).[3]

The ready availability of a real-time fiscal dataset is potentially very useful therefore and this paper describes how we constructed such a database for Australia. The vintages of data are collated from various sources and accommodate multiple definitional changes, providing a comprehensive description of the fiscal environment as experienced by Australian policy-makers at the time decisions are made. The database is available through the University of Melbourne along with a Data Manual describing the sources and definitions of the series in more detail than is possible in this paper; see Lee, Morley, Shields and Tan (2015). The description of the database provided in Section 2 below gives an overview of the structure and content of the database and illustrates some of the difficulties in drawing inferences on fiscal policy on the basis of data that is subject to revision. Section 3 focuses on the gap between planned and realised policies as measured in real time and their use in measuring the fiscal multiplier, providing an illustration of the insights provided by the data and its implications for understanding the role of fiscal policy in the macroeconomy. Section 4 offers some concluding comments.

[2]The named databases are available at http://alfred.stlouisfed.org, http://www.philadelphiafed.org/research-and-data/real-time-centre/realtime-data, http://stats.oecd.org/mei/, http://www.eabcn.org/data/rtdb/index.htm and http://www.economics.unimelb.edu.au/RTAustralianMacroDatabase, respectively.

[3]To give a sense of what this data collection involves, we note that Golinelli and Momigliano (2006) compile a real-time database for government primary balance from the OECD's bi-annual Economic Outlook; Holm-Hadulla et al. (2012) construct a real-time database of government expenditure for the EU economies from annual updates of the EU's Stability and Convergence programmes; and so on.

2 An Overview of the Australian Real-Time Fiscal Database

2.1 Structure and Content

The Australian Real-Time Fiscal Database includes a total of twelve variables relating to budget outcomes over time plus nine variables describing the evolving state of the government's debt/wealth. The data is collected primarily from the annual Commonwealth Budget which consists of several documents known as Budget Papers, and real-time fiscal data is mainly found in Budget Paper No. 1. The data vintages each match the corresponding budget publication and are available on an annual basis therefore. The time span of the variables in the data varies, running from Australian Federation in 1901 to the present day for some variables while others are much shorter (e.g. those variables defined following a change in the accounting system in 1998 are only available from the 1999 vintage onwards). The specifics of data availability for each series are provided in Table A1 of the Appendix. Detailed information on the series are provided in the Data Manual.

The variables relating to budget outcomes are set out below:

Table 1: Summary of Budget Data

Outlays		**Revenues**	
Spending on Goods and Services	E_t	Income Tax (or Direct Taxation)	τ_t^Y
(of which Health	E_t^H		
Education	E_t^{ED}	Expenditure Tax* (or Indirect Taxation)	τ_t^{EX}
Defence)	E_t^D		
Spending on Capital Goods	I_t	Other Revenue	τ_t^O
Transfers	W_t		
(of which Welfare	W_t^{SS}		
Pensions)	W_t^{PEN}		
Debt Interest Paid	F_t		
Total Outlays	$G_t = E_t + I_t + W_t + F_t$	Total Revenues	$\tau_t = \tau_t^Y + \tau_t^{EX} +$

The evolution of these series over 1947-2014 is described in Figure 1a - 1d. Figure 1a shows the time series of E_t, I_t, W_t and G_t measured in nominal terms and as first published after one year (i.e. ${}_{t+1}G_t$, for example, showing the first-release of the realised observations). Figure 1b shows the same series but expressed relative to (first-release) nominal GDP. Figures 1c - 1d show the time series of τ_t^Y, τ_t^{EX} and τ_t expressed in nominal terms and relative to GDP respectively, again based on first-release data.[4] On the expenditure side, the plots show the total $ outlay rising rapidly, but relatively smoothly, after the inflationary period of the seventies. The components (transfers, expenditure on goods and services, and capital spend) also rise reasonably smoothly, although there are genuine shifts in this composition over time and also evidence of breaks due to measurement conventions following the move to an accruals accounting system in 1998-99 as discussed below. Perhaps surprisingly, the plots of Figure 1b show a high degree of constancy in the expenditures relative to output over the period, with the 'Great Ratio' of total outlay to output taking an average value of 26% and lying in the range 24-28% for most of the sample. There is a little more variability in the component parts, but these are reasonably constant too, suggesting the presence of strong political and social pressures to maintain and control the size of government relative to the economy as a whole. On the revenue side, Figure 1c illustrates that Income (or Direct) Taxation makes up the largest portion of Total Receipts, contributing around two-thirds of the total tax take over the sample and with this contribution rising a little over time. Figure 1d again shows the striking constancy of total outlays when expressed relative to total output, suggesting further political and social equilibrating pressures to maintain a broadly balanced budget.

The database also includes series describing the evolving debt/wealth position of the Federal Government. These include:

- Debt, measured in three alternative ways: Net Debt, D_t; Gross Debt, D_t^G; Public Debt, D_t^P;

[4]Note that expenditure taxes $\left(\tau_t^{EX}\right)$ are raised through taxes such as GST and excise duties. This is not to be confused with tax expenditures which refer to the revenue foregone from concessions and exemptions.

- Interest payments, measured in three alternative ways: Net Interest Outlays F_t; Commonwealth Interest Liability F_t^C; and Total Interest Liabilities, F_t^L; and

- Wealth, again measured by three complementary variables: Net Worth V_t; Net Operating Balance V_t^O; and Net Financial Worth V_t^F.

The existence of the various different measures of similar concepts reflects the complexity of government accounting standards and practices. For the debt series, 'gross debt' and 'public debt' both refer to the stock of debt held by the government but the former refers to debt held by both Commonwealth and State governments while the latter measures the stock of debt held by the Commonwealth government only. 'Net debt' differs from these two measures in that it is a flow variable and indicates the net position of debt held by the Commonwealth general government. It is a measure that is used as a standard to compare debt positions across different countries. The interest payment variables are similarly related: 'commonwealth interest liability' refers to the interest owing on the stock of public debt whereas 'total interest liability' refers to the interest due on the stock of debt held by both the Commonwealth and States. The 'net worth' and 'net financial worth' variables reflect the wealth position of the Commonwealth government, the latter focusing on that part of net worth held in the form of financial assets and liabilities. 'Net operating balance' refers to the viability of the government position, showing the difference between total revenue and total expenditure in the operating statement. More complete details on the coverage of the data is provided in Table A1 of the Appendix and in the Database Manual.

We also provide data on three important constructed variables:

- The Public Sector Financial Surplus (or 'Cash Balance'), $S_t = \tau_t - G_t$, which shows the excess of receipts over total outlays on all its activities;

- The Primary Surplus $S_t^P = \tau_t - (G_t - F_t)$ showing the financial surplus of the government's revenues over its spending but abstracting from interest payments on debt; and

- The Stock-Flow Residual $\nu_t = D_t - (D_{t-1} - S_t)$ which aims to reconcile the budget balance sheet outcomes with the evolving debt position.

The first two of these are the focus of much policy discussion reflecting the government's spending decisions relative to its ability to finance these within the year. The stock-flow residual ν_t is equally important in understanding government's financial constraints over the longer term. Specifically, we note that, if changes in liabilities are the result of "above-the-line" budgetary operations only, then debt in t would equal $(1 + r_t)D_{t-1} + S_t^P = D_{t-1} + S_t$. In practice, however, debt liabilities are influenced by a whole range of additional factors, including privatisation proceeds, off-budget operations, gains and losses on (below-the-line) financial operations; valuation changes due to exchange rate movements and central bank deficit financing, such as purchases of government debt (seigniorage). These values can be very large at times and can therefore, have a considerable impact on government's plans over the longer term.

The variables in the database are presented in a common format. There is an Excel workbook for each of the variables containing a summary of the details of the data (source, definition, etc.) on the first sheet and the raw data in a second sheet. If we denote a variable Z at time $t - s$ by Z_{t-s} and the measure of this magnitude as published in time t by ${}_tZ_{t-s}$, then the time-t vintage of data typically includes the observations ${}_tZ_1$, ${}_tZ_2$,..., ${}_tZ_t$. The observation ${}_tZ_t$ shows the value of the variable that the government *plans* to spend in year t as published in year t. The observation ${}_tZ_{t-1}$ shows the first-release of the measure of Z_{t-1}, taking into account that there is usually a one year delay in the release of data, and the observations ${}_tZ_{t-s}$ $s = 2, ...$ shows the time t measures of past values accommodating any revisions. The raw data presented in the second sheet is in the form of "data triangles" where each column of data relates to a data vintage so that the successive columns grow longer each period to give a triangular shape to the dataset. The rows show the published measure for the same observation at different vintages so the revisions to a particular observation can be tracked by looking horizontally across the spreadsheet.

2.2 Unrealised Plans, Definitional Changes and Revisions in Australian Fiscal Data

The various vintages of data show how the measurement of a variable might change over time. These are often best expressed in proportional terms and, in what follows, we use upper case letters to denote the value of a variable and lower case to denote its logarithm; i.e. $z_t = \log(Z_t)$. Our real time dataset includes measures of the planned values of variables (e.g. ${}_tg_t$) as well as the subsequent measures of the actual value of the variable (${}_{t+s}g_t$, $s = 1, 2, ...$). Comparison with the first-release data ${}_{t+1}g_t$ shows the extent to which the stated plans were or were not realised, but changes in the measures of the actual outcomes can also occur, either through 'revisions', based on the arrival of new information on the series, or through a change in the way a concept is conceived; i.e. involving a 'definitional change'.

Definitional changes produce once-and-for-all shifts in a series, they typically occur only periodically and their timing and nature are well-documented. This means that their effect can usually be readily taken into account by a simple scaling of the pre-change data by some additive or multiplicative factor. Fiscal data is particularly vulnerable to definitional changes because public spending can have multiple purposes (for example, spending on health or education involves an element of investment as well as immediate consumption). Further definitional changes can arise because the role and scope of the State changes over time, because responsibility can switch across different agencies (State versus Commonwealth for example), and because there is often a political dimension to fiscal decisions. Definitional changes that have had particularly wide-ranging impacts on fiscal data include:

- The *1910 and 1966 currency changes*: from the British pound to the Australian pound in 1910, and to the Australian dollar in 1966;

- The *1974 accounting framework change*: when the 1974-75 Budget switched from an accounting classification to a functional classification, aligning expenditures with function rather than portfolios due to an appropriations system within the legal framework, as previously;

- The *1994 accounting year change*: when the Budget release day was moved from the first quarter of the fiscal year to mid-May;

- The *1996/97 definitional changes:* when net advances are excluded from the reported measure of outlays;

- The *1998/99 legal reform:* the Charter of Budget Honesty Act 1998 introduced a mid-year update to the budget, a move from a cash accounting to an accrual accounting system and, in 1999, the reporting of new accrual Government Financial Statistics (GFS) variables in the budget[5]; and

- The *2008 reporting standards reform*: the introduction of a new accounting system (AASB 1049) harmonised the ABS GFS and AAS 31 reporting standards used previously. Major differences between these systems relate to accounting for asset write-downs (treated as operating expenses under AAS 31 but negative equity revaluations pursuant to the GFS framework), other gains and losses on assets (not included as revenues or expenses under GFS), bad and doubtful debts (not recognised under the GFS framework) and the acquisition of defence weapons platforms (capitalised and depreciated under AAS 31 but expensed at the time of acquisition pursuant to the GFS framework)[6]. Where the GFS differs from accounting standards, a reconciliation and explanation is required under the new AASB 1049 system.

It is well understood that definitional changes of this sort will effect measurement. But data "revisions" can also be substantial because, for example, revenue collection, auditing of accounts and collating information on spending across government departments are all time consuming processes. Published data often supplements raw source data with

[5]The differences between cash versus accrual accounting terms are noted. However, for comparability across time and for ease of narrative, cash and accrual terminologies are used interchangeably. For example, outlays with expenses/expenditures, and receipts with revenues, wherein the cash balance is defined as the simple difference between receipts/revenues and outlays/expenditures.

[6]See full explanation at ABS or summary of differences here: http://dro.deakin.edu.au/eserv/DU:30077129/wines-australiangovernment-post-2015.pdf

'modelled' data that anticipates the arrival of additional and/or more reliable data and so revisions in measures of realised fiscal magnitudes can continue for some time.

Figures 2a and 2b illustrate some of the effects of data definitions and revisions in the Australian fiscal data. Figure 2a shows the measure of the surplus in 1948/49 as reported first in 1949/50 and then subsequently in publications dated through to 2015/16; i.e. ${}_tS^P_{1948/49}$, $t = 1949/50,..., 2015/16$.[7] The measure refers to the surplus in a given year but it experiences a number of clear and distinct changes, sometimes more than fifty years later, to reflect the definitional changes flagged above. Indeed, while it is not easy to see from this Figure, the measure of the 1948/49 surplus switches from negative to positive in 1996, highlighting the insights that can be lost in working only with final-vintage datasets. The Figure also shows measures of the primary balance in five later years - in 1958/59, 1968/69, 1978/79, 1988/89 and 1998/99 - again as first-released and then in subsequent publications. These measures also undergo considerable shifts to reflect the definitional changes mentioned above. Of course, the plots also capture the (more modest) effects of data revisions which typically show as adjustments in the measures over a small number of years after the first-release.[8]

The measures in Figure 2a are in nominal terms and so the size of the surpluses, and definitional changes involved, are larger at later dates (and particularly after the seventies) simply reflecting rising prices. Figure 2b considers the real surpluses therefore, expressing the series as a ratio to the first-release measures of nominal output. The break points associated with definitional changes are, of course still apparent and, in comparison with Figure 2a, there is additional time-variation in the series introduced through updates on the output data. It is interesting to see that, having scaled by output level, the sizes of the definitional shifts now appear larger for earlier dates than for later ones, suggesting that it is less disruptive to update observations from the near past than the distant past when definitional changes are introduced. These measurement issues potentially introduce systematic features into the data therefore which are difficult to overcome but

[7]The 1948/49 statistic was not reported in the 1962/63, 1963/64 or 1964/65 publications and so the statistics plotted for these dates are assumed unchanged from those published in 1961/62.

[8]As it turns out, revisions in the primary balance statistics are driven primarily by revisions in data on receipts, with government spending figures relatively stable after first release.

which cannot be ignored in empirical work. One approach to the problem is to conduct the analysis on transformed data (e.g. working with differences or even differences in differences), but our recommendation is to deal with the effects of definitional changes on a case-by-case basis *prior to any analysis*. This has the advantage that adjustments to the data can take into account any known information relevant to the change while leaving the interpretation of the series and any relationships between series unaltered.[9]

3 Using the Real-Time Fiscal Data: Fiscal Plans and Outcomes

The importance of the use of real-time data is best conveyed by looking at a specific issue and in this section we make use of the real-time budget data to examine (i) whether the government's fiscal plans are realised and, to the extent that they are not, whether there are any systematic patterns in the gap between plans and outcomes; and (ii) whether the information on plans and outcomes provides insights on the usefulness of fiscal policy in demand management.

These are important questions. If the government announces in year t that it plans to spend ${}_tg_t$ but it turns out that spending is ${}_{t+1}g_t \neq {}_tg_t$ and that this gap is systematically related to information that was known at t, then the government is either deceitful or inept. The same applies for government announcements and realisations of revenues, ${}_t\tau_t$ and for measures of the overall financial surplus, ${}_tS_t$, although the nature of the deceit/ineptitude differs between these. A finding that government spending and overall spending turns out to be systematically higher than announced, say, means the government is simply spending beyond its stated intentions; if spending is systematically higher than announced but the overall deficit turns out as planned, the government has expanded the size of government beyond its announcements but is balancing the books as it does so.

The second question relates to the size of the fiscal multiplier. This has attracted considerable attention over recent years as many governments have turned to fiscal policies following the global financial crisis and given the constraints imposed on monetary policy by the zero lower bound on interest rates. Several recent studies have employed VAR

[9]See the discussion in Garratt et al (2008) and Clements and Galvao (2013) on the pros and cons of using levels or differences in real-time measures of output when estimating the output gap.

models to isolate government spending shocks and to trace out their dynamic effects on output to estimate the size of the multiplier[10]. However, these rely on potentially controversial identifying assumptions and are undermined by the 'fiscal foresight' problem. This problem arises because it is difficult to quantify the output effects of agents' reactions to spending plans that have been announced but not yet implemented if the investigator uses output and spending data alone. Lee, Morley, Ong and Shields (2018) [LMOS] address these difficulties in a VAR analysis of the US multiplier using data on spending plans alongside data on actual spending. This work finds that the multiplier effect of spending undertaken in reaction to adverse circumstances ('policy responses') is approximately half the size of the multiplier effect of planned spending ('policy initiatives'). This idea has important implications for macroeconomic policy and can only be examined empirically employing real-time fiscal data of the sort we have collated here for Australia.

3.1 The Modelling Framework

Both of the questions raised can be examined through a time series analysis of the different measures of spending and receipts that are available in our database. For example, focusing on the spending data first, an analysis of the interplay between spending plans and outcomes can be conducted in a simple VAR framework, as exemplified by:

$$\begin{aligned} \mathbf{G}_t &= \begin{pmatrix} {}_tg_{t-2} - {}_{t-1}g_{t-2} \\ {}_tg_{t-1} - {}_{t-1}g_{t-1} \\ {}_tg_t - {}_tg_{t-1} \end{pmatrix} = \mathbf{A}_0 + \mathbf{A}_1 \begin{pmatrix} {}_{t-1}g_{t-3} - {}_{t-2}g_{t-3} \\ {}_{t-1}g_{t-2} - {}_{t-2}g_{t-2} \\ {}_{t-1}g_{t-1} - {}_{t-1}g_{t-2} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{pmatrix} \qquad (3.1) \\ &= \mathbf{A}_0 + \mathbf{A}_1 \mathbf{G}_{t-1} + \boldsymbol{\varepsilon}_t \end{aligned}$$

Here, ${}_tg_{t-2} - {}_{t-1}g_{t-2}$ shows the revision in the measures of spending in time $t-2$ as revealed between the publications in $t-1$ and t. The coefficients in the first rows of the 3×1 vector $\mathbf{A}_0$ and the 3×3 parameter matrix $\mathbf{A}_1$ will be non-zero if there are systematic elements in these revisions (reflecting deficiencies in the measurement process) and ε_{1t} represents the unsystematic "measurement error". The variable ${}_tg_{t-1} - {}_{t-1}g_{t-1}$ shows the gap between

[10]Ramey (2016, 2018) provide useful overviews of the literature and summaries of estimated multipliers.

the actual government spending outcome in time $t-1$ and the original planned spending level. The extent to which this over- or under-predicts spending is captured by the second element of $\mathbf{A}_0$ and on the known information captured by the elements in the second row of $\mathbf{A}_1$. These parameters provide an indication of the deceitfulness or ineptitude of government then, while ε_{2t} represents the unsystematic "implementation error". The third row of $\mathbf{G}_t$ contain the planned growth in spending in time t, ${}_tg_t - {}_tg_{t-1}$, as announced in the time-t budget and the ε_{3t} represents news arriving in time-t on planned spending in t. If revisions and unplanned spending are stationary (whether systematic or not) and if actual government spending is driven by a stochastic trend,[11] then the three series in $\mathbf{G}_t$ - which can all be written as sums of revisions, actual growth and unplanned spending - are all stationary and the VAR model of (3.1) is appropriate.

An examination of the hypothesis that the government's announced plans for spending are realised on average - taking measurement issues into account and with no systematic element in unplanned spending - involves testing whether ${}_tg_{t-1} = {}_{t-1}g_{t-1}$ in (3.1); i.e. given by a test of

$$H_0 : a_{21} = a_{22} = a_{23} = 0 \text{ in } \mathbf{A}_1. \tag{3.2}$$

so that unplanned spending depends only on the random "implementation error". An equivalent test can also be conducted to test whether there are systematic elements in the revisions between the first- and second-release of the policy measures, testing

$$H_0 : a_{11} = a_{12} = a_{13} = 0 \text{ in } \mathbf{A}_1. \tag{3.3}$$

Similar exercises can be conducted for the three measures of receipts and for the three measures of the financial surplus to judge whether government's fiscal plans are realised, whether there are any systematic patterns in the gap between plans and outcomes, and how these gaps, if they exist, effect the public finances.

The information on plans and outcomes in our database can also be used to investigate the effectiveness of fiscal policy in demand management through estimation of the fiscal

[11] This will be the case if, for example, output is driven by a stochastic productivity shock and a constant Great Ratio is maintained between spending and output.

spending multiplier, as in LMOS. The modelling again focuses on the time series characterisation of the spending measures in (3.1) but now considers the interplay between spending, receipts and output in the extended model:

$$\begin{pmatrix} {}_tg_{t-2} - {}_{t-1}g_{t-2} \\ {}_tg_{t-1} - {}_{t-1}g_{t-1} \\ {}_t\tau_{t-1} - {}_{t-1}\tau_{t-2} \\ {}_ty_{t-1} - {}_{t-1}y_{t-2} \\ {}_tg_t - {}_tg_{t-1} \end{pmatrix} = \mathbf{A}_0 + \mathbf{A}_1 \begin{pmatrix} {}_{t-1}g_{t-3} - {}_{t-2}g_{t-3} \\ {}_{t-1}g_{t-2} - {}_{t-2}g_{t-2} \\ {}_{t-1}\tau_{t-2} - {}_{t-2}\tau_{t-3} \\ {}_{t-1}y_{t-2} - {}_{t-2}y_{t-3} \\ {}_{t-1}g_{t-1} - {}_{t-1}g_{t-2} \end{pmatrix} + \boldsymbol{\alpha} \begin{pmatrix} {}_{t-1}g_{t-2} - {}_{t-1}y_{t-2} \\ {}_{t-1}\tau_{t-2} - {}_{t-1}y_{t-2} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \end{pmatrix}. \tag{3.4}$$

The measures ${}_t\tau_{t-1}$ and ${}_ty_{t-1}$ are, respectively, the (logarithms of the) actual level of government receipts received and the actual level of output observed during year $t-1$ as reported in the fiscal budget published in year t. The model of (3.1) is extended in (3.4) to include growth in receipts and growth in outputs as part of the VAR plus two additional equilibrating terms: ${}_{t-1}g_{t-2} - {}_{t-1}y_{t-2}$ capturing any pressures to return to a constant 'Great Ratio' between spending and output; and ${}_{t-1}\tau_{t-2} - {}_{t-1}y_{t-2}$ which, if there are pressures to establish a constant Great Ratio, implies that equilibrating pressures are also experienced to establish a balanced budget.

Estimates of the fiscal spending multiplier are obtained by examining the effects of a shock to government spending, expressing the accumulated addition to output as a ratio to the accumulated increase in spending. These effects can be obtained from an impulse response analysis of the estimated model in (3.4). LMOS highlight two issues that complicate this analysis but which provide new insights when we employ data on planned spending alongside the actual outcomes. The first issue relates to defining the appropriate impulse in the analysis and can be explained by noting that the model in

(3.4) can be rewritten as the following VAR in levels:

$$\mathbf{Z}_t = \begin{pmatrix} {}_tg_{t-2} \\ {}_tg_{t-1} \\ {}_t\tau_{t-1} \\ {}_ty_{t-1} \\ {}_tg_t \end{pmatrix} = \mathbf{B}_0 + \mathbf{B}_1 \begin{pmatrix} {}_{t-1}g_{t-3} \\ {}_{t-1}g_{t-2} \\ {}_{t-1}\tau_{t-2} \\ {}_{t-1}y_{t-2} \\ {}_{t-1}g_{t-1} \end{pmatrix} + \mathbf{B}_2 \begin{pmatrix} {}_{t-2}g_{t-4} \\ {}_{t-2}g_{t-3} \\ {}_{t-2}\tau_{t-3} \\ {}_{t-2}y_{t-3} \\ {}_{t-2}g_{t-2} \end{pmatrix} + \begin{pmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \\ e_{4t} \\ e_{5t} \end{pmatrix}$$

$$= \mathbf{B}_0 + \mathbf{B}_1\mathbf{Z}_{t-1} + \mathbf{B}_2\mathbf{Z}_{t-2} + \mathbf{e}_t$$

where the $\mathbf{B}$'s are transformations of the parameters in $\mathbf{A}$, restricted to retain the property of (3.1) that the three series move together one-for-one in the long run, and where $\mathbf{e}_t = (\varepsilon_{1t}, \varepsilon_{2t}, \varepsilon_{3t}, \varepsilon_{4t}, \varepsilon_{2t} + \varepsilon_{5t})'$ - i.e. an accumulation of the implementation shock and news on time-t plans for the spending variable ${}_tg_t$. A Generalised Impulse Response analysis can be used to trace out the effects of a typical time-t shock to $\mathbf{Z}_t$ which, of course, includes the responses of ${}_tg_{t-1}$ and ${}_ty_{t-1}$. But if our interest is on the effect of time-t news on spending and output from time-t onwards, we are really interested in the effects of a shock to the one-step-ahead forecast $\widehat{\mathbf{Z}}_t = E[\mathbf{Z}_{t+1} \mid \Omega_t]$ based on information at time t, Ω_t , which has the representation

$$\widehat{\mathbf{Z}}_t = (\mathbf{B}_0 + \mathbf{B}_0\mathbf{B}_1) + (\mathbf{B}_1\mathbf{B}_1 + \mathbf{B}_2)\,\mathbf{Z}_{t-1} + (\mathbf{B}_1\mathbf{B}_2)\,\mathbf{Z}_{t-2} + \widetilde{\mathbf{e}}_t \tag{3.5}$$

where now $\widetilde{\mathbf{e}}_t = \mathbf{B}_1\mathbf{e}_t$ is the news arriving at time-t on spending that will actually take place in t. An impulse response analysis based on (3.5) is likely to be quite different to an impulse response analysis of (3.5). For example, if ${}_tg_t$ has good forecasting power for $E[{}_{t+1}g_t \mid \Omega_t]$, then strong weight will be given - via $\mathbf{B}_1$ - to news on planned spending e_{5t} in the impulse response analysis of a shock to $E[{}_{t+1}g_t \mid \Omega_t]$ using (3.5). This news is likely to receive less weight in the impulse response analysis of a shock to ${}_tg_{t-1}$ through (3.5) which is more backward-looking and likely to be dominated by the e_{2t}.

The second issue raised in LMOS further explores this idea through a decomposition of the $\mathbf{e}_t$ into five orthogonal shocks v_{1t},...,v_{5t} based on a number of identifying restrictions. In the context of (3.5), it might be assumed that the policy variables ${}_tg_{t-2}$, ${}_tg_{t-1}$, ${}_t\tau_{t-1}$, and ${}_tg_t$ are determined in that order, and that the system is driven by four transitory shocks v_{1t},...,v_{4t} and a single stochastic trend v_{5t} driving the variables in the long-run. The timing assumptions on the policy variables means that v_{1t} can be interpreted as a 'measurement error', v_{2t} and v_{3t} can be interpreted as 'spending policy response' and 'receipts response' shocks respectively, and v_{4t} can be interpreted as a 'spending policy initiative' shock. This decomposition can be applied to the impulse responses and to the estimated spending multipliers and LMOS find that, in the US, the multiplier effects of forward-looking policy initiatives are considerably higher than the overall multiplier effects based on policy responses and policy initiatives taken together. Of course, it is interesting to find whether a similar conclusion is obtained with the Australian data.

3.2 Australian Fiscal Plans and Outcomes, 1957-2015

Figures 3a plots the three spending series discussed above as published in time t; namely, ${}_tG_t$, ${}_tG_{t-1}$ and ${}_tG_{t-2}$. The plots show that, broadly speaking, the series are horizontal displacements of each other, moving one-for-one over the long term but with some substantial discrepancies from this pattern over some periods. Figures 3b and 3c make the same point for receipts and the primary surplus with the latter - being based on both series - showing the most striking differences between the measures. Table 2 provides some basic summary statistics for the series showing, for example, that the actual annual growth in spending averaged 3.7% over the period 1957-2015 and published spending growth plans averaged at 3.8%. On face value, it appears that spending did not systematically outpace planned spending then, and with standard errors of the series at 4%, the simple gap between these averages is also not statistically significant.

Table 2: Summary Statistics for Selected Policy Variables, 1957-2015

Revision	Mean (St.Dev.)	Actual Growth	Mean (St.Dev.)	Planned Growth	Mean (St.Dev.)
${}_tg_{t-2} - {}_{t-1}g_{t-2}$	0.037 (0.044)	${}_tg_{t-1} - {}_{t-1}g_{t-2}$	0.037 (0.044)	${}_tg_t - {}_tg_{t-1}$	0.038 (0.043)
${}_t\tau_{t-2} - {}_{t-1}\tau_{t-2}$	0.037 (0.046)	${}_t\tau_{t-1} - {}_{t-1}\tau_{t-2}$	0.036 (0.056)	${}_t\tau_t - {}_t\tau_{t-1}$	0.037 (0.050)
${}_tS^p_{t-2} - {}_{t-1}S^p_{t-2}$	-102.69 (173.33)	${}_tS^p_{t-1} - {}_{t-1}S^p_{t-2}$	-38.06 (146.84)	${}_tS^p_t - {}_tS^p_{t-1}$	-87.72 (146.84)

Notes: g_t, τ_t and S^p_t refer to government spending, receipts and primary budget surplus respectively.

A more thorough examination of the data can be obtained through estimated models of the sort described in (3.1). Unit root tests applied to the various individual spending series, and to the receipts and output data establishes that these series are all individually difference-stationary. Figure 4 shows that spending-to-output and receipts-to-output ratios are remarkably constant over time and unit root tests applied to the (logarithm of the) spending-to-output and receipts-to-output ratios show these too are stationary. These results confirm that the VAR modelling approach presented in (3.4) are appropriate therefore, although we found that a VAR order 2 is appropriate to eliminate any residual serial correlation.[12] Table 3 summarises the outcome of the tests described in (3.2) and (3.3) to establish whether the revisions between the first and second releases of the measures are simply random measurement error, and whether the gaps between the planned policy and the outcomes are simply random 'implementation errors'.

Table 3: Tests of Whether Data Revisions and Unplanned Policy Outcomes are Unsystematic

Revision	LM	(p-value)	Unplanned Policy	LM	(p-value)
${}_tg_{t-2} - {}_{t-1}g_{t-2}$	11.96	0.22	${}_tg_{t-1} - {}_{t-1}g_{t-1}$	14.80	0.10
${}_t\tau_{t-2} - {}_{t-1}\tau_{t-2t}$	51.27	0.00	${}_t\tau_{t-1} - {}_{t-1}\tau_{t-1}$	36.13	0.01
${}_tS_{t-2} - {}_{t-1}S_{t-2}$	47.54	0.00	${}_tS_{t-1} - {}_{t-1}S_{t-1}$	22.51	0.01

Note: Statistics refer to LM tests of (3.2) and (3.3). Statistics are compared to a χ^2-distribution with 9 degrees of freedom. See also Notes to Table 2.

The results establish that the unplanned policy gaps and revisions are both systematically related to past information. This is clearly the case for receipts and surpluses, where significance is established at the 1% level, but is more marginal for unplanned spending gaps (where significance is established only at the 10% level) and the test is not significant for the revisions in the spending data. Of course, the finding that there are systematic patterns in revisions in the receipts data may not be sinister. Data collection takes

[12] Results for these various tests are available from the authors on request.

time and it is sometimes preferable to publish measures of a variable obtained through best practice measurement techniques even if that means there is a systematic pattern in subsequent revisions.[13] On the other hand, the fact that the revisions in surpluses are systematic and negative on average could be because government wishes to err on the side of reporting that they have behaved more prudently than they actually have. The finding that the published plans for spending systematically understate the level of spending that actually takes place is more difficult to justify however, and suggests that governments are intentionally deceitful or unable to control spending in a way that is entirely predictable when the plans are announced.

The finding that there are no systematic patterns in the spending revision, ${}_tg_{t-2} - {}_{t-1}g_{t-2}$, means we can work with a simplified version of the model at (3.5) to investigate the multiplier, dropping this variable from the analysis to work with a four-variable VAR. Figures 5a and 5b report two Generalised Impulse Response (GIR) functions obtained using this estimated model. Figure 5a provides a 'standard' GIR showing the effects of a system-wide $\mathbf{e}_t$ shock to $\mathbf{Z}_t$ - as captured by the four-variable version of (3.5) - that causes ${}_tg_{t-1}$ to rise by 1% on impact. This shock is also associated with planned spending ${}_tg_t$ rising on impact (although not by as much) and with a first-release measure of output *falling*. The subsequent dynamic response has the spending level falling monotonically and shows that it takes around a decade for the effects of the shock to work themselves out. The new equilibrium position re-establishes the Great Ratio with spending and output converging to the same level around 1% *lower* than would have been observed in the absence of the shock. In contrast, Figure 5b traces the effects of a system-wide $\widetilde{\mathbf{e}}_t = \mathbf{B}_1\mathbf{e}_t$ shock to to $\widehat{\mathbf{Z}}_t$ - as captured by the four-variable version of (3.5) -which cause the one-step ahead forecast $E[\,{}_{t+1}g_t \mid \Omega_t\,]$ to rise by 1% on impact. Here output rises on impact and the subsequent dynamic response has spending and output rising for three/four years, then falling to around 0.4% higher than would be achieved in the absence of the shock after

[13] The users of the data can then deal with the predictable element of the revision as they see fit. The alternative is for the government to eliminate the systematic element of revisions prior to publication but this may involve a mechanical adjustment that users of the data would prefer not to have to unravel before their own analysis.

about a decade and finally settling at a permanent 0.15% increase. If we are interested in the multiplier effects of time-t innovations on spending and output at time-t and beyond, it is the latter response that is relevant.

The two GIRs illustrate the effects of two different types of shock and highlight different features of the interplay between planned and actual spending and output. As noted earlier, one possible explanation of the figures is that Figure 5a, which is dominated by the effects of the shock to ${}_tg_{t-1}$, shows the effects of an unanticipated adverse macroeconomic event causing output to fall and initiating an offsetting policy response, while Figure 5b is dominated by the effects of the shock to ${}_tg_t$, which might better reflect the effects of productivity-based improvements in output and associated proactive increase in spending through policy initiatives. This idea can be pursued through the orthogonalisation of the $\mathbf{e}_t$ shocks mentioned above. Here, the estimated model is re-cast in a form that assumes the presence of a permanent productivity shock v_{4t} and the timed sequence of events identifying the spending implementation shock v_{1t}, the receipts implementation shock v_{2t} and the spending initiative shock v_{3t}. The spending implementation shock and the spending initiative shock identified in this way are plotted in Figure 6 and the impulse responses associated with these two innovations are plotted in Figure 7, replicating the shape of the response in Figure 5b and showing that this response is indeed driven primarily by the initiative shock rather than the implementation shock. Figure 8 traces out the output effect too and Figure 9 translates these effects into the measure of the multiplier, calculated as the ratio of the accumulated output effect divided by the accumulated spending effect (and rescaled by the sample mean of output over spending to convert elasticities into dollar units). This shows a total multiplier of effect of around 1.41 over the first six years but rising to 1.72 ultimately. Moreover, the multiplier effect is still larger, reaching 1.79 at the long horizon, if we focus only on the effects of policy initiative shocks, showing that the output effect of implementation shocks (whereby spending is higher than had been originally planned) are actually negative. The total multiplier estimate is at the upper end of the range of multiplier estimates for the U.S. that are reported in the literature[14]

[14]Ramey (2016) notes that these typically lie in the range [0.6, 1.5] although larger estimates are not unusual. In the case of Australia, Li and Spencer (2015) develop a small open economy dynamic stochastic

but the finding that the output response to backward-looking policy reactions offsets that of the more forward-looking policy initiatives is exactly as found in LMOS for the US and illustrates the importance of being able to distinguish the effects of planned spending and spending outcomes through the real-time dataset.

4 Concluding Comments

The Australian Real-Time Fiscal Database provides an invaluable source of information on government spending, government receipts and its debt position, providing information on plans as well as outcomes, as published in real time. The data is complex and this paper provides an overview of the complexity, illustrating the nature of the definitional changes and revisions that are embedded within it for example. But the data is also extremely informative and necessary if decision-making is to be properly evaluated taking into account the information available at the time. The empirical analysis of the paper illustrates the point highlighting the predictability of the gaps between announced plans and realised outcomes and showing the importance of distinguishing between policy responses and policy initiatives in estimating the fiscal multiplier.

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general equilibrium model and estimate the fiscal multiplier associated with the fiscal stimulus package in the aftermath of the Global Financial Crisis. They also find estimates of the fiscal multiplier to be relatively high with estimates of 0.9 on impact and 1.26 after one year.

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Figure 1a: Nominal Outlays, Investment and Transfers

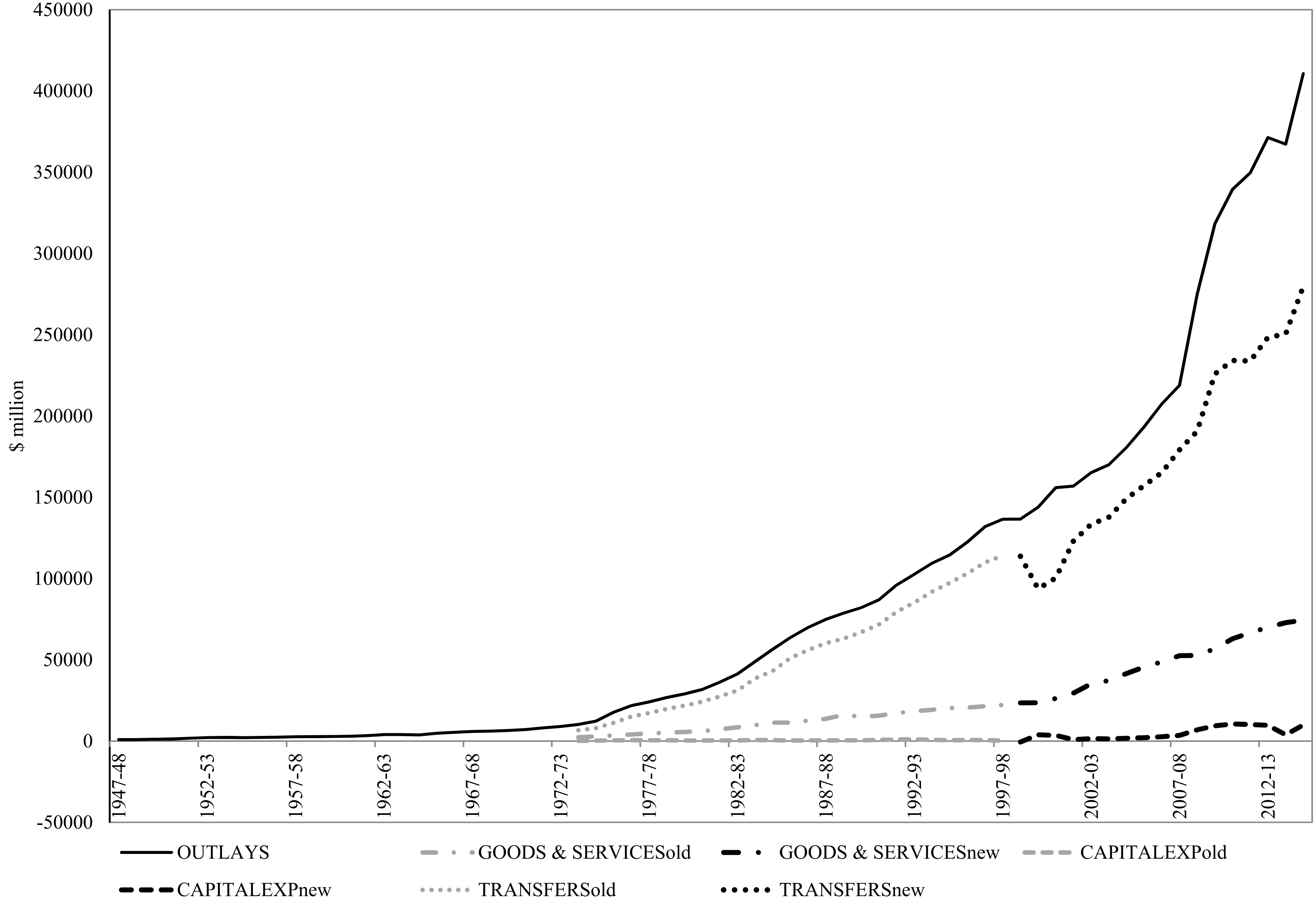


Figure 1b: Nominal Outlays, Investment and Transfers (% of GDP)

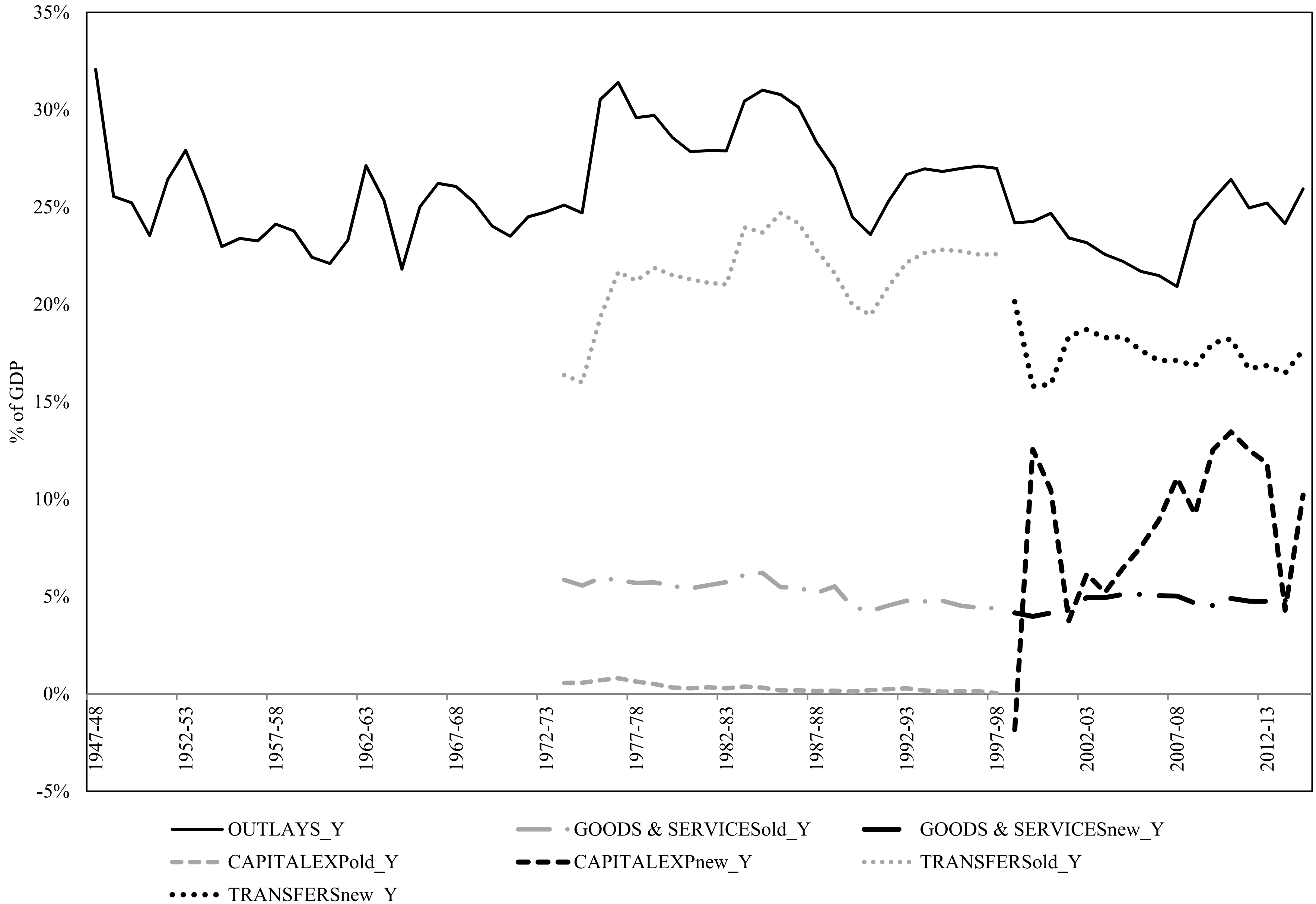


Figure 1c: Nominal Receipts, Indirect and Direct Taxation

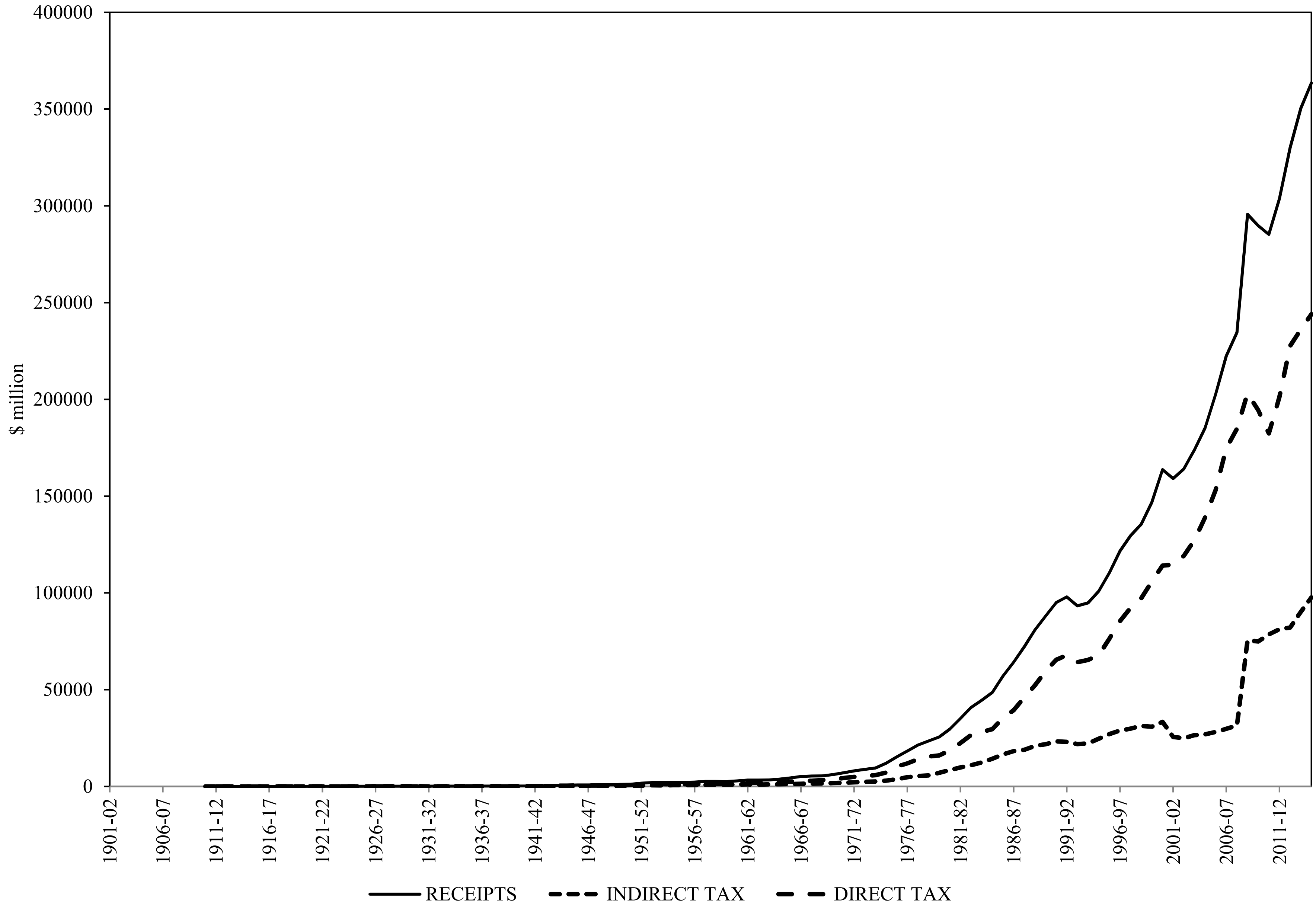
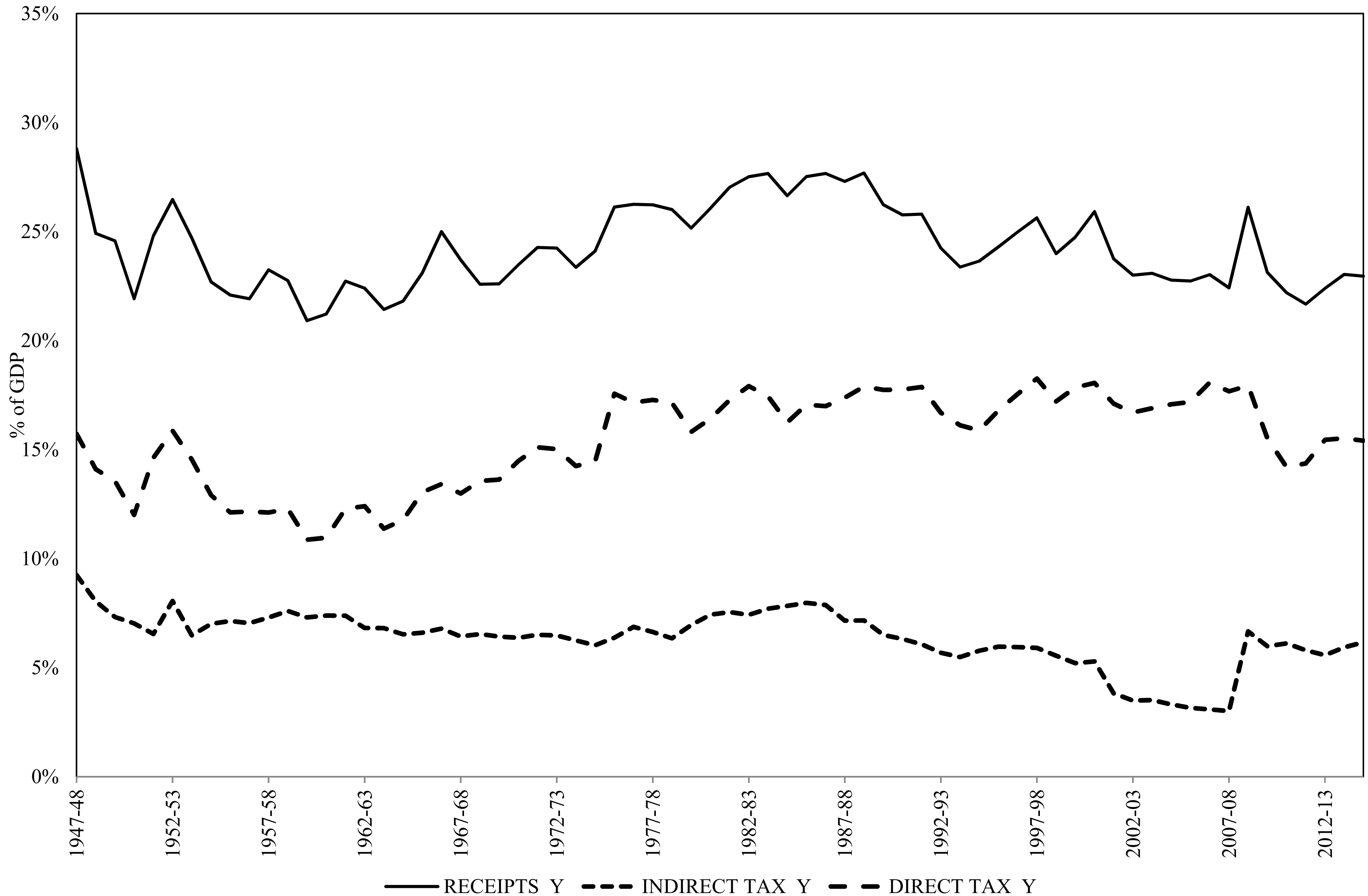


Figure 1d: Nominal Receipts, Indirect and Direct Taxation (% of GDP)



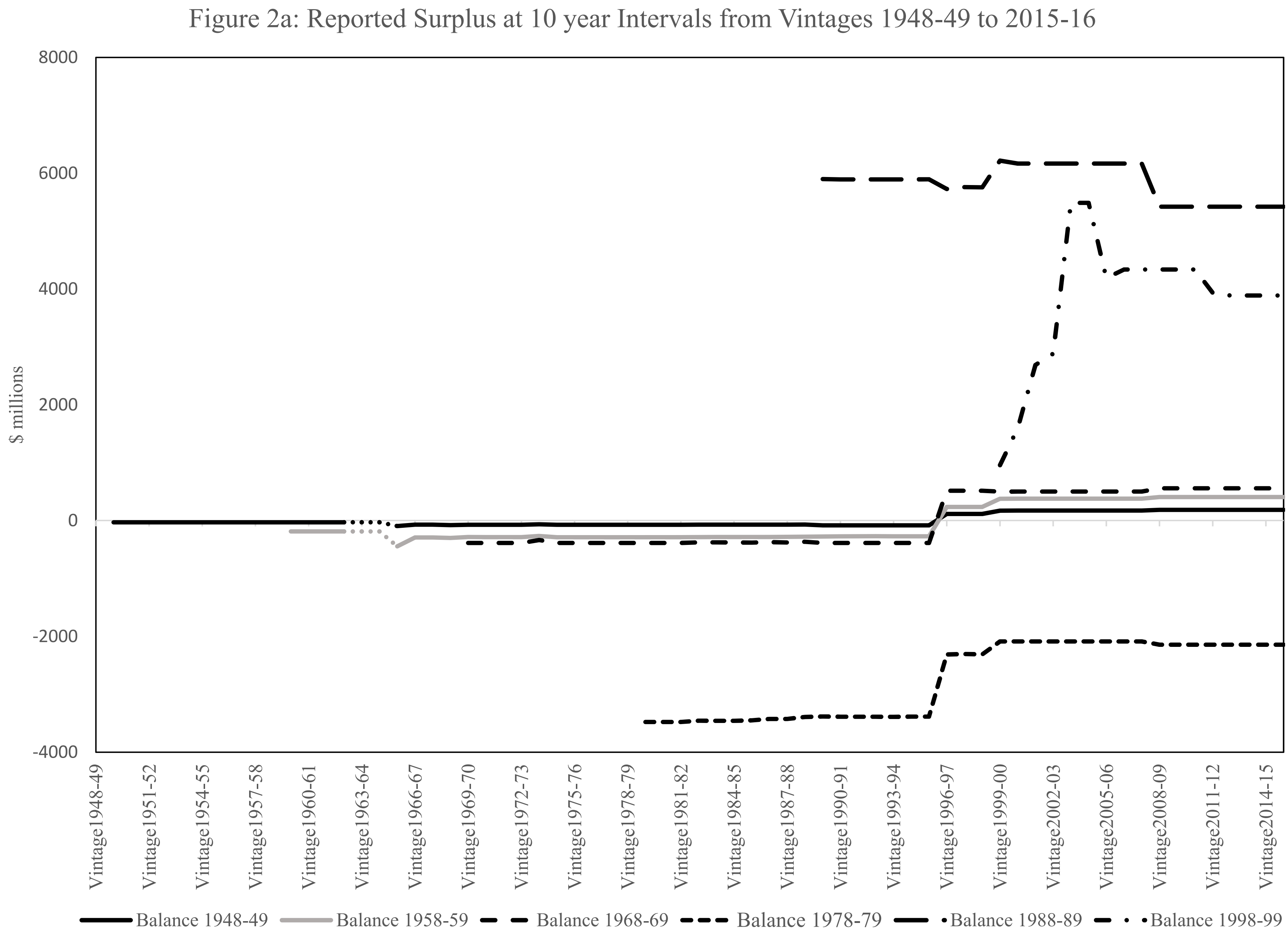
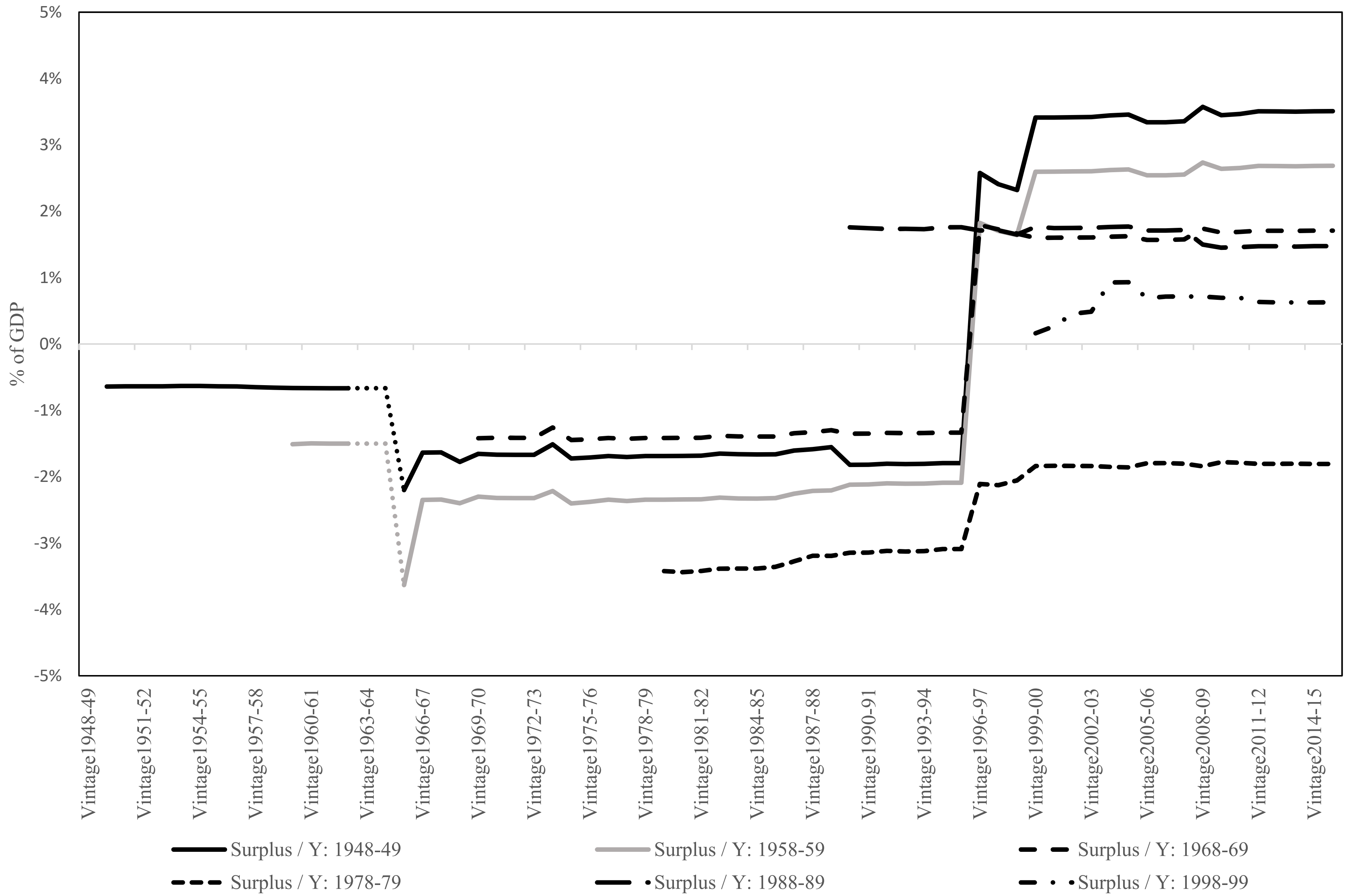


Figure 2a: Reported Surplus at 10 year Intervals from Vintages 1948-49 to 2015-16
$ millions
8000
6000
4000
2000
0
-2000
-4000
Vintage1948-49
Vintage1951-52
Vintage1954-55
Vintage1957-58
Vintage1960-61
Vintage1963-64
Vintage1966-67
Vintage1969-70
Vintage1972-73
Vintage1975-76
Vintage1978-79
Vintage1981-82
Vintage1984-85
Vintage1987-88
Vintage1990-91
Vintage1993-94
Vintage1996-97
Vintage1999-00
Vintage2002-03
Vintage2005-06
Vintage2008-09
Vintage2011-12
Vintage2014-15
Balance 1948-49
Balance 1958-59
Balance 1968-69
Balance 1978-79
Balance 1988-89
Balance 1998-99

Figure 2b: Reported Surplus as a Percentage of GDP at 10 year Intervals from Vintages 1948-49 to 2015-16



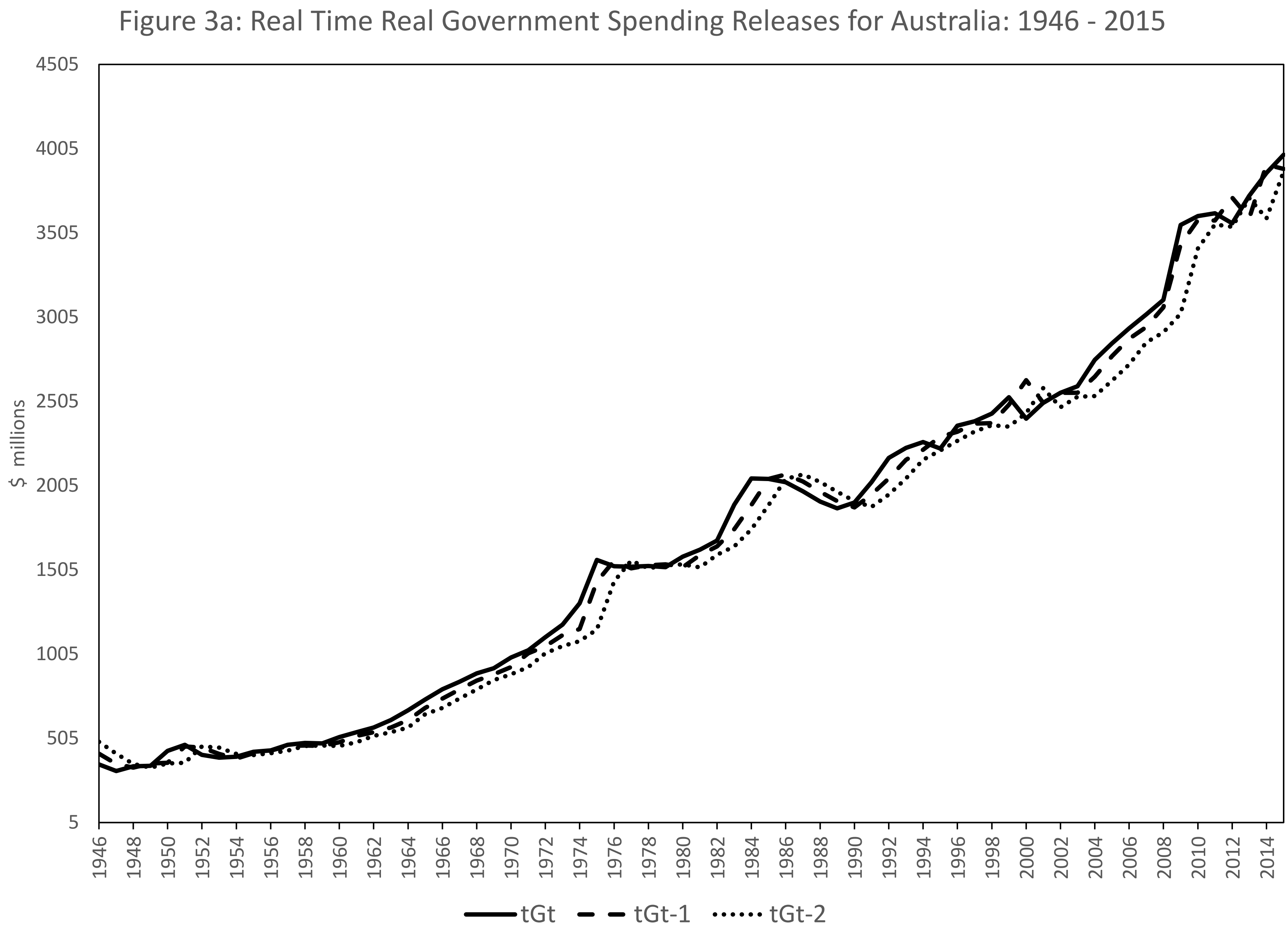


Figure 3a: Real Time Real Government Spending Releases for Australia: 1946 - 2015
$ millions
4505
4005
3505
3005
2505
2005
1505
1005
505
5
1946
1948
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
tGt
tGt-1
tGt-2

Figure 3b: Real Time Real Government Receipt Releases for Australia: 1946 - 2015

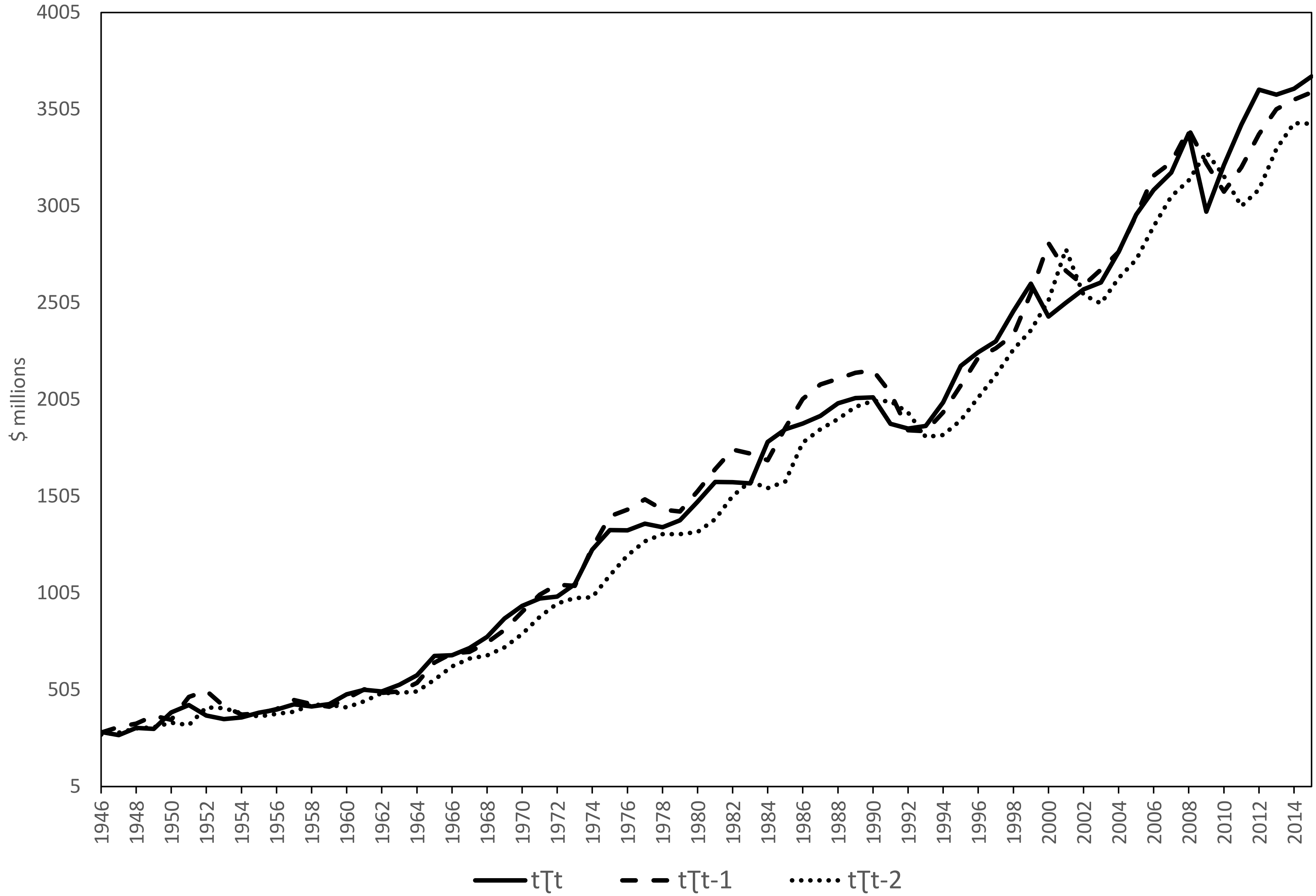


Figure 3c: Real Time Real Primary Balance Series for Australia: 1946 - 2015

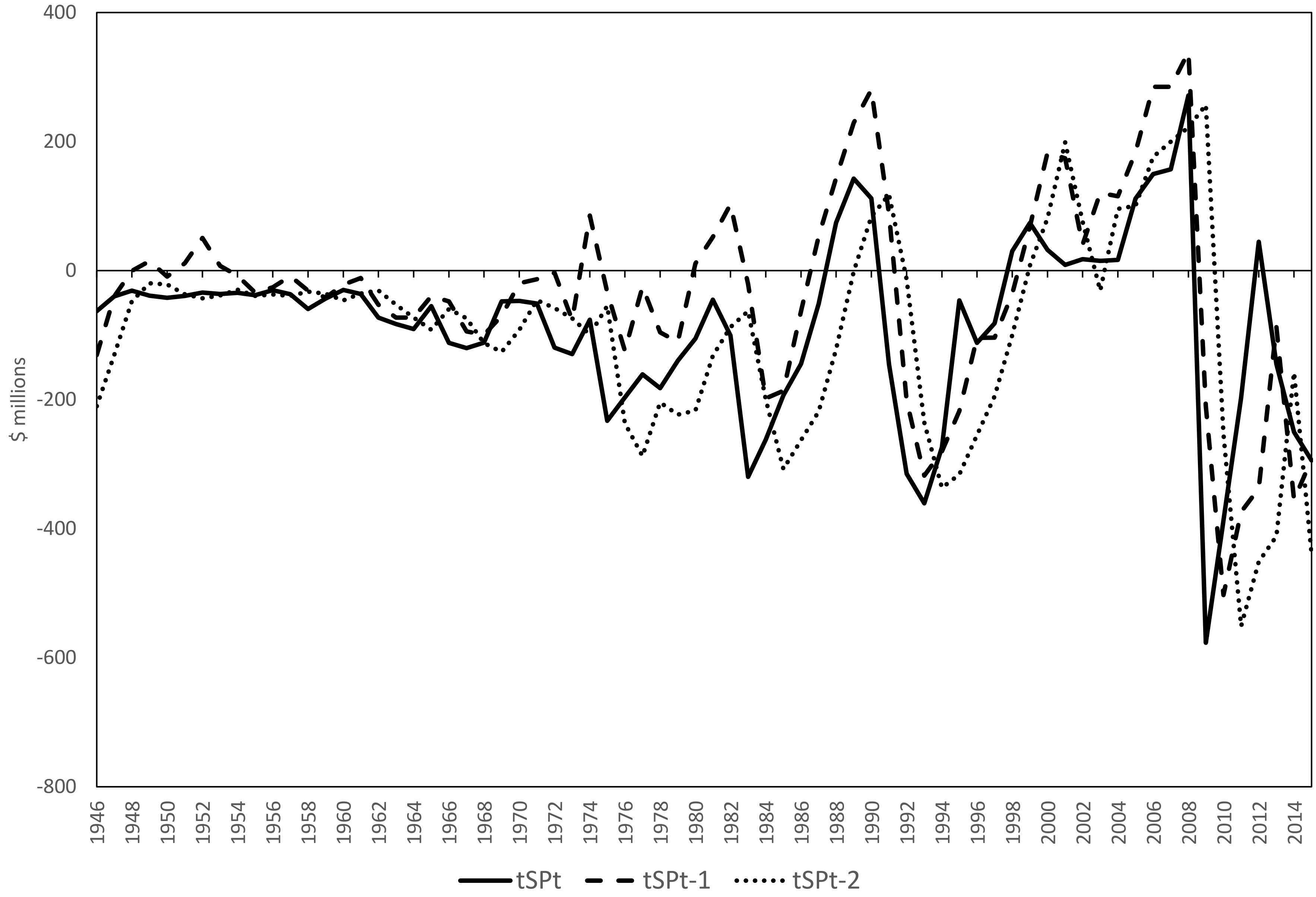


Figure 4: Ratios of Actual Spending to Output $({}_tG_{t-1}/{}_tY_{t-1})$ and Actual Receipts to Output $({}_t\tau_{t-1}/{}_tY_{t-1})$

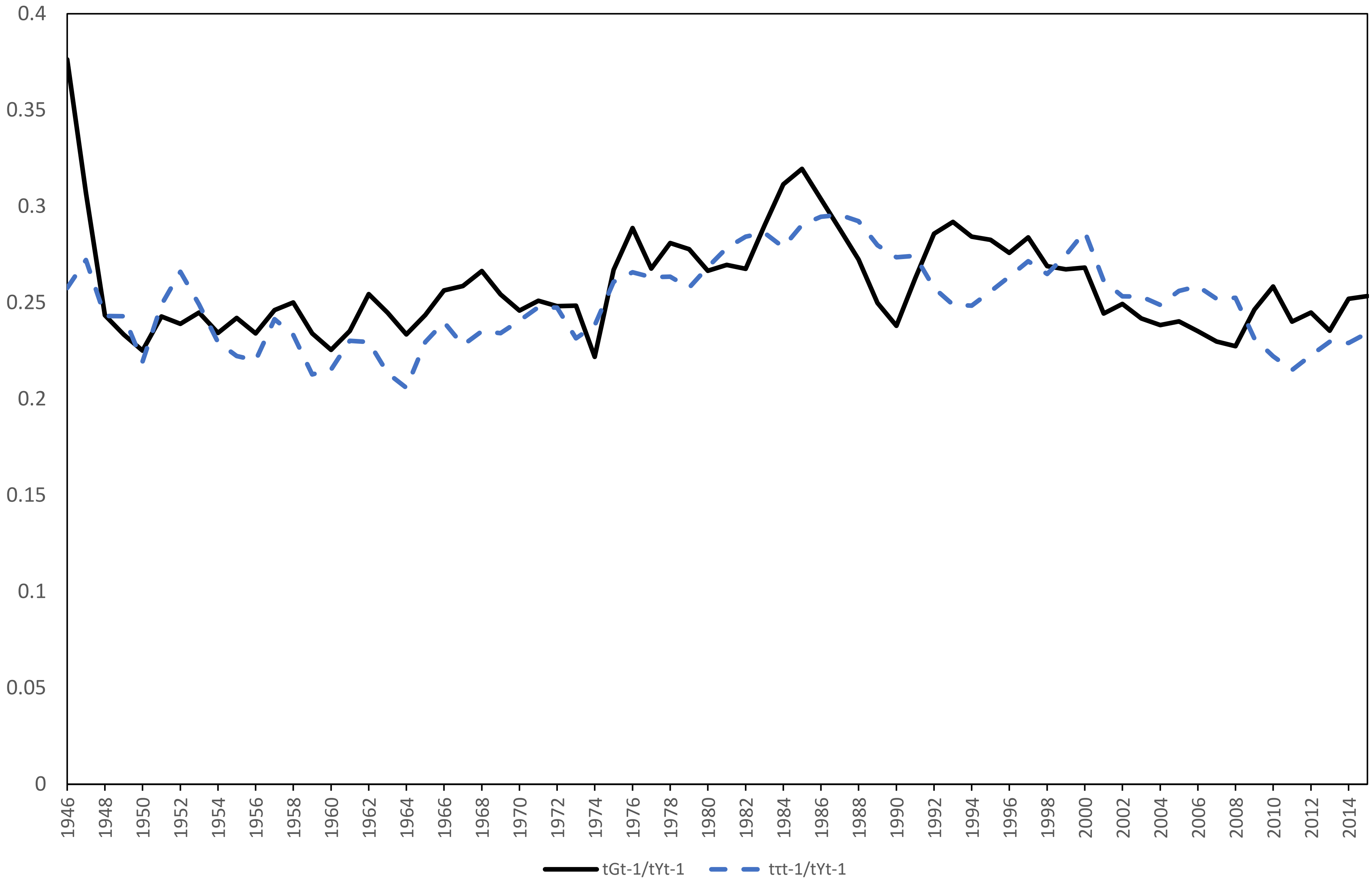


Figure 5a: GIR of a unit ${}_tg_{t-1}$ ('e') shock

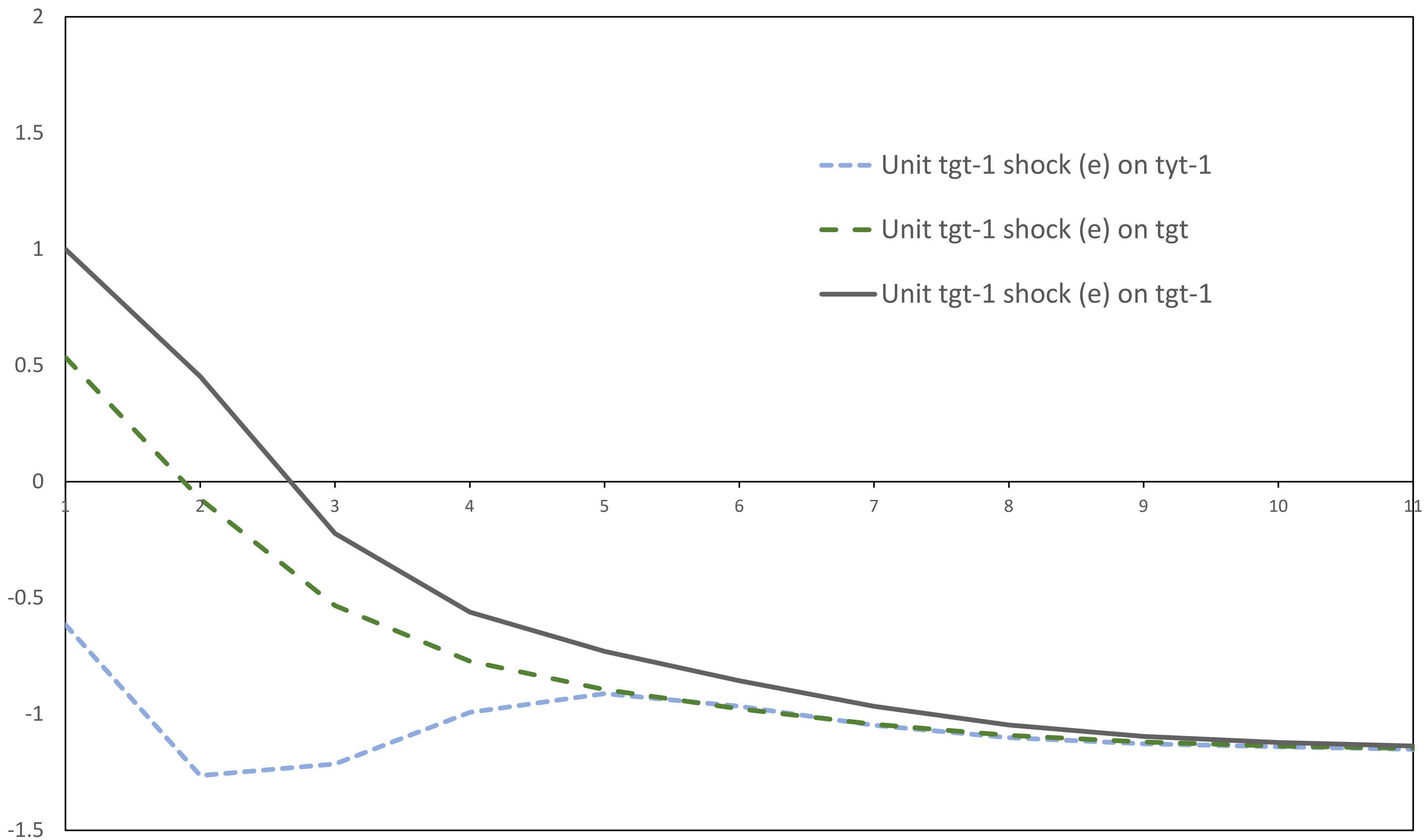


Figure 5b: GIR of a unit ('e-tilde') $_{t+1}g_t$ shock

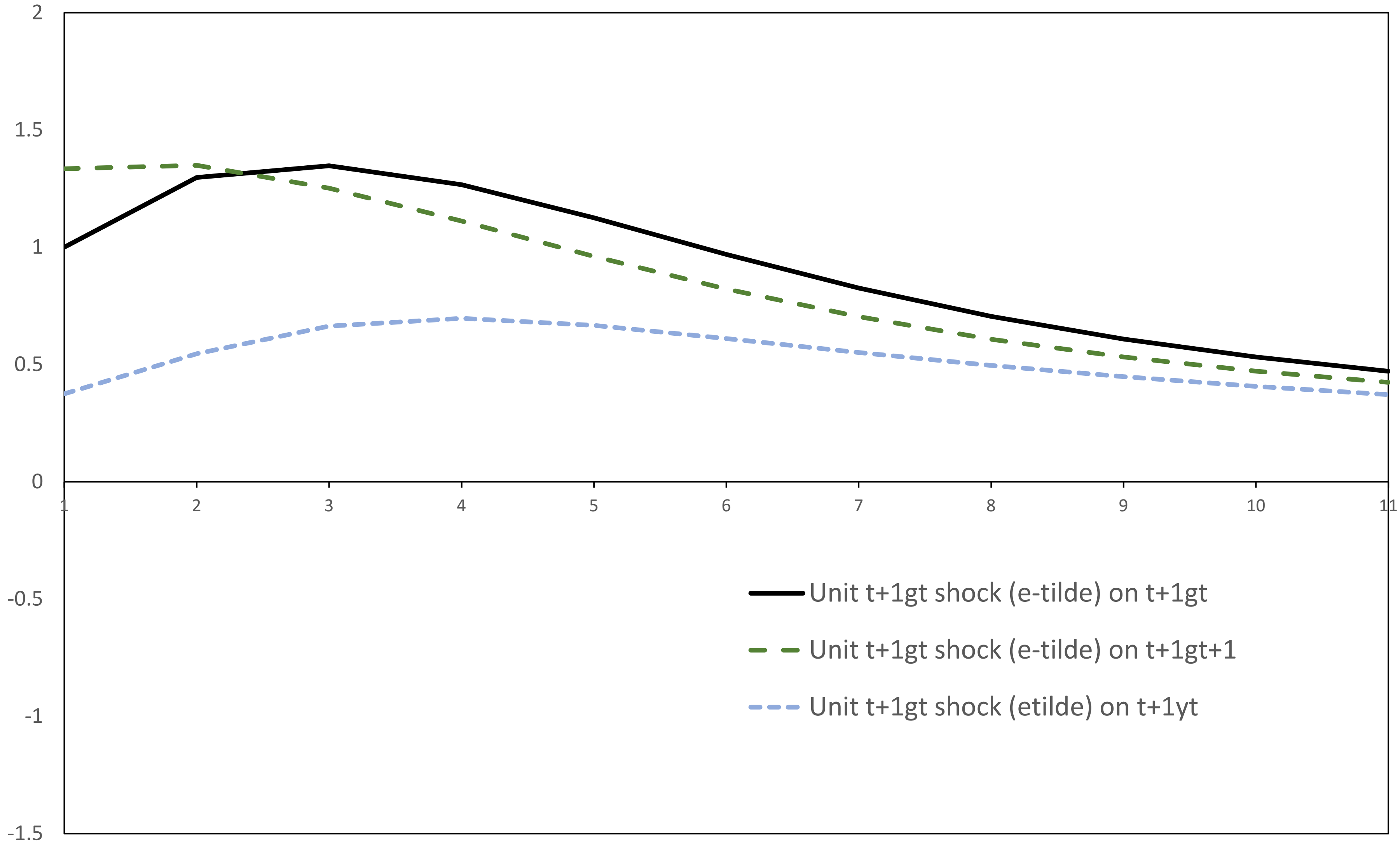


Figure 6: Implementation Shock (v_{1t}) and Fiscal Shock (v_{3t}) (with 1975, 2009 dummies)

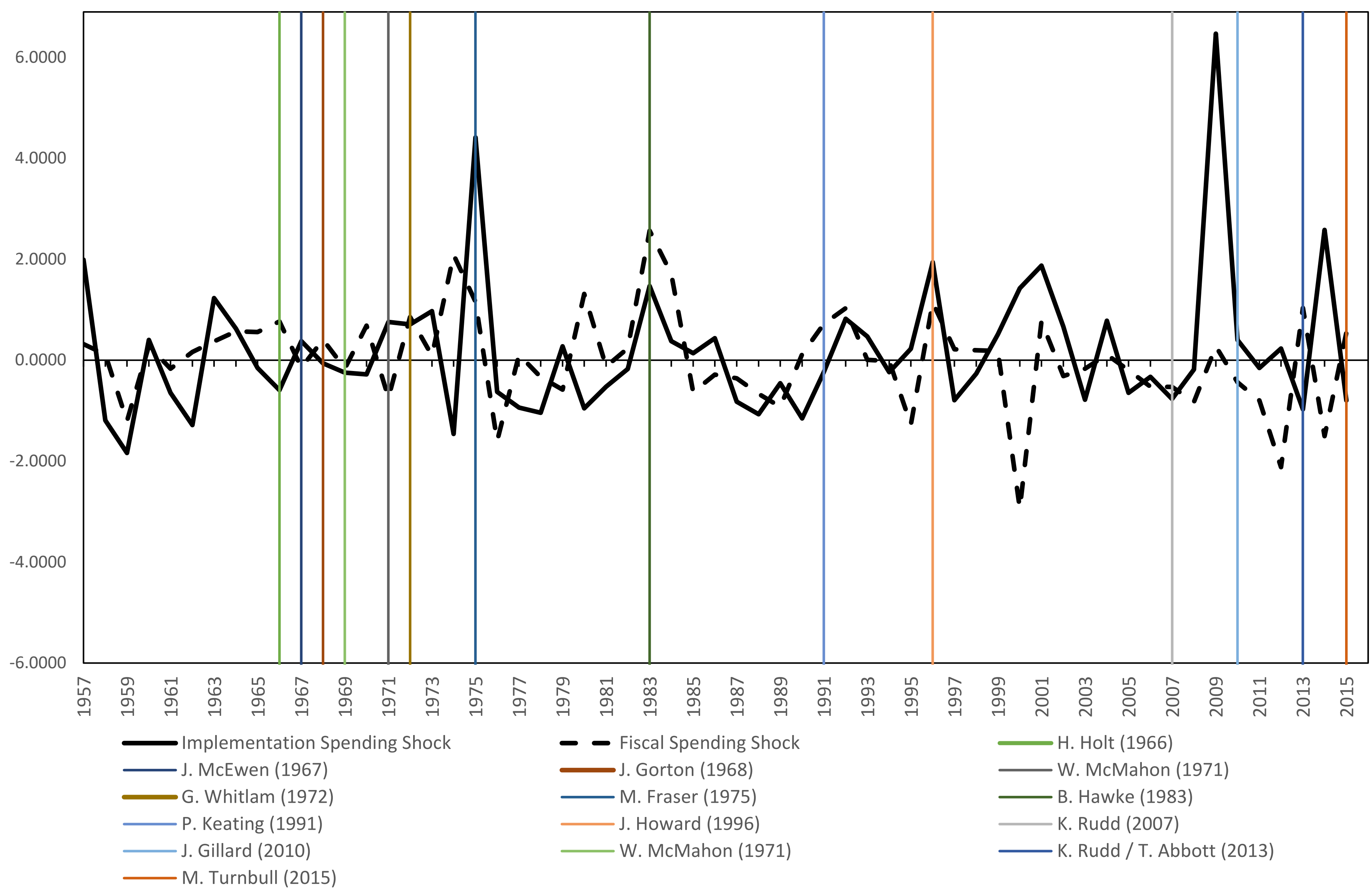


Figure 7: Orthogonal Impulse Reponse Functions:
Dynamic effects of 'implementation shocks' and 'fiscal initiative shocks' on forecasted actual spending at time t, $_{t+1}g_t$

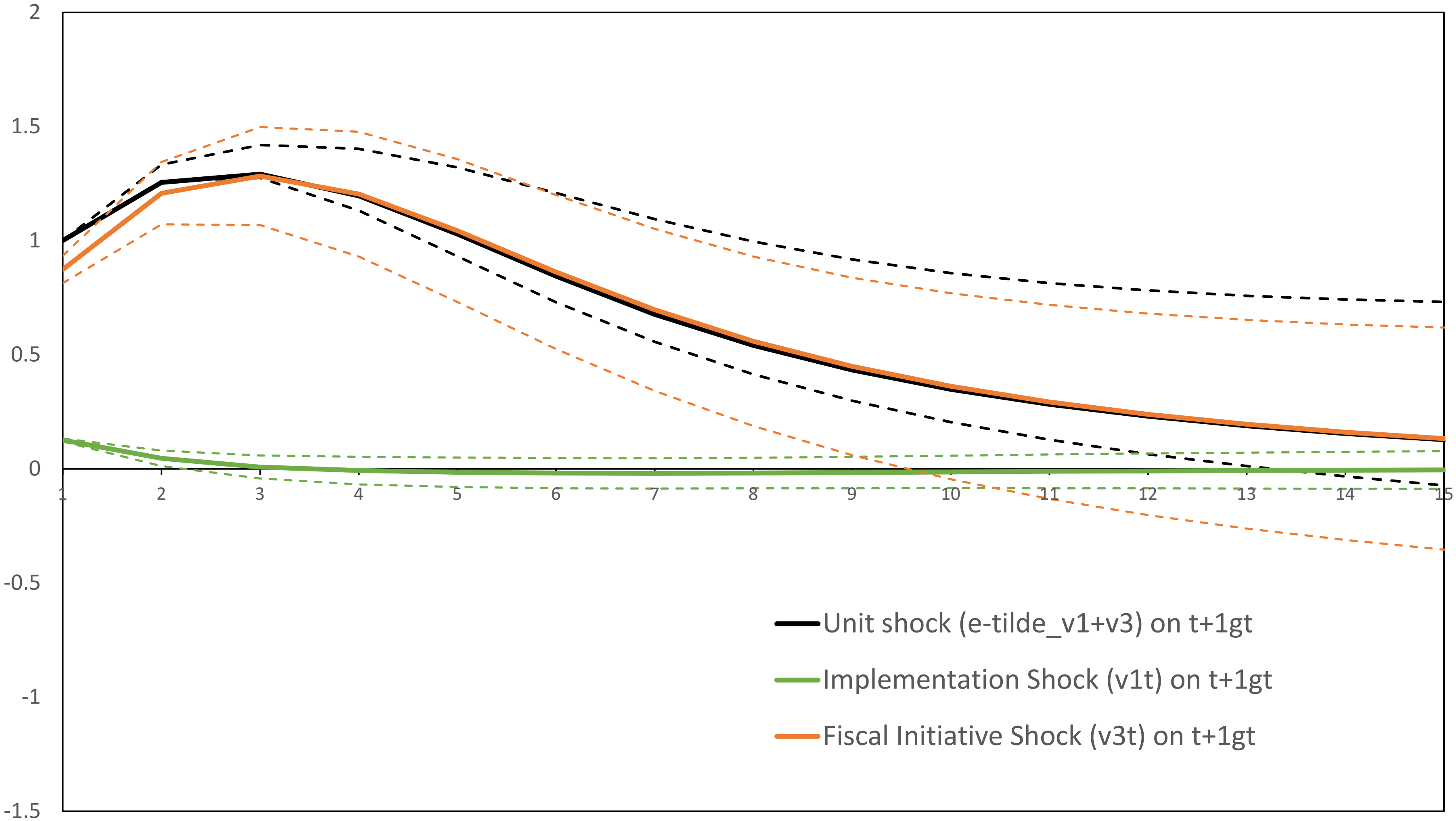


Figure 8: Orthogonal Impulse Response Functions:
Dynamic effects of 'implementation shocks' and 'fiscal initiative shocks' to forecasted actual spending, ${}_{t+1}g_t$ and forecasted actual output, ${}_{t+1}y_t$, at time t

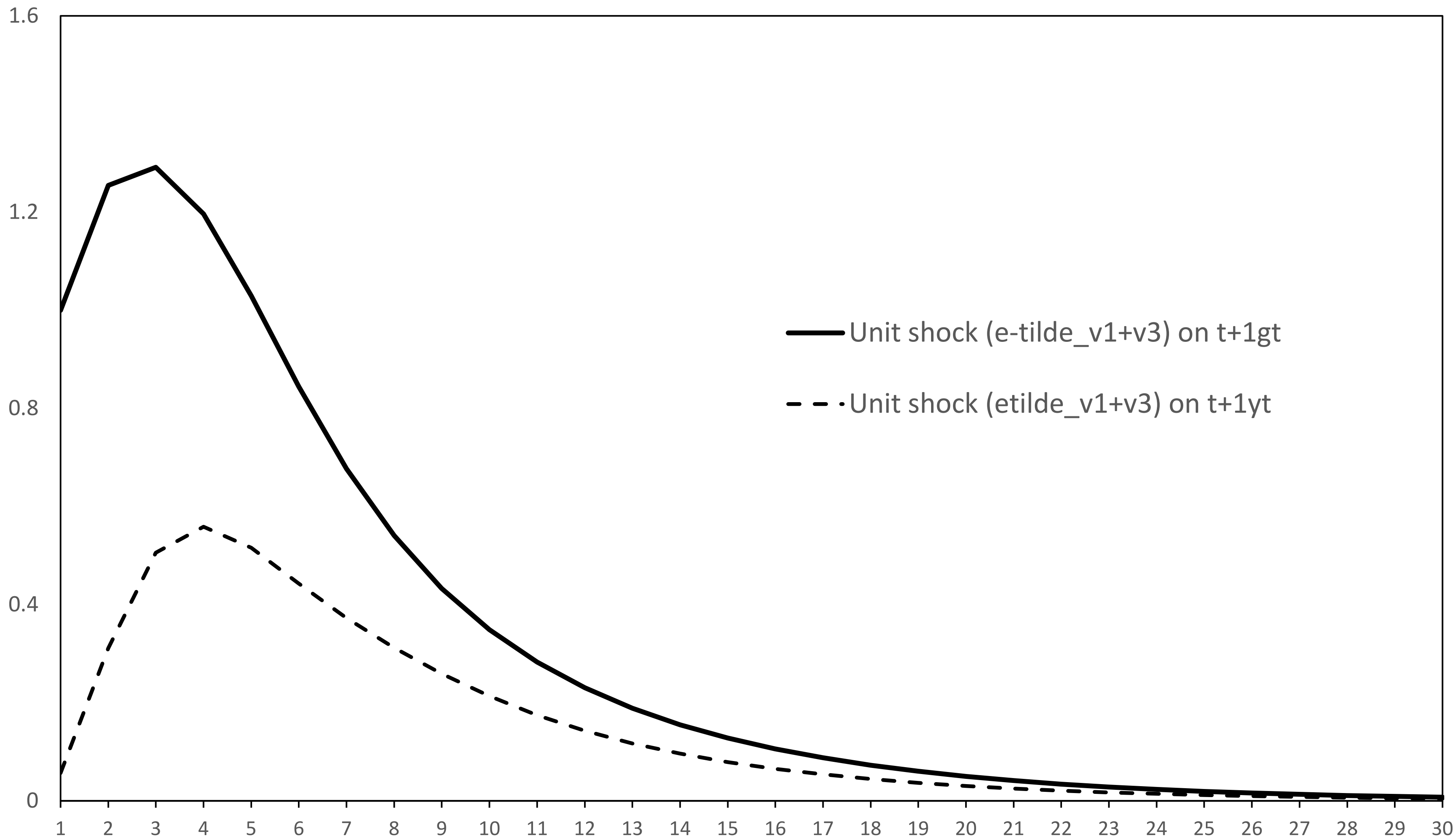
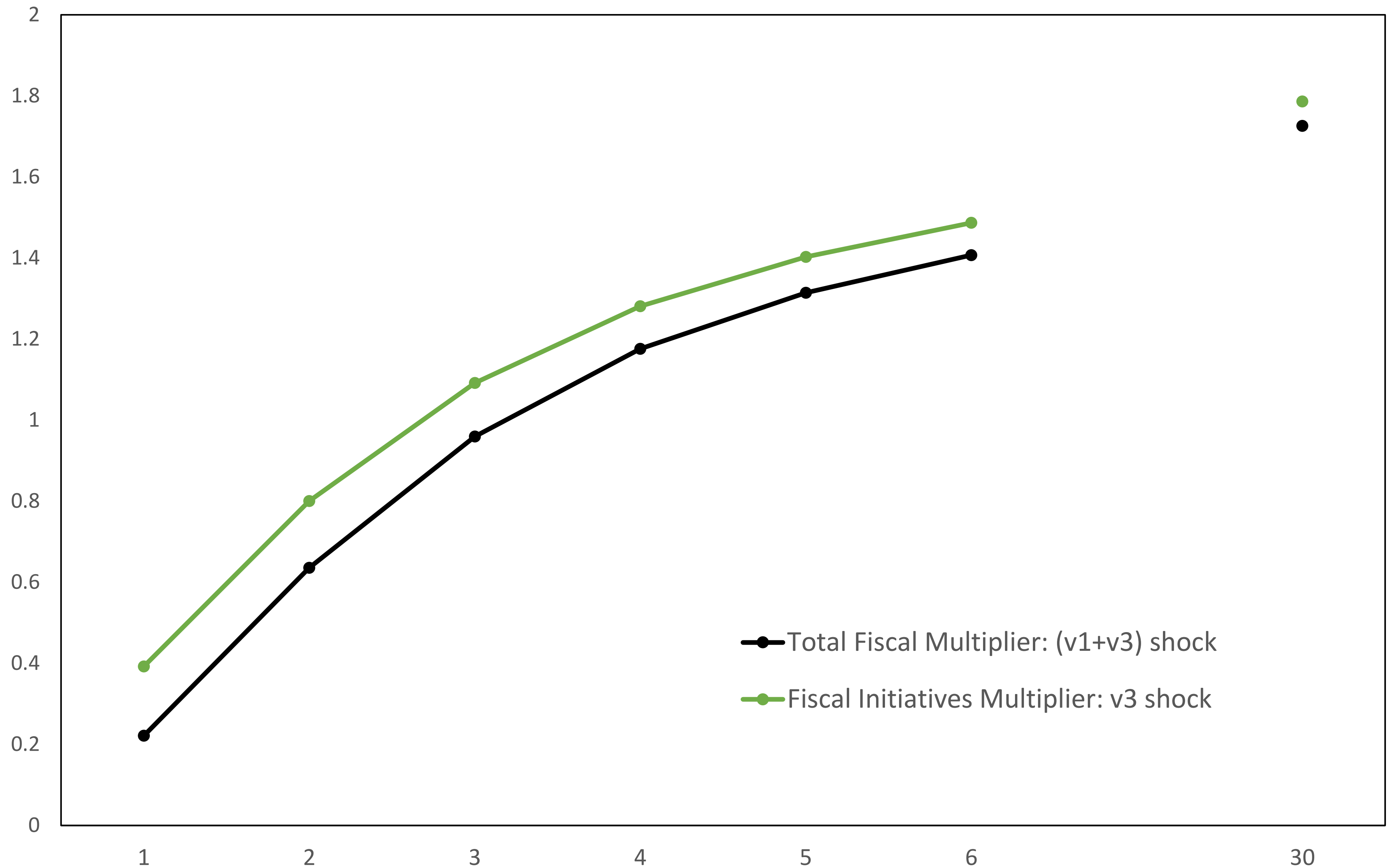


Figure 9: Total Fiscal Multiplier and Fiscal Initiatives Multiplier



Appendix

Table A1 Contents of the Australian Real-Time Fiscal Dataset

No	Name		Notation in Manual	First Vintage Date	Last Vintage Date
A	***Revenue***				
1		Receipts	REV	1901-02	2015-16
2		Income Tax (Direct)	DTAX	1901-02	2015-16
3		Expenditure Tax (Indirect)	IDTAX	1901-02	2015-16
B	***Expenditure***				
4		Outlays	OUT	1901-02	2015-16
5		*Spending on Goods and Services*	GSEXP	1973-74	2015-16
6		Health	OUTHEA	1946-47	2015-16
7		Education	OUTEDU	1967-68	2015-16
8		Defence	OUTDEF	1947-48	2015-16
9		*Spending on Capital Goods*	CAPEXP	1973-74	2015-16
10		*Transfers*	TPAY	1973-74	2015-16
11		Welfare	OUTSSEC	1946-47	2015-16
12		Pensions	OUTPEN	1946-47	2015-16
13		*Debt Interest Paid*	PDI	1962-63	2015-16
C	***Balance***				
14		Cash Balance	BAL	1962-63	2015-16
15		Fiscal Balance	FBAL	1999-00	2015-16
D	***Debt***				
16		Gross Debt	GDEBT	1925-26	2013-14
17		Public Debt	PDEBT	1912-13	2015-16
18		Net Debt	NDEBT	1994-95	2015-16
19		Commonwealth Interest Liability	COMINTLIAB	1932-33	1989-90
20		Total Interest Liability	TOTINTLIAB	1932-33	2015-16
21		Net Interest Outlays	NIO	2002-03	2015-16
E	***Wealth***				
22		Net Worth	NWORTH	1999-00	2015-16
23		Net Financial Worth	NFW	2000-01	2015-16
24		Net Operating Balance	NOB	1999-00	2015-16