Fiscal policy and private saving in Australia: Ricardian equivalence, twin deficits and broader policy inferences

Shane Anthony Brittle
University of Wollongong

FISCAL POLICY AND PRIVATE SAVING IN AUSTRALIA: RICARDIAN EQUIVALENCE, TWIN DEFICITS AND BROADER POLICY INFERENCES

A thesis submitted in fulfilment of the requirements
for the award of the degree

Doctor of Philosophy

University of Wollongong
School of Economics
Faculty of Commerce
New South Wales, Australia

By

Shane Anthony Brittle

Bachelor of General Studies (Economics), University of South Australia
Master of Commerce (Quantitative Economics), University of Wollongong

October 2009

CERTIFICATION

I, Shane Anthony Brittle, declare that this thesis, submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the School of Economics, Faculty of Commerce, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

Shane Anthony Brittle

October 2009

ABSTRACT

Concern in the United States over fiscal and current account deficits during the 1980s led to arguments that these deficits were linked, or "twins". The Reagan Administration conducted an expansionary fiscal policy by cutting taxes, which was not accommodated by monetary policy. This placed upward pressure on US interest rates – which subsequently boosted the US dollar. The exchange rate appreciation led to a fall in net exports and a rise in the US current account deficit. Under these circumstances, the current account appeared to mirror the fiscal position, leading to the popularisation of the twin deficits hypothesis.

Similar concerns were also held in Australia. Following the depreciation of the Australian dollar after its float in December 1983, the remainder of the decade saw a widening of the current account deficit; while net foreign debt increased from around 6 per cent of GDP in June 1981 to 32 per cent five years later. This led to both political and community unease over the large current account and rising stock of net foreign debt. Policymakers subsequently focused on fiscal consolidation as a means of reducing the current account deficit – leading to the establishment of policies such as the trilogy commitments in the Commonwealth's 1985-86 Budget.

An antonym to the twin deficit argument is provided by Ricardian equivalence, which asserts that deficits merely postpone taxes, and through the actions of altruistically motivated individuals, budget deficits have no real affects on the economy – including the current account. Australian academics during the late 1980s and early 1990s such as Makin (1988), Pitchford (1989) and Corden (1991) also challenged the notion that Australia's level of net foreign debt and the current account were concerns for fiscal policy. They argued that private sector investment and saving decisions were made by optimising private individuals and organisations, with any benefits or costs of these decisions being a matter for these private agents.

Research interest in fiscal policy waned over the 1990s, and for the most part of the 2000s, as monetary policy assumed the role of stabilising short-term fluctuations in prices and output in most advanced economies. Fiscal policy was left to focus upon the medium-term sustainability of government balance sheets, which for Australia

was reflected in the introduction of the *Charter of Budget Honesty Act* by the Howard Government, and the adoption of its medium-term fiscal strategy.

More recently, the sharp economic downturn associated with the global financial and economic crises of 2008 and 2009 has seen fiscal stimulus packages enacted in many countries, and a renewed interest in activist fiscal policy. With little empirical knowledge on the efficacy of fiscal policy in modern economies, recent discretionary fiscal policies have been enacted without a thorough understanding of the potency of these policy actions – particularly given the marked structural changes in many developed economies over the past two decades (such as the increased integration of global product and financial markets).

The purpose of this thesis is to provide an assessment of the potential efficacy of fiscal policy in Australia as a countercyclical policy tool. More specifically, the thesis considers whether private saving behaves in a manner that is consistent with Ricardian equivalence, thus mitigating the effects of fiscal policy, or conversely, if fiscal policy has some ability to influence real economic activity – leading to effects consistent with the twin deficits hypothesis.

This thesis seeks to make an original contribution to the literature by first considering a large sample, both in the number of observations (188), and across almost 50 years from 1959-2006. Second, a great deal of attention is given to structural change in the Australian economy over this time – something which previous empirical literature (particularly for Australia) has paid little attention to. Econometric techniques that consider the possibility of two structural breaks in each time series will be utilised. Incorporating these structural breaks into a cointegration analysis will allow for the estimation of such a large sample. Further, the work conducted here provides a more up-to-date analysis of the efficacy of fiscal policy in Australia. As noted by Kennedy (et al: 2004), there is little empirical evidence on the efficacy of fiscal policy in Australia, or estimates of fiscal multipliers.

The analytical model employed in this thesis considers the extent to which private saving responds to changes in the total general government (Commonwealth, state and local) fiscal stance. While this framework lends itself towards explaining

Ricardian equivalence effects, it can also be considered as a broad measure of the impact of fiscal policy on short- and long-run aggregate demand. The model is estimated using the autoregressive distributed lag approach (ARDL) to cointegration, which provides both short- and long-run coefficient estimates, but also provides the flexibility to accommodate the introduction of coefficients for structural breaks.

As mentioned above, it is likely that the Australian economy has been subject to a substantial amount of structural change over the past 50 years. From the 1950s through to the early 1980s, the economy was heavily regulated, with markets subject to price controls and tariff protection, a fixed exchange rate, and government controls on bank deposits, interest rates and credit. The 1980s saw a period of rapid reform, with the floating of the dollar, removal of restrictions on credit creation, interest rates, foreign capital inflows and other broader reforms around market pricing and removal (or lowering) of tariffs and subsidies. Not accounting for these changes could lead to spurious results in the econometric analysis. While traditional Augmented Dickey-Fuller tests are conducted, the more advanced Lee and Strazicich one and two-break unit root tests are also used – which will also yield information regarding the timing of structural breaks in the Australian economy.

Results indicate that while there is not a full Ricardian response to changes in the fiscal stance, there is some partial offsetting behaviour. The results imply that fiscal policy does elicit some impact on the real economy which will be partly offset by increased private saving or other crowding out effects. Lower short-run private saving offsets revealed through the error correction mechanisms indicate that nominal and real frictions and/or rigidities prevent some proportion of any offsetting savings behaviour occurring more quickly. Additionally, some households may also be subject to short-run liquidity constraints. However, nominal and real rigidities appear to have lessened as the Australian economy has been subject to significant economic reform.

ACKNOWLEDGEMENTS

My greatest thanks are reserved for my PhD supervisors, Associate Professor Nelson Perera and Associate Professor Ed Wilson. You have both been patient with my progress in completing this thesis, and I am extremely thankful for the assistance and advice that you have provided to me. I hope that the experience has been one where I have also contributed new information and understanding into the Australian economy and macroeconomic policy. I look forward to working with you on other projects in the future.

I would like to thank the Commonwealth Treasury, which has provided both financial assistance for my PhD studies, and the flexibility to take leave in order to complete major parts of this thesis. I am grateful to my colleagues in the Macroeconomic Policy Division for providing useful insights into fiscal policy and the Australian economy, and with the opportunity to work on projects that have had direct relevance to this thesis. I would also like to thank Tony McDonald for prompting me to pay some attention to the economic concept and statistical measurement of saving.

I would also like to thank staff and participants in the International Monetary Fund's workshops on fiscal policy (Fiscal Policy: Fiscal Discipline, Institutional Considerations, and Public Investment) held in Washington D.C. over November 2007. These workshops enhanced my understanding of contemporary fiscal policy issues – greatly benefiting the preparation of this thesis. Advice provided by David Hauner (IMF Fiscal Affairs Department) on measuring financial openness was also extremely helpful.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1 INTRODUCTION

Fiscal policy has been subject to recurring debate in Australia for several decades, with its status as an arm of macroeconomic policy influenced by its perceived ability to affect prices and real economic activity. Over the 1960s and through to the 1980s, fiscal policy was frequently utilised for activist demand management, along with other objectives such as controlling inflation (depending on the prevailing economic circumstances at the time). However, the adoption of monetary policy (inflation targeting) over the past two decades has seen fiscal policy move to a focus on medium-term objectives and the sustainability of government finances; which continued through to the mid to late parts of this decade. The global financial crisis and recession over 2008 and 2009 has produced a renewed interest in activist fiscal policy – particularly where monetary policy has reached its zero nominal bound in a number of countries.

The following section provides a terse chronology of developments in Australian fiscal policy over the past two to three decades, which then leads into a discussion of the research motivation for this thesis. Section 1.3 states the research objectives, which includes the hypothesis to be tested. This is followed by a statement on the original contribution to the literature in section 1.4, and concludes with a discussion of the organisation of the thesis in section 1.5.

1. 1 Recent fiscal policy developments

During the early to mid 1970s, fiscal policy was heavily conditioned by inflation considerations, but held a central theme of managing short-run fluctuations in output. Kennedy (et al: 2004) note that the election of the Fraser Government in 1975 saw a marked shift in the Commonwealth's fiscal strategy, with spending restraint emphasised as a means of reducing inflationary pressures. While the focus remained on reducing inflation through to the early 1980s, large budget deficits were delivered by the Hawke Government in 1983-84 and 1984-85 as a means of supporting the economy following a number of financial and regulatory reforms (Kennedy et al: 2004).

In the United States during the 1980s, expansionary fiscal policy by the Reagan Administration placed upward pressure on US interest rates – subsequently boosting the US dollar. An appreciation of the exchange rate led to a fall in net exports and a rise in the US current account deficit; leading economists such as Martin Feldstein to argue that these deficits were linked, or "twins". However, proponents of the new classical theories challenged this proposition – pointing to the Ricardian equivalence theorem as an antonym to twin deficit theory – and arguing that fiscal deficits have no impact on real economic activity.

Australia's fiscal policy debate in the mid to late 1980s was influenced by the twin deficits hypothesis. Following the depreciation of the Australian dollar, a widening of the current account deficit (and a marked increase in net foreign debt) led to community unease. A period of fiscal consolidation in the late 1980s was undertaken in an attempt to reduce the current account deficit. However, a number of prominent academics[1] argued that the current account was not a concern for fiscal policy, with the balance of payments being the outcome of saving and investment decisions made by optimising individuals and organisations.

Research interest in fiscal policy waned over the 1990s, and for the most part of the 2000s, as the "new consensus" on macroeconomic policy saw monetary policy (inflation targeting) assuming the role of stabilising short-run fluctuations in prices and output in most advanced economies. Fiscal policy was increasingly directed toward the medium-term sustainability of government balance sheets and allowing the automatic stabilisers to freely operate. Fiscal policy debates in Australia were reignited in the mid 2000s as the Howard Government undertook a series of personal income tax cuts. At that time, the economy was operating at or near full capacity with unemployment around 30-year lows. Critics argued that this loosening of fiscal policy would only add to aggregate demand – leading to higher inflation and interest rates.

Sharp falls in output associated with the global financial and economic crisis in 2008 and 2009 has seen fiscal stimulus packages enacted in many countries, and a

[1] Makin (1988), Pitchford (1989) and Corden (1991).

renewed interest in activist fiscal policy. In a number of countries monetary policy had reached the zero bound on nominal interest rates, leaving quantitative easing measures and fiscal policy to support aggregate demand.[2] To prevent a severe and prolonged global downturn, in late 2008 the International Monetary Fund (Spilimbergo et al: 2008) called for a fiscal loosening across the advanced economies amounting to at least 2 per cent of global gross domestic product (GDP). By mid 2009, Australia had implemented fiscal stimulus packages amounting to around 3 per cent of GDP in 2008-09 and 2 per cent of GDP in 2009-10 (Commonwealth of Australia: 2009a).

1. 2 Research motivation

Of key interest for this thesis is the debate as to whether fiscal policy has a marked impact on national saving and economic activity. Considering a deterioration in the government's fiscal position, if private saving rises by less than the fall in government saving, national saving falls. In an open economy where capital mobility is perfect, the adjustment required to restore balance between national saving and investment is met through higher capital inflows. The higher demand for domestic assets results in an appreciation of the exchange rate. Where capital mobility is imperfect, the decline in national saving results in higher interest rates, and a combination of lower domestic investment and higher capital inflows; again leading to an appreciation of the currency.

Under both cases of perfect and imperfect capital mobility, the higher exchange rate results in a deterioration in the balance of payments. As noted above, this twin deficit argument had a marked influence on Australia's fiscal strategy through the late 1980s and early 1990s. Contrary to this view, where private saving rises by the same amount as the deterioration in government saving, national saving remains unchanged; and further adjustments to interest rates, the exchange rate and capital inflows are not required. This situation is consistent with the Ricardian equivalence theorem, which posits that fiscal policy is relatively ineffective in its ability to influence the macroeconomy.

[2] Countries including the United States, Japan and the United Kingdom had nominal interest rates at or near zero from late 2008 through 2009.

1. 3 Objectives of the study

The primary objective of this thesis is to assess the efficacy of fiscal policy in Australia as a countercyclical policy tool. The thesis will consider whether private saving behaves in a manner that is consistent with Ricardian equivalence, where the actions of far sighted agents mitigate the effects of fiscal policy, or conversely, whether fiscal policy has some ability to influence real economic activity – leading to effects consistent with the twin deficits hypothesis. The specific objectives for this study include:

- testing the relationship between private saving and the general government's fiscal position in Australia;
- determining to what extent this relationship is consistent with the Ricardian equivalence theorem or the twin deficits hypothesis, and using the results to make a broad assessment on the efficacy of fiscal policy;
- assessing how this relationship has evolved over time, particularly with regard to structural change in Australia's economy; and
- examining structural breaks in both the individual variables and the analytical model using recently-developed econometric procedures.

To meet these objectives, a model that considers the extent to which private saving responds to changes in general government[3] saving (the fiscal stance) is employed. While this framework lends itself towards explaining Ricardian equivalence effects, the coefficient on government saving can also be considered as a broad measure of the impact of fiscal policy on short- and long-run aggregate demand. Additional explanatory variables have also been selected with regard to what economic theory suggests are significant drivers of private saving. These variables include income, real interest rates, inflation, unemployment, welfare safety nets, the terms of trade, and proxies for financial openness and wealth. The analytical model is estimated within a cointegration framework using the autoregressive distributed lag (ARDL)

[3] The System of National Accounts (Australian Bureau of Statistics: 2000) defines general government (total) as the summation of the Commonwealth, state and local government sectors.

method. This estimation procedure provides both short- (error correction) and long-run coefficient estimates, and can easily accommodate both stationary and non-stationary variables.

The hypothesis to be tested in this thesis has been constructed as:

> *Does fiscal policy influence private saving behaviour in a manner that is consistent with Ricardian equivalence, thus mitigating the effects of fiscal policy, or does fiscal policy exert a substantial influence on the Australian economy – invoking effects on the balance of payments consistent with the twin deficits hypothesis?*

Chapter 5 will specify how the estimated sign and magnitude of the coefficient on government saving will allow for testing of this hypothesis.

1. 4 Contribution to the literature

The work conducted in this thesis will provide a more up-to-date analysis of the efficacy of fiscal policy in Australia. As noted by Kennedy (et al: 2004), there is little empirical evidence on the efficacy of fiscal policy in Australia, or estimates of fiscal multipliers. Additionally, most empirical work focusing on the twin deficits versus Ricardian equivalence debate was conducted in the late 1980s, or early 1990s.

A long sample is considered, using quarterly data from 1959 through to 2006. However, it is important to note that the Australian economy has been subject to a substantial amount of structural change over this time. From the 1950s through to the early 1980s, the economy was heavily regulated, with markets subject to price controls, tariff protection, a fixed exchange rate, and government controls on bank deposits, interest rates and credit. The 1980s saw a period of large and rapid reform, with the floating of the dollar, removal of restrictions on credit creation, interest rates, foreign capital inflows (licensing of foreign banks) and other broader reforms around centralised wage fixation, market pricing and removal (or lowering) of tariffs and subsidies.

Recent developments in time series econometrics have recognised that structural shifts can lead to spurious estimation results and may bias standard cointegration tests. While traditional Augmented Dickey-Fuller tests for stationarity are conducted, the more advanced Lee and Strazicich one- and two-break unit root tests are also used. Attention is also paid to the timing of the structural breaks, and how these accord with *a priori* expectations of when major changes in the economy have occurred. An additional flexibility of the ARDL method for cointegration is that it can allow for additional variables, which in this case will be dummy variables that correspond to structural breaks in the Australian economy.

With the economy becoming more integrated into global markets over the past two decades – particularly capital markets – the analytical model will also be estimated with the sample split between the pre and post financial market and regulatory reforms. As private credit markets have become more developed, access to personal credit has improved, meaning that households may in fact find it easier to smooth consumption. In this situation one may observe households behaving in a Ricardian manner, particularly where they may offset a short-term fiscal contraction with increased borrowing (higher consumption and lower saving). It is anticipated that the estimation results from the split sample will indicate whether fiscal policy has become relatively less effective over time. These estimations will also shed further light as to whether the other explanatory variables have become more or less influential as determinants of private saving.

1. 5 Organisation of the thesis

Chapter 2 surveys the empirical evidence for both the Ricardian equivalence theorem and the twin deficits hypothesis. Previous studies that present empirical evidence for Australia are also highlighted. Attention is also given to the general efficacy of fiscal policy – particularly the empirical literature regarding the size and magnitude of fiscal multipliers. This chapter concludes with a critique of the literature.

Chapters 3 and 4 outline the statistical definition of the balance of payments, theories of current account determination, and the economic theory underlying both twin deficits and Ricardian equivalence. Some discussion is provided to the fundamental differences in the Keynesian and New Classical economics underlying both theories,

while Chapter 4 also notes how structural change – particularly financial liberalisation – may have eroded the efficacy of fiscal policy.

Chapter 5 outlines the analytical model that will be employed in this thesis. As noted above, the analytical model considers the extent to which private saving responds to changes in government saving. Additional explanatory variables include income, real interest rates, inflation, unemployment, welfare safety nets, the terms of trade, and proxies for financial openness and wealth. This chapter also discusses how official measures of saving in Australia relate to the economic concept of saving. Similarly, the measurement of financial openness and wealth effects are also discussed in some detail. Previous empirical studies, particularly those that focus on Australia, have not paid a great deal of attention to the measurement of these variables.

Before proceeding with the estimation of the analytical model, Chapter 6 considers the time series properties of the data. Recent theoretical developments regarding time series econometrics for dealing with structural breaks are outlined. Following this, the Lee and Strazicich one- and two-break tests are conducted on each data series. Attention is then given to the timing of the structural breaks suggested by these tests and how they accord with historically significant changes in the Australian economy.

Chapter 7 estimates the analytical model. Following the results from Chapter 6, dummy variables are introduced into the estimations to accord with structural breaks in the Australian economy. The analytical model will also be estimated with the sample split between the pre and post financial market and regulatory reforms which occurred in the 1980s; with the floating of the Australian dollar in December 1983 taken as the sample break. It is anticipated that the split sample estimations will indicate whether fiscal policy has become relatively less effective over time. After conducting the estimations, hypothesis tests are applied to the coefficient on government saving.

Chapter 8 summarises and concludes this thesis. In reviewing the results, areas for further research are canvassed. Policy implications arising from the results are also considered.

CHAPTER 2 LITERATURE REVIEW

2. 1 Introduction

Before proceeding with chapters covering the underlying economic theory for this thesis and the analytical framework that will be employed, it is crucial to survey the previous literature that is relevant to this work. In addition to considering the empirical evidence regarding Ricardian equivalence and the twin deficits hypothesis, the literature review will also consider previous empirical studies on the efficacy of fiscal policy (fiscal multipliers).

This chapter consists of four sections, which begins with a survey of the empirical literature on the efficacy of fiscal policy. Section 2.3 includes a number of subheadings, and considers the empirical literature for Ricardian equivalence, the twin deficits hypothesis, and empirical studies on the twin deficits in Australia. This is followed by a critique of the previous literature in section 2.4. The chapter concludes with a summary of the literature and a discussion that highlights the original contribution that will be made in this thesis.

2. 2 Empirical studies on the efficacy of fiscal policy

During the 1980s and 1990s, discussion and empirical research on fiscal policy focused primarily on fiscal deficits and government debt as a source of balance of payments problems (twin deficits) and inflation. Research on these areas of fiscal policy waned (particularly in Australia) as balance of payments issues were increasingly viewed as the outcome of optimising individuals and organisations, and monetary policy had assumed the role for achieving short-run stability in output and prices in most advanced economies. However, economic circumstances in a number of countries has seen a renewed interest in the use of fiscal policy for macroeconomic stabilisation. This occurred in Japan over the 1990s – where activist fiscal policy was used in an attempt to boost the economy in the face of slow economic growth and deflation (which had reduced the effectiveness of monetary policy) – and secondly in the United States with a series of income tax cuts in 2001 and 2003 to support economic recovery.

More recently, the sharp economic downturns associated with the global financial crisis in 2008 and 2009 has seen fiscal stimulus packages enacted in many countries, including Australia. However, this increased interest in activist fiscal policy (and earlier actions by Japan and the United States) has to date not seen a large increase in empirical work on the efficacy of fiscal policy and multipliers. As noted by Bayoumi and Sgherri (2006), the volume of analysis on fiscal multipliers is in fact relatively small.

Fiscal multipliers are a feature of Keynesian models – where price rigidity and excess capacity is assumed – and output is determined by aggregate demand. Fiscal expansions therefore have a multiplier effect on aggregate demand and output, with the value of the multiplier usually greater than one and increasing with the responsiveness of consumption to current income. These models also allow for crowding out, which can occur through either: changes in interest rates; exchange rate movements; the extent to which government-provided goods and services substitute for those provided by the private sector; and the extent to which an increase in demand is met through imports. Such crowding out affects will alter the size of fiscal multipliers.

In contrast, the New Classical economics has developed alternative theories regarding the impact of fiscal policy. Ricardian equivalence, rational expectations, consumption-smoothing and uncertainty impacts all emphasise microfoundations, and where such effects occur, act to offset or dampen the efficacy of fiscal policy.

Hemming (et al: 2002) provides an excellent survey of the international evidence on fiscal multipliers from simulations using macroeconomic models and reduced-form specifications. In short, Hemming reports that positive fiscal shocks, generated using estimated macroeconomic models, produce positive multipliers, with expenditure multipliers in the range of 0.6 to 1.5 and tax multipliers in the range of 0.3 to 0.8; long-term multipliers are generally smaller and some are negative.

Reduced-form estimates of fiscal multipliers have tended to place a great deal of attention on the United States, and more recently, Japan. Early studies were usually characterised by output as a dependent variable, followed by other explanatory

variables to capture discretionary fiscal policy (Hemming et al: 2002). Barro (1981) found that temporary changes in defence spending have strong positive effects on output, implying a multiplier in the range of 0.6-0.8; permanent shifts in defence spending have a weaker but still positive effect on output, with a multiplier in the range 0.2-0.6. Romer and Romer (1994) and Perry and Schultze (1993) include variables to control for monetary policy and lags, and derive significantly smaller fiscal multipliers (closer to those yielded by simulation models).

Hemming (et al: 2002) note that a number a number of studies have sought to identify exogenous fiscal shocks more precisely, particularly with regard to endogeneity problems that can occur when estimating fiscal policy effects on output. Ramey and Shapiro (1997) identify three episodes of sharply increased military spending and use these as dummy variables in autoregressions on GDP. They report a positive and significant effect of these defence spending shocks on GDP at impact and after 4-6 quarters. Edelberg, Eichenbaum and Fisher (1999) use the same dummy variables in a VAR framework, and find a similar response on GDP. Other VAR analyses have sought to determine the output effects of fiscal shocks. These studies infer multipliers between 0.1 and 0.9. Using cointegration and error correction analysis, Weber (1999) found long-run multipliers between 1.1 and 1.4.

For Japan, Matsuoka (1996) estimates short-term spending multipliers between -0.2-0.4, while the International Monetary Fund (IMF) estimated a spending multiplier of 0.6 using OLS techniques. Bayoumi (2000) found a short-run government spending multiplier of 0.7 through a VAR model, while the IMF (2002), using a structural VAR model, found the short-run impact multiplier of government spending to be around 0.4.

For the Euro area, Bruneau and de Bandt (1999) report estimates for France and Germany and conclude that fiscal shocks have had almost no effect on output in France in the short-term, but a more significant impact in Germany, with the multiplier peaking at 0.8. Van Aarle (et al: 2003) estimate fiscal multipliers for the euro area and for fifteen EU countries individually. Positive tax and expenditure multipliers were found, while the individual country estimates produced a substantial amount of variation. More recently, Al-Eyd and Barrell (2005) estimated multipliers

for five European countries (France, Germany, UK, Italy, Spain). Results from this study broadly confirm those of other findings, particularly larger multipliers for Germany, and suggest that the proportion of liquidity constrained households in each country impacts the multiplier estimates.

As Kennedy (et al: 2004) note, there is little empirical evidence on the efficacy of fiscal policy in Australia, or estimates of fiscal multipliers. What little evidence that is available is broadly consistent with what has been observed in other studies. Perotti (2002) finds a positive short-term impact spending multiplier of 0.6 for Australia over the past two decades, peaking at 0.8 after 14 quarters. The estimate of the long-term spending multiplier is 0.6 over the same period. Perotti (2002) also found solid short-term multipliers for Germany, consistent with Bruneau and de Bandt (1999).

De Arcangelis and Lamartina (2003) estimate an SVAR model similar to that of Blanchard and Perotti (2002) for Germany, France, Italy and the United States. The estimated impact of fiscal policy shocks was limited: with a 1 per cent change in government spending (or taxes) on GDP rarely having an impact on output no greater than 0.1 per cent in a quarter. These low multiplier estimates are consistent with those of Perotti (2002).

Bayoumi and Sgherri (2006) estimate fiscal multipliers based on an intertemporal model where households are myopic, discounting the future at a higher rate than the prevailing real rate of interest. In this framework, a tax cut (or an increase in transfers) raises spending because the wedge between the real interest rate and the discount rate implies that the net present value of the tax cut exceeds that of the subsequent increase in taxes needed to keep the government solvent. Consumption functions were estimated with error corrections models for the United States from 1955. Results suggest that consumers spend almost two-thirds of a change in their income, but only about one-third of any change in net taxes.

More recent studies have included those of Gali (et al: 2007), and Perotti (2007). Gali estimated the response of several macroeconomic variables to a government spending shock, with results suggesting an output multiplier in the United States of

0.68 per cent on impact, rising to 1.74 per cent after two years. Perotti conducted an SVAR analysis on both quarterly and annual data for the United States, the United Kingdom, Canada and Australia. Responses of GDP and consumption were positive in all countries, but smaller than the US, where the output multiplier was estimated as 0.72-0.98 on the quarterly data, and 3 on the annual data series – which is substantially higher than many other studies. For Australia, Perotti estimates output multipliers of around 1.3 on the quarterly data (1959:3-2006:2), and between 1.13-1.68 on the annual data (1949-2006). Outside of the United States, Perotti's estimated consumption multipliers were rarely larger than 0.5, and were statistically insignificant for Australia.

The IMF's 2008 World Economic Outlook contains recent measures of fiscal multipliers. A regression analysis attempted to examine the effects of discretionary fiscal policy on real GDP growth, while controlling for the potential effects from monetary policy and other sources of demand that might affect the transmission of fiscal stimulus. The IMF finds that for advanced economies, a 1 percentage point fiscal stimulus leads to an increase in real GDP growth of around 0.1 per cent on impact, and up to 0.5 per cent after three years. Additionally, the IMF's analysis suggests that revenue-based stimulus measures seem to be more effective in boosting real GDP than expenditure-based measures, particularly in the medium term and in advanced economies. Expenditure-based shocks were found to have consistently negative effects in emerging economies after three years, perhaps reflecting concerns that once implemented, increased expenditures become entrenched spending and difficult to remove.

Mountford and Uhlig (2008) conducted a VAR analysis on quarterly data for three types of policy scenarios for the United States: a deficit financed spending increase; a balanced budget spending increase (financed with higher taxes); and a deficit financed tax cut, in which revenues increase but government spending stays unchanged. Estimated multipliers were 0.91 for deficit spending, 0.47 for balanced budgets and 3.8 for tax cuts – which is quite large compared with previous empirical estimates of tax multipliers for the United States.

2. 3 Theories on the relationship between budget and trade deficits

As noted in the preceding discussion, empirical research on fiscal policy throughout the 1980s and early 1990s was focused upon fiscal deficits as a source of balance of payments problems. The hypothesis that increases in the government's budget deficit lead to increases in the trade deficit (in the sense that they are "twins") can be regarded as a feature of Keynesian models, with excess capacity and price rigidity. Fiscal expansions lead to higher domestic interest rates, and other things being equal, a higher exchange rate and subsequent deterioration in the balance of payments. Proponents of Ricardian equivalence argue that fiscal and trade deficits are entirely unrelated to one another. If Ricardian equivalence holds, shifts between taxes and government borrowing have no real effect on interest rates, aggregate demand and consequently the trade balance.

The previous section provided estimates of fiscal multipliers that were generally less than one in magnitude. While this may be due to leakages and crowing out effects, it may also be due to Ricardian behaviour on the part of households and business. The following section examines the empirical evidence for both Ricardian equivalence and the twin deficits proposition. While the empirical literature is surveyed below, the specific theories for both Ricardian equivalence and the twin deficits hypothesis will be discussed in Chapter 4.

2.3.1 The Ricardian equivalence theorem

As noted by Leachman (1996), David Ricardo (1966) argued that there is no first-order difference between debt and tax-financed government expenditure. Public debt imposes a stream of future interest payments as well as possible repayment of the principal. These payments must be financed by future taxes, money creation, reduced government expenditure, or additional deficits. Perpetual debt finance may provide an avenue of escape for governments, however, such Ponzi schemes are dependent upon the public's willingness to hold ever expanding amounts of debt without concern for the government's limited ability to raise revenue. Ricardian equivalence restricts this debt 'chain letter mechanism' by imposing increases in future taxes.

In his 1974 paper titled '*Are government bonds net wealth?*', Barro considered the effects on bond values and tax capitalisation of finite lives, imperfect capital markets, a government monopoly in the production of bond 'liquidity services' and uncertainty about future tax obligations. Within the context of an overlapping generations model, Barro showed that finite lives will not be relevant for future tax liabilities so long as current generations are connected to future generations by a chain of operative intergenerational transfers (Barro: 1974). This paper gave rise to what is now known as the Ricardian equivalence theorem, or the Barro-Ricardo hypothesis. The key result of Barro's investigation being that so long as there is an operative intergenerational transfer, there will be no net-wealth effect and no effect on aggregate demand; or on interest rates of a marginal change in government debt. Essentially, under the Barro-Ricardo hypothesis deficits do not matter, and do not have any impact on the macroeconomy.

Buchanan (1976) first pointed to the close relationship between the Barro proposition and the work of David Ricardo. However, as noted by Ricciuti (2003), other scholars such as Patinkin (1965), Bailey (1971), and Kochin (1974) had also suggested the means of funding government debt creation does not matter and produced work similar to that of Barro (1974).

Following his 1974 work, Barro (1979) noted that the Ricardian equivalence theorem appeared to be evolving into a respectable viewpoint on public debt. However, having concluded that the choice between debt and taxes did not matter, a theory of public debt creation was yet to be constructed for proponents of the Ricardian hypothesis. Barro (1979) sought to develop a simple theory of "optimal" public finance that identified factors that would influence the choice between taxes and debt issue. Barro's theoretical model was formulated to test a number of hypotheses which included: the positive effects on debt issue of temporary increases in government spending; the negative effects of temporary increases in income; and one-to-one effects of expected inflation rates on the growth rate of nominal debt (Barro: 1979). Utilising time series data on public debt issues in the United States since World War I, Barro found that the results supported his underlying hypotheses.

In a later paper, Barro (1989) reviewed and summarised the Ricardian approach to budget deficits, while also summarising the main theoretical objections to the hypothesis. These objections include: that people do not live forever and do not care about future taxes; private capital markets are not perfect; future taxes and income are uncertain; taxes are not lump sum; and the assumption of full employment. Barro argued that a number of empirical findings on interest rates, consumption and saving and the current account balance tended to mainly support the Ricardian viewpoint. However, Barro also noted that empirical analysis involves substantial problems with data and identification – leading Barro to form a view that the empirical literature is inconclusive. Elmendorf and Mankiw (1999) have also concluded that the empirical evidence is inconclusive.

Both Leiderman and Blejer (1988) and Seater (1993) provide in-depth overviews of the Ricardian equivalence theorem. Leiderman and Blejer (1988) illustrated the implications of Ricardian equivalence. In addition to critically surveying the previous literature, Leiderman considered the effects of relaxing the main assumptions of the Ricardian model, and provided a framework for studying various extensions to the theorem. Leiderman concluded that deviations from the core assumptions of Ricardian equivalence imply that debt finance policies can have an impact on private consumption and aggregate demand.

Seater (1993) reviewed the underlying theory of Ricardian equivalence while also surveying both the indirect and direct evidence supporting the hypothesis. Seater found that while Ricardian equivalence is logically consistent, the restrictions required for it to hold are many and not likely to be met. Seater concluded that once the empirical studies are corrected for econometric problems, Ricardian equivalence is corroborated – or at least that it is not possible to reject Ricardian equivalence.

Gale and Orszag (2004) note that previous empirical studies of the effects of fiscal policy on consumption and saving have taken three general approaches – the first, and largest body of literature, uses reduced-form analysis of consumption and saving patterns in United States and other countries. These studies include consideration of variables such as private saving, interest rates, exchange rates and income. The most common of these studies focus on equations for consumption and/or saving to

produce estimates of the offset coefficients for private-public saving. International evidence from these studies suggest a partly Ricardian world, with an average private sector saving offset coefficient of around one half (Masson, Bayoumi and Samei (1995), Edwards (1996), Callen and Thimann (1997), and Loayza, Schmidt-Hebbel and Serven (2000)). For a panel of OECD countries, a recent paper by de Mello (et al: 2004) also estimated a private savings offset of around one half in the short run, which decreases to around a third over the long run.

Walker (2002) considered the extent to which Japanese households are Ricardian – particularly given high private saving rates and large fiscal deficits. VAR techniques on Japanese national accounts data yielded fiscal multipliers which the author found to be of negative sign for tax changes on output – suggesting that Ricardian equivalence holds – and that there is some form of private savings offset to changes in fiscal policy. Looking at South Korea, Yi (2003) considered the responses of the real exchanges rate, current account and consumption to changes in fiscal policy. The author did not find a cointegrating relationship between these variables – which was interpreted as evidence supporting Ricardian equivalence.

Following the analytical framework presented in Bernheim (1987), Giorgioni and Holden (2003) considered Ricardian equivalence across ten developing countries: Burundi, El Salvador, Ethiopia, Honduras, India, Morocco, Nigeria, Pakistan, Sri Lanka and Zimbabwe. Applying Bernheim's framework of private consumption across this panel of countries, the authors concluded that some evidence of Ricardian equivalence was present, but stressed caution given the diversity of countries and data limitations within the panel.

In a short empirical analysis, Azar (2005) estimated a linear Keynesian (investment-saving) curve, and a second curve consistent with Ricardian equivalence. Looking specifically at the United States, the author compared diagnostic results between the two regressions, and concluded that the Ricardian specification was more appropriate – primarily due to this model having a higher R-square, no serial correlation or heteroscedasticity. However, this article did not contain any discussion regarding the sign and size of the estimated coefficients.

Drakos (2001) considered the extent to which private saving in Greece offsets government debt. A long-run cointegrating relationship was found between private saving and government borrowing. The author's null hypothesis of a long-run coefficient on private saving equal to unity (full Ricardian equivalence) was rejected – leading to the conclusion of only a partial private savings offset.

Afonso (2005) examined a panel of EU-15 countries for evidence of Ricardian equivalence. While the sample period covered 1970-2003, the author also examined subsamples associated with the Maastricht Treaty (1992) and the Stability and Growth Pact (1996). Using two-stage least squares, a model of primary balance and debt to GDP ratios was estimated for the panel. The author concluded that the EU-15 governments have a tendency to use the primary budget surplus to reduce debt to GDP ratios – which he regards as being synonymous with Ricardian equivalence. These results also held for the pre- and post-Maastricht and pre- and post-Stability and Growth Pact periods. While subsample estimations were considered (given the likely presence of structural change over these periods), the author did not undertake any econometric investigation of structural breaks. More recently, Reitschuler (2008) tested for Ricardian equivalence in eleven new EU-member states and concluded that Ricardian equivalence could not be rejected for four of these new member countries.

Berben and Brosens (2007) considered whether government debt levels could explain observed consumer reactions to fiscal policy. Looking at a panel of seventeen OECD countries, the authors estimated a non-linear consumption function via the ARDL approach to cointegration. The authors concluded that in the long-run, consumption is positively related to disposable household income, equity wealth, and housing wealth. Government debt has a statistically significant negative impact – implying that a fiscal expansion is partly crowded out by a fall in private consumption (higher saving).

There have been few reduced-form studies of the Australian situation. However, two studies undertaken in the early 1990's (see Blundell-Wignall and Stevens: 1992, and Edey and Britten-Jones: 1990) and a study undertaken by the IMF in the late 1990's (Lee: 1999) suggest no significant offset in private saving. More recently Comley

(et al: 2002) estimated a private savings offset for Australia of around 0.34 in the short run, and 0.5 over the long run.

The second stream of empirical literature identified by Gale and Orszag (2004) focuses on testing the underlying assumption of the permanent income/life cycle hypothesis that underpins Ricardian equivalence. Results from this research are varied, but tends to reject Ricardian equivalence – finding that consumption is more sensitive to fluctuations in current income than predicted by permanent income/life cycle models. Studies include Hall and Mishkin (1982), Flavin (1985), Zeldes (1989) and Caroll and Summers (1991).

A number of papers have found that consumption is split between permanent income consumers and current income consumers. Results from authors including: (Campbell and Mankiw (1989, 1991); Corbo and Schmidt-Hebbel (1991); and Evans and Karras (1996) tend to corroborate the reduced-form studies, in that there appears to at least be some partial Ricardian equivalence. Kormendi (1983) also found no evidence of non-Ricardian effects. Other studies in this area include those of Feldstein (1982), and Seater and Mariano (1985).

A third strand of the literature focuses on Euler equation tests, although the number of empirical studies has been quite scant. Gale and Orszag (2004) note that the advantage of using the Euler equation approach is that Ricardian equivalence requires a combination of utility maximisation and rational expectations – which can be explicitly incorporated into the Euler equation. Studies in this area have included Graham and Himarios (1991), who found non-Ricardian results using a nonlinear instrumental variables procedure. Using the Blanchard (1985) model, which includes both Ricardian and non-Ricardian alternatives, Evans (1988, 1993), and Evans and Hasan (1994) obtained results that support Ricardian equivalence.

Considering these three broad streams of empirical analysis, Gale and Orszag (2004) provided evidence that sustained budget deficits reduce national saving and raise interest rates in the United States. Applying econometric specifications that nest Ricardian and non-Ricardian models, these authors provided evidence of strong non-Ricardian behaviour in aggregate consumption. Projected future deficits were found

to affect long-term interest rates, whereas current deficits do not. For each one per cent of GDP increase in current debt, national savings falls by 0.5 to 0.8 per cent of GDP. Further to this, each one per cent of GDP increase in projected future deficits raises long-term interest rates by 25 to 35 basis points, and each one per cent of GDP increase in future primary deficits was estimated to raise interest rates by 40 to 70 basis points.

2.3.2 The twin deficits hypothesis

A combination of large Federal Government deficits and large current account deficits (in the United States) during the 1980s led many observers to believe that the deficits may be closely related. Martin Feldstein (1985 & 1987) is often attributed as having popularised the twin deficits hypothesis in the United States. However, after reviewing United States fiscal policy and trade performance during the 1980s, Feldstein later (1990) noted that the deteriorating trade balance was due to a higher dollar, which was caused by higher interest rates as a result of fiscal deficits. This according to Feldstein should be treated as a special one-off and not as an indication of a long-run phenomenon. Despite this conclusion, a great deal of empirical research has sought to determine whether fiscal and trade deficits are linked.

Previous empirical literature on the twin deficits hypothesis was conducted primarily in the United States around the late 1980s and early 1990s. Techniques used to examine the hypothesis have included reduced-form models, multiple equation and small-scale structural models, vector autoregressions (VARs), cointegration (both univariate and multivariate) and error-correction models. The literature surveyed below suggests that not only are the models sensitive to the choice of variables employed, but they are also particularly sensitive to choosing variables which accurately reflect the transmission path, or causation, from budget to trade deficits.

Early VAR analyses of twin deficits include those of Miller and Russek (1989), who estimated VAR and univariate cointegration models to test the twin deficit relationship over the period 1946-1987. Evidence of causation from the government deficit to net exports was found by the authors for the flexible exchange rate period. Abell (1990) tested for evidence of the twin deficits in the US economy throughout the 1980s, and found that budget deficits influence trade deficits indirectly rather

than directly. Through Granger causality testing, Abell found that the deficits are linked through the transmission mechanisms of interest rates and exchange rates. However, Mohammadi and Skaggs (1999) note that Abell's study focused on a period of continuous dollar appreciation in the United States.

Enders and Lee (1990) estimated a consumer optimisation model consistent with the Ricardian equivalence hypothesis. A six variable VAR for the post-war period (1947-1987) was estimated. Results from the unconstrained VAR suggest that government spending innovations generate a persistent current account deficit. However, when the authors imposed restrictions on the model consistent with the Ricardian equivalence hypothesis, which included a representation of how the growth in past government debt affects real interest rates and consumption; the authors were unable to reject this hypothesis.

Kearney and Monadjemi (1990) used VAR regressions across eight countries (Australia, Britain, Canada, France, Germany, Ireland, Italy and the United States) for the period of floating exchange rates (1972-1987). The authors found evidence of a temporary or short-run twin deficit relationship which does not persist over time.

A five variable VAR is used by Rosenwig and Tallman (1993) over the period 1961-1989 to test the relationships between fiscal deficits, the dollar and trade deficits. The authors constructed five variables (government purchases, government balance, trade balance, interest rates and exchange rate) based upon a series of theoretical transformations which included: taking ratios to nominal GDP (to obtain measures in real terms); constructing estimates of real interest rates (difference between the nominal rate on three month Treasury bills and the ex post consumer price index); and constructing a real exchange rate series (trade-weighted exchange rate against ten major currencies). Using this data, the authors' VAR model was intended to distinguish between the Mundell-Fleming and Ricardian interpretations. Results suggest that US government deficits may have contributed to dollar appreciation and large trade deficits in the 1980s.

Corsetti and Muller (2006) use a structural VAR model to investigate the transmission of fiscal shocks for Australia, Canada, the United Kingdom and the United States. The authors show that the likelihood and magnitude of twin deficits increases with the degree of openness of an economy, and decreases with the persistence of fiscal shocks. For the United States, the authors found evidence that corroborates earlier findings that fiscal expansions only have a negligible or even positive effect on the external balance. For Canada and the United Kingdom, economies which the authors considered to be more open than the United States, stronger evidence was found for a twin deficit relationship. Curiously, the authors considered that like the United States, the Australian economy is relatively less open. Nevertheless, results suggested little evidence of twin deficits in Australia.

Most recently, Kim and Roubini (2008) considered the twin deficits hypothesis for the United States over the flexible exchange rate period. Based on a VAR analysis, results suggest that expansionary fiscal policy shocks (including deficit shocks) actually improve the current account and depreciate the real exchange rate – which the authors refer to as "twin divergence" as opposed to twin deficits. This result is driven by a partial Ricardian savings offset (private savings increases) combined with a fall in investment due to crowding out effects (via an increase in the real interest rate).

Studies using systems of equations include those of Zietz and Pemberton (1990), who sought to examine the relationship between the United States Federal budget and the US trade deficit along with other factors including slow income growth in trading partner countries. The sample period used by the authors was from the floating of the US exchange rate (1972), to just prior to the stock market crash (1987). Model simulations showed that the United States budget deficit in the 1980s was transmitted to the trade balance through the impacts of rising domestic absorption and income as opposed to rising interest and real exchange rates. Foreign income was also found to have had a small influence on the trade deficit during the 1980s. Dewald and Ulan (1990), who followed the methodology adopted by Roubini (1988), found no association between the current-account and government budget balances.

Kasa (1994) studied the twin deficits in the United States, Germany and Japan with a finite horizons model applied to annual post-war data. After estimating a system of equations using joint maximum likelihood estimation, the author found that in all three countries there is a significant link between trade deficits and budget deficits. Additionally, the data analysed by the author suggested wide disparities in planning horizons (as measured by their expected lifetimes) between the United States, Germany and Japan. The longer individuals' time horizons are, other things being equal, the weaker will be the relationship between budget and trade deficits – leading to Ricardian equivalence effects. The United States was found to have a much shorter planning horizon than Japan, with Germany falling somewhere between the two.

Erceg (et al: 2005), of the United States Federal Reserve Bank, used an open economy dynamic general equilibrium model (SIGMA) to assess the quantitative effect of fiscal shocks on the trade balance. The authors' model emphasises a New Keynesian methodology, where there is a monopolistically competitive framework to represent stickiness in the aggregate price level. Non-Ricardian consumption behaviour is introduced into the model by assuming two types of households: optimising households which maximise welfare subject to an intertemporal budget constraint; while the other type of households consume their entire disposable income in each period. The authors considered the effects of two alternative fiscal shocks: a rise in government consumption; and a reduction in the labour income tax rate. A one per cent rise in the US government spending share of GDP was found to cause a trade balance (as a share of GDP) deterioration of less than 0.2 per cent after 2-3 years. Reducing the labour income tax rate, so that it induces a deterioration the fiscal balance of about one per cent, also caused a deterioration in the US trade balance of less than 0.2 per cent of GDP.

An early study of twin deficits using time series econometrics was that of Darrat (1988), who examined evidence of Granger causality between budget and trade deficits. While evidence of bidirectional causality between budget and trade deficits was found, the use of multivariate causality tests also indicated that a number of macroeconomic variables (such as the exchange rate, interest rates and the monetary base) are key variables causing changes in the trade deficit. Causality tests

undertaken by Bachman (1992) suggested a unidirectional Granger causation from the budget deficit to the current account – despite the author finding no evidence of cointegration between the United States current account and budget deficit for the period 1974-1988.

Mohammadi and Skaggs (1999) estimated a five variable vector error correction model for the US economy over the period 1973 to 1991. While bivariate cointegration between fiscal and trade deficits was not found, the authors noted that by experimenting with longer lag lengths, the ordering of variables, and the use of broad measures of budget and trade deficits, would virtually guarantee relatively large estimated effects of budgets on trade deficits.

Hatemi-J and Shukur (2002) undertook Granger causality tests to determine the direction of causality between government expenditure, real interest rates, investment and the current account in the United States. For the entire sample period (1975-1998), Granger causality tests indicate that current account deficits do not Granger-cause budget deficits in the United States. However, for the period 1975-1989, fiscal deficits Granger-caused current account deficits. These results were reversed for the period 1990-1998 – suggesting that current account deficits Granger-cause budget deficits.

Other empirical studies which have not followed the broad methodologies considered above include those of Normandin (1999), who studied the relationship between budget and trade deficits for both the United States and Canada from the perspective of Blanchard's (1985) overlapping generations model. Results of Normandin's model revealed that the response of the trade deficit to changes in the budget deficit is positively affected by changes in the birth rate (a large birth rate implies that the tax burden can be more easily shifted to future generations) and by the degree of the persistence of the budget deficit. The overall results of Normandin's research revealed that formally taking into account the stochastic properties of the budget deficit is crucial for testing the twin deficits hypothesis.

Sopraseuth (1999) examined the relationship between net exports in the United States and the government budget balance using a real business cycle model. The

author discovered that when technological shocks are more volatile than government spending shocks, US net exports and the budget balance move in opposite directions. Conversely, twin deficits appears because of dominant government shocks. This finding seems to support the twin deficits hypothesis from the 1960s to the 1980s. However, Sopraseuth notes that further investigation is required for the 1990s where trade and fiscal deficits in the United States are negatively correlated, and government spending shocks were much more volatile.

With the exception of Kasa (1994) and Kearney and Monadjemi (1990), the preceding discussion of studies undertaken on the twin deficits phenomenon has primarily focused upon the United States. Twin deficits theory has interested researchers elsewhere – particularly for small open economies such as Australia. Islam (1998) studied the relationship between budget and trade deficits in Brazil over the period 1973-1991. Using Granger causality tests, the author found that there is bidirectional causality between trade and budget deficits in Brazil. Vamvoukas (1999) studied the relationship between budget and trade deficits in Greece. Using annual data based on multivariate cointegration analysis, error correction mechanisms and Granger trivariate causality, the author found unidirectional causality from budget deficits to trade deficits in both the short and long run.

Using the National Institute of Social and Economic Research (London) Global Econometric Model (NiGEM), Peeters (1999) studied the relationship between national and public savings, investment and the current account in the United States, Japan, Germany and the UK. The main objective of Peeter's research was to verify whether: the NiGEM model corroborates the results of partial studies which have sought to evaluate whether public and private saving affects (private) investment positively; investment as well as government deficits affect current account balances negatively; and government deficits affect future saving positively. In relation to twin deficits, the model suggested that decreasing the government deficit by fiscal policy is preferred as it lowers the current account deficit in the model (as opposed to an increase in private saving).

Kouassi (et al: 2004) considered causality tests of the twin deficits hypothesis for a sample of twenty developed (Australia, Austria, Canada, France, Italy, Netherlands,

New Zealand, United Kingdom and the United States) and developing countries (Columbia, Dominican Republic, India, Israel, Korea, Malaysia, Singapore, South Africa, Thailand and Venezuela). Results of multivariate cointegration tests (Johansen procedure), did not find a cointegrating relationship between the current account and budget deficits in Australia (annual data 1969-1997), while Granger-causality tests did not indicate any causal relationship. For the other developed countries, only the United Kingdom displayed evidence of a cointegrating relationship and uni-directional causality. Most of the developing countries displayed both cointegrating relationships and uni-directional causality.

Baharumshah (et al: 2006) examined the twin deficits in the ASEAN-4 countries. Attention was paid to structural breaks with the Zivot and Andrews (1992) unit root test, along with the Gregory and Hansen (1996) cointegration test with structural breaks. Cointegration was found (Johansen) for Indonesia, Malaysia and Thailand. Considering the Gregory and Hansen test, cointegration with one structural break was found for the Philippines. Causality tests also indicated uni-directional causality from budget deficits to current account deficits. Indirect support was found for a causal relationship that runs from budget deficits to higher interest rates, and higher interest rates leading to an appreciation of the exchange rate, which in turn leads to the widening of the current account deficit. In a similar study, Kim and Kim (2006) considered the case of South Korea, and found structural breaks around 1997 and 1985 on the budget deficit and current account using the Zivot and Andrews unit root test. While Granger causality from budget deficits to the current account was not established, test results suggest that causality runs in the opposite direction.

Bagnai (2006) revisted Fidrmuc's (2003) analytical model for 22 OECD countries for the period 1960-2005 (annual data). Attempting to take into account structural change, Bagnai employs the Gregory and Hansen cointegration technique. However, the author did not fully consider the possibility of structural breaks in the unit root tests – relying upon conventional Augmented Dickey-Fuller tests. This is a critical point as Chapter 7 notes that all variables entering into the Gregory and Hansen model need to be integrated of order one. Without considering the possibility of structural breaks in the unit root tests, the possibility exists that a number of variables could be stationary time series with one or more structural breaks. Notwithstanding

these shortcomings, the Gregory and Hansen procedure suggests a cointegrating relationship between fiscal and current account deficits for both the United States and Australia. The average long-run coefficient on the government budget was 0.4 – suggesting that the impact from government budgets to the current account is not one-for-one, and that there is either some form of offsetting savings behaviour or leakage.

Bartolini and Lahiri (2006) reconsidered Bernheim's (1987) analysis of the response of private consumption to changes in fiscal policy for two panels of countries: the 26 countries used by Bernheim, and the OECD group of countries as a whole. The authors find that lower public saving in advanced economies is associated with higher private consumption and hence reduced national saving. These results also suggest that there is only a partial effect. On average, each extra dollar of fiscal deficits is associated with a rise in private consumption – or a fall in national saving – of about 35 cents in the 1972-2003 period, compared with a rise in consumption of 40 to 50 cents in the 1972-83 period. The authors cite financial innovation and increased financial openness, along with forward looking fiscal rules as key determinants of the differences between the sample periods.

Mukhtar (et al: 2007) considered twin deficits in Pakistan. Cointegration results suggest evidence of cointegration between fiscal and current account deficits, while Granger causality tests indicate bidirectional causality between the two variables.

Beetsma (et al: 2008), consider twin deficits for a panel of European Union countries. Rather than considering the trade balance as a ratio of GDP, the authors split the trade balance into its components and included these as elements in their VAR estimation. Results showed that a one per cent of GDP spending impulse causes output to rise by 1.2 per cent, and the trade balance to deteriorate by 0.5 per cent of GDP – lending some support to twin deficits.

Corsetti and Muller (2006) consider a sample of 10 OECD countries to study the co-movement of government budget and trade balances over the post-Bretton Woods period (1973-2005). Correlation between budget and trade deficits was established

for most of the OECD countries (including Australia and the United States). However, the authors note that this relationship is weaker for more open economies.

2.3.3 Twin deficits in Australia

One of the earliest studies to consider twin deficits in Australia was by Kearney and Fallick (1987), who considered the extent to which the formulation of fiscal policy in Australia is constrained by the balance of payments. Using ordinary least squares as the estimation technique, two equations were estimated separately for Australia. The first equation measured the relationship between the current account deficit and budget deficit (as ratios of GDP), while the second equation estimated investment as a function of saving (as ratios of income). These two equations were estimated not only for Australia, but also for Canada, Germany, Japan, the United Kingdom and the United States. With the exception of the United States, the authors concluded that evidence of a relationship between budget and trade deficits does not hold for all of the countries examined.

Nguyen and Pagan (1990) employed a number of Australian macroeconometric models to test the relationship between fiscal policy and the current account. Nguyen and Pagan's analysis sought to determine the predicted value of *k* in these models, where *k* is the multiplier showing how much the current account improves for every unit decrease in the fiscal deficit. A value of *k* equal to one implies an equal offsetting improvement in the current account for every one unit decrease in government spending (twin deficits), and a value of *k* equal to zero implies no change in the current account for a one unit decrease in government spending (Ricardian equivalence). The authors requested the proprietors of the main Australian macroeconometric models at that time: County/Nat West, IMP, NIF88 (Treasury), ORANI-F, AMPS, MSG and MURPHY to simulate the impact of a permanent, unanticipated reduction in the fiscal deficit of two per cent of GDP for a period of five years. The simulation results produced an average value of *k* equal to 0.5 for a three year simulation, whilst five-year simulations produced an average value of *k* equal to 0.52. For most of the models, Nguyen and Pagan noted that the effect of reduced government spending was mainly seen through exports and price effects on imports. The Treasury model obtained an improvement in the current account due to

the effects on interest payments arising from a decline in debt and an appreciation of the Australian dollar.

Following Nguyen and Pagan (1990), a number of other studies into the twin deficit phenomenon in Australia also utilised large macroeconometric models. Freebairn (1990) reported the results of an application of the ORANI model, which was used to project the medium-term effects of reductions in government expenditure on real macroeconomic activity, the government budget balance, the balance of payments, industry output and relative prices. Following a simulation where government expenditures were lowered, the model suggested that the trade balance in dollar terms improves by about half of the dollar reduction in government expenditures. Within the framework of the IMP model, Hughes (1990) analysed the effects of a cut in government expenditure amounting to approximately two per cent of GDP. In response to this, the current account deficit was found to improve by 0.24 percentage points in the initial year of the cut. After five years, the improvement in the current account deficit was only a quarter to a third of a percentage point.

Parsell (et al: 1991) reported results of simultaneous equation simulations (made with both the Murphy and McKibbin-Sachs Global models) on the effects of fiscal restraint on the Australian economy. The authors examined the response of each model to a two percentage point reduction in the share of government spending to GDP maintained for five years. The result of the decrease in government expenditure was a decline in interest rates – resulting in a depreciation of the dollar as investors sought to hold assets denominated in foreign currency. Consequently, these effects resulted in an improvement in the trade balance as lower domestic consumption also resulted in a fall in imports, and the lower exchange rate resulted in a lift in exports.

Karunaratne (1992) focused upon the twin deficits in the Australian context for the flexible exchange rate period 1983 to 1991. Cointegration (univariate) and causality tests revealed a weak relationship between the deficits, with causality running from the budget deficit to the current account. Based upon the empirical results, the Karunaratne concluded that the twin deficits hypothesis in the Australian context cannot be rejected.

Fidrmuc (2003) examined the time series properties of the current account, fiscal balance, and investment shares in industrial countries (including Australia) and a number of emerging and transition economies over the period 1970-2001. Multivariate tests for a cointegrating relationship between the trade balance (X-M), the fiscal balance (T-G) and gross fixed capital formation (I) for Australia indicate a relationship over the 1980s, but not for the 1990s. Interestingly, estimates of the long-run cointegrating equation for Australia produced a negative coefficient for the fiscal balance in the 1980s, and a positive value for the 1990s.

2.3.4 The intertemporal current account model

A number of studies have considered Australia's current account from the perspective of the intertemporal approach – which views the current account as the outcome of forward-looking dynamic saving and investment decisions.[4] The intertemporal model is important for explaining the long-run evolution of the current account, particularly for situations where countries may run persistent current account surpluses or deficits, and is also well suited for identifying factors which may cause sudden current account reversals.

Empirical evidence supporting the intertemporal current account model for Australia is mixed.[5] Milbourne and Otto (1992) rejected the intertemporal model using quarterly data for Australia (1959:3-1989:1), and noted that the consumption-smoothing model was unable to explain a number of large sustained movements in Australia's current account balance. Conversely, McDermott (1999) found evidence that supports the intertemporal model with a smaller data sample covering 1981:1-1998:1. Studies using annual data have included those of Cashin and McDermott (1998) and Otto (2003), who both find support for the intertemporal approach. Bergin and Sheffrin (2000) found evidence that supports the intertemporal model by extending their analysis to account for exogenous shocks.

More recently, Belkar (et al: 2007) provide an overview of the historical development of Australia's current account and discuss the public concerns with

[4] This model is discussed in the next chapter.

[5] These studies follow Campbell (1987), and Campbell and Shiller (1987).

Australia's growing stock of net foreign liabilities in the 1980s (following the float of the dollar), along with the associated policy arguments put forward at that time. The authors test an intertemporal model of the current account that considers a long data set (annual data covering 1949-2005) to account for the effect of the opening of Australia's capital markets and financial market deregulation during the 1980s. The model also incorporated shocks to net cash flows that may be correlated with disturbances in the rest of the world (which will have a limited effect on the current account). Belkar (et al: 2007) find that Australia's current account adjusts in a manner that is consistent with the intertemporal model when faced with temporary shocks to output, government expenditure and investment. However, the authors note that this result only applies in the period following financial liberalisation in the early 1980s. The authors also find evidence of consumption tilting, and that this has contributed to a persistent current account deficit of around 4½ per cent of GDP since the mid 1980s.

2. 4 Critique of the existing literature

Conflicting results found in the empirical literature for Ricardian equivalence and the twin deficits appear to stem from wide differences in empirical techniques, data measures and samples. However, econometric techniques to study the twin deficits hypothesis over the past two decades have varied markedly with the development of new estimation methods – the most significant being the introduction of time series and cointegration analysis throughout the late 1970s and through to the 1990s. While the general functional forms of the models did not generally alter, attention was paid to the time series properties of the data, and cointegrating relationships were examined.

Early cointegration techniques were of the univariate type, with multivariate techniques used in the 1990s as the theoretical and empirical literature dealing with this area of econometrics developed. VAR techniques were also utilised – particularly for obtaining empirical estimates of fiscal multipliers.

A substantial criticism that can be directed at previous studies is a lack of consideration for structural change – particularly over long samples. While this is addressed in more detail in subsequent chapters, structural breaks can have

permanent effects on the long-run level of many macroeconomic data series. Failing to account for these breaks can lead to results that are biased and do not accurately reflect the true population mean. The last decade has seen a great degree of research on structural change and time series econometrics, which will be applied to the estimation procedures undertaken in this thesis. A number of recent studies, notably those of Baharumshah (et al: 2006), Kim and Kim (2006) and Bagnai (2006) have sought to examine the implications of structural change. However much of this analysis is focused on one-break unit root tests, such as those proposed by Zivot and Andrews (1992), and the cointegration tests developed by Gregory and Hansen (1996).

Mohammadi and Skaggs (1999) note that no previous studies take into account an appropriate measure of the budget deficit as official statistics often do not separate government purchases into consumption and investment expenditures. Further, state and local government budgets should also be considered in an aggregate measure of the government budget. These criticisms will be addressed in the analysis undertaken in this thesis. The Australian National Accounts includes disaggregated government consumption expenditure across all three levels of government (Commonwealth, State and Local), as well as a measure of general government (total) which is the summation of budget aggregates across the Commonwealth, state and local government sectors.

Empirical literature covering the efficacy of fiscal policy, Ricardian equivalence, and the twin deficits proposition has also focused heavily on the United States. While recent years have seen greater attention paid to small open economies, very little research has been produced for Australia. Previous research for Australia is also extremely dated – particularly with regard to the twin deficits hypothesis. Additionally, the structure of Australia's economy has changed markedly since the late 1980s and early 1990s.

2. 5 Summary and concluding remarks

During the 1980s, concern in the United States over fiscal and current account deficits led to arguments that these deficits were linked, or 'twins'. The Reagan Administration conducted an expansionary fiscal policy by cutting taxes, which was

not accommodated by monetary policy. This placed upward pressure on US interest rates – which subsequently boosted the US dollar. The exchange rate appreciation led to a fall in net exports and a rise in the US current account deficit. Under these circumstances, the current account appeared to mirror the fiscal position, leading to the popularisation of the twin deficits hypothesis. These debates were not restricted to the United States, where political and public concern in Australia was also focused on the current account and rising net foreign debt.

Barro's Ricardian equivalence theorem presents an alternative viewpoint on public debt. Due to its focus on successive generations (particularly the behaviour or altruistically motivated individuals), present value constraints and debt financing mechanisms, the Ricardian equivalence theorem gained many adherents at a time when theoretical literature emphasising dynamics and the microfoundations of macroeconomics was increasing at a rapid pace. At this time, the Ricardian equivalence theorem, and the accompanying literature of the New Classical Macroeconomics, provided a more rigorous and longer-term perspective on the effects of public debt.

As noted in the previous section, differing results found in the empirical literature on Ricardian equivalence and twin deficits have been driven by wide differences in empirical techniques, data measures and samples. Econometric techniques have also varied markedly with the development of new estimation methods – placing an additional degree of variation in results from previous work. Previous research has also paid little attention to the issue of structural change, and this thesis seeks to make an original contribution to the literature by addressing this.

Recent developments in time series econometrics have recognised that structural shifts can lead to spurious estimation results and may bias standard cointegration tests. Traditional Augmented Dickey-Fuller tests for stationarity will be conducted in Chapter 6, and the more advanced Lee and Strazicich one- and two-break unit root tests will also be introduced. This thesis will also pay attention to the timing of the structural breaks, and how these accord with *a priori* expectations of where major changes in the Australian economy have occurred.

Empirical literature covering the efficacy of fiscal policy, Ricardian equivalence, and the twin deficits proposition has focused heavily on the United States, with previous research for Australia now being quite dated (having been undertaken in the late 1980s, or early 1990s). In addition to incorporating econometric techniques that account for structural change, the thesis will also provide a more contemporary analysis on the effects of fiscal policy in Australia.

CHAPTER 3 THE CURRENT ACCOUNT

3. 1 Introduction

Prior to discussing the underlying theory of the twin deficits hypothesis and the Ricardian equivalence theorem in Chapter 4, this chapter considers the construction of the balance of payments – which represents transactions between Australian households and businesses with the rest of the global economy – along with theories of current account determination.

The following section considers the accounting framework for constructing the balance of payments. Following this, section 3.3 derives the Mundell-Fleming approach to explaining the current account. Section 3.4 then introduces the intertemporal approach to the current account, which is more conducive to explaining long-run current account dynamics.

3. 2 Balance of payments flows

Transactions between Australian residents and the rest of the world are represented and recorded in the nation's balance of payments. There are two main accounts in the balance of payments, the current account and the capital account.

A country's current account balance over any time period is the increase in foreign residents' claims on domestic income and/or capital. The current account (Table 3.1) is a record of trade in goods and services, net income payments and net unrequited transfers. The merchandise trade balance consists of merchandise exports net of merchandise imports, with the difference between merchandise exports and imports known as the trade balance. Service items such as freight, royalty payments and insurance, with the balance between services provided by Australian residents and services provided by the rest of the world, are recorded under 'net services' in the current account. Receipts and payments between Australian residents and the rest of the world for items such as interest and dividends are recorded in the current account under 'net income'. 'Net unrequited transfers' consist of transfer payments between Australian residents and the rest of the world (such as pensions paid to Australian residents residing overseas and aid grants). The total of these items produces the

current account balance (Table 3.1). The large negative entry against net income in Table 3.1, reflects both interest payments on Australia's foreign debt, and profits repatriated to foreign-owned corporations.

Table 3.1 Current account of the balance of payments ($A million)

	2003-04	2004-05	2005-06	2006-07	2007-08
Merchandise trade	-23 559	-23 006	-15 291	-13 790	-22 027
Net services	2 050	380	771	1 757	820
Net income and unrequited transfers	-24 412	-32 853	-39 364	-47 156	-49 179
Current account balance	-45 921	-55 479	-53 884	-59 189	-70 385

Source: Reserve Bank of Australia, *Bulletin*.

Following the end of World War I, international capital flows and countries' holdings of foreign assets had been limited in both quantity and scope. During this period, Obstfeld and Rogoff (1995) note that the current account tended to be viewed as the net export balance with relative prices as its central determinant. This led to the 'elasticities approach' to the current account, under which the determinants of international expenditure levels and incomes are held fixed, while static price elasticities of demand and supply determined the net international flow of capital.

The current account is also equal to national saving less domestic investment. If national savings are less than domestic investment, then foreigners take up the balance, acquiring claims on domestic income or output. Known as the absorption approach, this model stresses how macroeconomic factors must ultimately determine international borrowing or lending patterns.

The capital account (Table 3.2) records purchases and sales of assets, such as equities, bonds or property. Official transactions on the capital account comprise net foreign investment and overseas borrowings of general government, the Reserve Bank's foreign reserve assets and other official capital transactions. The non-official transactions are those undertaken by the private sector and include net direct investment and net portfolio investment. Also reflected in the non-official transactions is the offshore capital raisings of Australian banks and other financial institutions.

Table 3.2 Capital account of the balance of payments ($A million)

	2003-04	2004-05	2005-06	2006-07	2007-08
General government	6 392	5 685	-747	1 697	3 019
Non-official	43 532	57 530	59 660	75 165	21 108
Reserve Bank of Australia	-5 141	-8 704	-5 626	-20 128	44 408
Capital account balance	44 783	55 141	53 287	57 184	68 535

Source: Reserve Bank of Australia, *Bulletin*.

The overall balance of payments is the sum of both the current and capital accounts (Table 3.3). From an accounting perspective, both the current and capital accounts should balance. However, this situation rarely occurs and the balancing item in Table 3.3 captures any errors and omissions in calculating the balance of payments.

Table 3.3 Balance of payments ($A million)

	2003-04	2004-05	2005-06	2006-07	2007-08
Current account	-45 921	-55 479	-53 884	-59 189	-70 385
Capital account	44 783	55 141	53 287	57 184	68 535
Balancing item	1 138	338	597	2 005	1 850

Source: Reserve Bank of Australia, *Bulletin*.

3. 3 The Mundell-Fleming approach to the current account

The Mundell-Fleming (M-F) model is an extension of the classic IS-LM model to an open economy. Knight and Scacciavillani (1998) noted that the development of the M-F model in the 1960s reflected the confidence of the ability of macroeconomic policies to achieve both internal and external balance.

The M-F model analyses the markets for goods, money/asset markets and foreign exchange. Equilibrium in goods markets is represented by the IS curve, while the LM curve represents equilibrium in money/asset markets. Combinations of income and interest rates at which the balance of payments is equal to zero are represented in the M-F model by the balance of payments (BP) curve. The M-F model is essentially a short-run model, where markets for domestic and foreign bonds may be treated as substitutes for domestic money, and the labour market enters the M-F model through the assumption that output responds to changes in demand.

Key assumptions of the ‘below full employment’ version of the M-F model are: international capital mobility; imperfect substitutability between domestic and

foreign goods; the domestic price level is fixed; real output is variable; and there is no analysis of aggregate supply.

Combining the IS, LM and BP curves determines output (*Y*), the interest rate (*r*) and either the balance of payments (BP), or the exchange rate *e*. The M-F model solves for the balance of payments if the exchange rate is assumed to be fixed. Under a floating exchange rate system the M-F model solves for *e* as in that case the exchange rate moves to maintain a zero balance of payments (Dornbusch et al: 1996). Overall, the M-F model is useful for drawing conclusions about the impact of policy actions on output, interest rates and the balance of payments adjustment process under both fixed and floating exchange rates.

The current account within the M-F model is represented by the balance of payments curve, where the balance of payments is equal to the goods and services balance (current account), CA, plus the capital account KA, that is, $BP = CA + KA = 0$. Expressed algebraically the BP curve may be written:

$$BP = (x_0 - z_0) + j(R - R^*) = 0 \qquad j > 0 \qquad 3.1$$

Where x represents exports, z imports, R is the domestic interest rate and R^* is the world interest rate. The parameter j represents the degree of capital mobility in response to the domestic/world interest rate differential $(R - R^*)$. Alternatively, we may substitute imports in equation (3.1) above with a simple linear import function, $z = z_0 + m'y$, which gives:

$$BP = (x_0 - z_0 - m'y) + j(R - R^*) = 0 \qquad 0 < m' < 1 \qquad 3.2$$

Where $m'y$ represents the marginal propensity to import out of income. Rearranging equation (3.2) to make the domestic rate of interest, R, the dependent variable yields:

$$R = [R^* - (1/j)(x_0 - z_0)] + (m'/j)y \qquad 3.3$$

which is a simple linear version of the BP curve. The slope of the BP curve is given by the term $+(m'/j)$ in equation (3.3).

When capital is imperfectly mobile, domestic and foreign assets are treated by investors as less than perfect substitutes, and subsequently the world capital market is less than perfect. In contrast, perfect capital mobility is said to exist when domestic and foreign assets are treated as perfect substitutes in a single world capital market. Following the deregulation of financial markets in the 1970s and 1980s world capital markets are likely to have moved to a state where they are close to perfect capital mobility.

The degree to which international capital is mobile exerts considerable influence over the slope of the BP curve. Under imperfect capital mobility, the domestic interest rate may deviate from the world rate. Given that domestic and foreign assets are not perfect substitutes, a differential between the rate of interest earned on these assets may exist, and in that case the BP curve has a positive slope. In the case of perfect capital mobility, domestic and foreign interest rates cannot differ. As j in equation (3.3) tends to infinity the expression collapses to $R = R^*$ and the BP curve is horizontal.

Knight and Scacciavillani (1998) note that in the M-F model the BP curve reflects not only current account equilibrium but overall equilibrium in the foreign exchange market. For a given real exchange rate, an increase in domestic income raises imports and the current account moves into deficit (any position to the right of the BP curve in *r*-*Y* space). Equilibrium in the overall balance of payments may be restored by raising the domestic interest rate relative to the world interest rate, and the resulting net capital inflow would result in a capital account surplus and the balance of payments would once again be equal to zero. Assuming that international capital is highly mobile, the LM curve in the M-F model will be steeper than the BP curve[6]. If

[6] The slope of the LM curve is given by the income elasticity of demand for money, *k*, relative to the interest rate elasticity of money demand, *h*. Given that the slope of the BP curve is *m*'/*j*, the LM curve will be steeper if $k/h > m'/j$.

income rises, it takes a larger increase in the interest rate to eliminate the excess demand for money than it does to eliminate the excess demand for foreign exchange.

The relative slopes of the three curves represented within the M-F model are important for understanding and assessing the impact of various policy actions on the current account balance. For example, under a floating exchange rate and high capital mobility, the M-F model concludes that, starting from current account balance, an expansionary fiscal policy will raise domestic output which results in higher demand for imports. This will subsequently result in a current account deficit, with higher domestic interest rates inducing a capital account surplus, which more than offsets the current account deficit. Under a floating exchange rate the balance of payments surplus leads to an exchange rate appreciation which ultimately reduces net exports. Relative to the initial position of the economy, the expansionary fiscal policy has resulted in a marginal increase in output with a higher interest rate. The current account is in deficit, and this is matched by a capital account surplus. These short-run comparative statics of the M-F model lend itself to explaining the twin deficits proposition.

The M-F model also concludes that under a floating exchange rate, expansionary monetary policy will also affect the current account balance. A monetary expansion will lower the domestic interest rate and raise output, with the higher output increasing the demand for imports which induces a current account deficit. However, under a floating exchange rate the currency will also depreciate as a consequence of lower interest rates. Other things being equal, this exchange rate depreciation increases the country's competitiveness and raises net exports. Therefore, expansionary monetary policy can possibly induce either an improvement or a deterioration in the current account balance, which is dependent upon the relative impacts of the exchange rate depreciation and the increase in income on exports and imports.

The major criticism of note here is that the M-F representation of the current account is essentially static. As the M-F model also focuses on the short run, it neglects the impacts of net investment on the stock of productive capital and of current account imbalances on net international indebtedness. The M-F model can only describe the

short-run effects of economic policies on the current account balance and not the long-run results that arise from the interaction of stocks and flows.

Given the deficiencies of the M-F model, more dynamic current account representations have been developed which focus upon long-run impacts of persistent current account deficits. The most notable and widely accepted is the intertemporal approach to the current account. Other models include overlapping generation representations of current account dynamics.

3. 4 The intertemporal approach to the current account

The intertemporal perspective views the current account balance as the outcome of forward-looking dynamic saving and investment decisions. Authors such as Sachs (1982) popularised the intertemporal approach in the early 1980s, while the rise in popularity of New Classical macroeconomics (following Robert Lucas's (1976) critique of econometric policy evaluation) was also an important influence. Lucas's critique insisted that grounding policy analyses in the forward-looking decision rules of economic agents may yield more reliable policy conclusions if demand and supply from the optimisation problems of households and firms is considered (as opposed to ad-hoc econometric specifications).

In addition to the critiques of comparative static models, current account imbalances following the world oil price shocks of the 1970s also highlighted the need to develop a more complete model of current account determination; which at the time was not offered by either the Keynesian or monetary approaches. Following the oil price shocks, divergent patterns of current account adjustment by both industrialised and developing nations raised the problem of characterising the optimal dynamic response following external shocks. The need to evaluate developing country debt levels also led to the notion of an intertemporally optimal (or sustainable) current account deficit (Obstfeld and Rogoff: 1995).

Following Obstfeld and Rogoff (1995), consider a small open economy which produces and consumes a single good, and trades with the rest of the world in a fully-liberalised trade system. The only asset which is traded is a consumption-indexed bond with a fixed value that pays net interest at a rate r_t between periods $t-1$ and

t. Labour is also internationally mobile. A_{t+1} is defined as the economy's per capita stock of net foreign assets at the end of period t, with Y_t denoting net domestic product in period t. C_t represents private consumption, G_t government spending, and I_t net investment (capital is assumed not to depreciate). The identity linking the current account (net foreign assets), CA_t, to the saving investment balance is:

$$CA_t = A_{t+1} - A_t = r_t A_t + Y_t - C_t - G_t - I_t \qquad 3.4$$

The market discount rate for consumption is:

$$R_{t,s} = \frac{1}{\Pi_{v=t+1}^{s}(1+r_v)} \qquad R_{t,t} = 1 \qquad 3.5$$

Iterating equation (3.4) forward gives:

$$(1+r_t)A_t = \sum_{s=t}^{\infty} R_{t,s}(C_s + G_s + I_s - Y_s) + \lim_{s\to\infty} R_{t,s}A_{s+1} \qquad 3.6$$

The condition $\lim_{s\to\infty} R_{t,s}A_{s+1} \geq 0$ is a no Ponzi financing requirement i.e. this condition implies that foreign lenders will not allow the economy to perpetually roll over a debt.

The intertemporal budget constraint for the economy is:

$$\sum_{s=t}^{\infty} R_{t,s}(C_s + G_s + I_s) \leq (1+r_t)A_t + \sum_{s=t}^{\infty} R_{t,s}Y_s \qquad 3.7$$

Equation (3.7) states that the present value of the economy's expenditure must equal its initial foreign wealth, plus the net present value of domestic production.

The representative consumer in this economy maximises the following time separable utility function:

$$U_t = \sum_{s=t}^{\infty} \beta^{s-t} u(C_s) \qquad 3.8$$

where $\beta \in (0,1)$, $u'(C) > 0$, $u''(C) < 0$.

V_t is defined as the real value of domestic firms at the end of period $t-1$ (after period $t-1$ dividends have been paid). The stock of interest yielding claims owned by the private sector at the end of period $t-1$ is represented by B_t, with w_t the real wage in period t, and L_t defined as the per capita supply of labour. Lump sum taxes administered by the home government are represented by T_t. Given these definitions, the intertemporal budget constraint of the representative consumer is:

$$\sum_{s=t}^{\infty} R_{t,s} C_s = (1+r_t)(V_t + B_t) + \sum_{s=t}^{\infty} R_{t,s}(w_s L_s - T_s) \qquad 3.9$$

Maximising (3.8) subject to (3.9) shows that consumption follows the Euler equation:

$$u'(C_t) = \beta(1+r_{t+1})u'(C_{t+1}) \qquad 3.10$$

Equating the marginal rate of substitution of present consumption for future consumption, $\beta u'(C_{t+1})/u'(C_t)$, to the price of future consumption in terms of present consumption, $1/(1+r_{t+1})$, provides the optimality condition. Leaving aside discrepancies between β and $1/(1+r_{t+1})$, optimised consumption will follow a smooth constant path. A closed-form description of the current account may be obtained by specialising further to where $u(C)$ takes the isoelastic form:

$$u(C) = \frac{c^{1-1/\sigma} - 1}{1 - 1/\sigma} \qquad 3.11$$

where $\sigma > 0$ is the elasticity of intertemporal substitution. Equation (10) implies that optimal consumption growth obeys:

$$C_{t+1} = \beta^{\sigma}(1+r_{t+1})^{\sigma} C_t \qquad 3.12$$

Therefore, the consumption path above must satisfy the economy's intertemporal constraint. Using (3.12) to eliminate $C_s (s > t)$ from (3.7) shows that consumption at date t in this economy will be:

$$C_t = \frac{(1+r_t)A_t + \sum_{s=t}^{\infty} R_{t,s}(Y_s - G_s - I_s)}{\sum_{s=t}^{\infty} R_{t,s}(\beta^{s-t} / R_{t,s})^{\sigma}} \qquad 3.13$$

Equation (3.12) will lead to a general characterisation of the current account. The permanent level of a variable, X, on date t, $\overline{X_t}$, is defined as:

$$\overline{X}_t = \frac{\sum_{s=t}^{\infty} R_{t,s} X_s}{\sum_{s=t}^{\infty} R_{t,s}} \qquad 3.14$$

and $(\beta / R)^{\sigma}$ is defined as the weighted average of ratios of $(s-t)$ – period subjective and market discount factors raised to the power of σ:

$$(\beta / R)^{\sigma} \equiv \frac{\sum_{s=t}^{\infty} R_{t,s}(\beta^{s-t} / R_{t,s})^{\sigma}}{\sum_{s=t}^{\infty} R_{t,s}} \qquad 3.15$$

Given this, from equations (3.4) and (3.13), note that the current account surplus at date t is:

$$CA_t = (r_t - \overline{r_t})A_t + (Y_t - \overline{Y_t}) - (G_t - \overline{G_t}) - (I_t - \overline{I_t})$$
$$+ \left[1 - \frac{1}{(\beta / R)^{\sigma}}\right](\overline{r_t} A_t + \overline{Y_t} - \overline{G_t} - \overline{I_t}) \qquad 3.16$$

A number of interesting inferences can be drawn from equation (3.16). First, if this economy is a net lender to the rest of the world, the current account will be in greater surplus as individuals smooth consumption faced with temporarily high foreign interest income. Conversely, if the economy is net borrower from the rest of the world (such as Australia) temporarily high interest rates will result in a larger current account deficit (as debt service obligations increase) and individuals will also be induced to smooth their consumption.

Second, when output is above its permanent level a higher current account surplus will result as individuals' again smooth consumption. The private sector will use foreign borrowing to cushion its consumption from abnormally high government consumption and investment needs. In this situation, private firms are borrowing from abroad as government consumption crowds-out private firms in domestic financial markets.

The last term in equation (3.16) reflects consumption tilting due to divergences in the current and future periods between world real interest rates and the domestic rate of time preference $(1-\beta)/\beta$. When the domestic economy is somewhat more impatient than the rest of the world, β is lower than future world interest rates will tend to be, resulting in $(\beta/R)^{\sigma}<1$. In this situation, there will be a tendency for the domestic economy to run current account deficits, with increasing foreign debt and declining consumption. When foreigners are more impatient, $(\beta/R)^{\sigma}>1$, the converse situation occurs and the consumption path will have an upward tilt. Obstfeld and Rogoff (1995) also note that this tilting effect is proportional to the economy's permanent resources, and the tilting effect is stronger the higher is the case of intertemporal substitution in consumption, measured by σ.

The general intertemporal model developed thus far will be useful for considering some of the model's predictions for steady-state current account behaviour in an expanding economy. Following Obstfeld and Rogoff (1995), the model can be expanded further to incorporate investment effects and the linkage between capital

accumulation and production. Importantly, the model can be used to demonstrate that in a growing economy, current account deficits can be run indefinitely.[7]

Assume that the production function in this economy follows the Cobb-Douglas function:

$$Y_t = \theta_t K_t^{\alpha} L^{1-\alpha} \tag{3.17}$$

where $\alpha < 1$, K_t is the end of period $t-1$ capital stock, L is the constant labour force (which is normalised to 1), and the productivity coefficient, θ, grows so that:

$$\theta_{t+1} = (1+g)^{1-\alpha}\theta_t \tag{3.18}$$

where $g > 0$. It is assumed that the capital stock can adjust in a single period without installation costs. When unanticipated shocks are not present, the marginal product of capital, $\alpha\theta_t K_t^{\alpha-1}$, must equal the constant world interest rate, r (where $r > g$ by assumption). In steady-state equilibrium, investment is shown to be:

$$I_t = K_{t+1} - K_t = g(\frac{\alpha\theta_t}{r})^{1/(1-\alpha)} = (\frac{\alpha g}{r})Y_t \tag{3.19}$$

Consequently, output and investment both growth at rate g. When government output is equal to zero, equation (3.16) can be used to show that the optimal current account is given by:

$$CA_t = A_{t+1} - A_t = -\left[1-(1+r)^{\sigma}\beta^{\sigma}\right]_t A_t$$
$$-\frac{1+g-(1+r)^{\sigma}\beta^{\sigma}}{r-g}(1-\frac{\alpha g}{r})Y \tag{3.20}$$

Dividing (3.20) by Y_t yields the following difference equation in A/Y:

[7] This is relevant for Australia, which has persistently run current account deficits for many decades.

$$\frac{A_{t+1}}{Y_{t+1}} = \left[\frac{(1+r)^{\sigma}\beta^{\sigma}}{1+g}\right]\frac{A_t}{Y_t} - \frac{1+g-(1+r)^{\sigma}\beta^{\sigma}}{(1+g)(r-g)}\left(1-\frac{\alpha g}{r}\right) \qquad 3.21$$

Provided $(1+r)^{\sigma}\beta^{\sigma} < 1+g$, the steady state is stable, and is equal to the negative number:

$$\overline{A/Y} = -\frac{1-(\alpha g/r)}{(r-g)} \qquad 3.22$$

Importantly, because $\alpha g / r = I / Y$, the long run ratio of foreign debt to output equals the ratio to current output of the entire present value of future output net of investment.

The intertemporal representation of the current account is important for explaining long-run evolution of the current account, particularly for situations where countries may run persistent current account surpluses or deficits. The long-run dynamics of the intertemporal current account model are also conducive to explaining longer-run considerations of public debt and private saving behaviour.

3. 5 Summary and conclusions

This chapter has considered the construction of the balance of payments in Australia, which was followed by a discussion of the Mundell-Fleming and intertemporal approaches to the current account.

The comparative statics of the Mundell-Fleming approach is conducive to explaining the twin deficits proposition – where an expansionary fiscal policy results in a current account deficit. However, this model is limited in that it can only describe the short-run effects of economic policies on the current account balance and not the long-run results that arise from the interaction of stocks and flows, and forward-looking saving and investment decisions.

Given these deficiencies, the intertemporal approach to the current account – which views the current account balance as the outcome of forward looking dynamic saving

and investment decisions – is a more dynamic current account representation. The dynamics of the intertemporal model are important for explaining the long-run evolution of the current account, particularly for situations where countries may run persistent current account surpluses or deficits. The model is also useful for identifying factors which may cause sudden current account reversals. The long-run dynamics of the intertemporal current account model also lend itself to accommodating longer-run considerations of public debt and private saving behaviour (such as through the Ricardian equivalence theorem).

CHAPTER 4 TWIN DEFICITS AND RICARDIAN EQUIVALENCE

4. 1 Introduction

Having surveyed the empirical literature in Chapter 2, which was followed by a discussion in Chapter 3 of the current account, this chapter considers the twin deficits hypothesis and Ricardian equivalence theorem. Section 4.2 considers the twin deficits hypothesis, with subsections considering the evolution of the twin deficits hypothesis in the United States and Australia, and how this theory relates more closely to Keynesian macroeconomics. This is followed by a discussion of Ricardian equivalence in Section 4.3, which also discusses open economy effects, and how Ricardian equivalence differs from other explanations of the effects of public debt. Section 4.4 briefly discusses the potential impact of financial market liberalisation on the efficacy of fiscal policy.

4. 2 The twin deficits hypothesis

As noted in Chapter 2, the combination of large fiscal and current account deficits in the United States during the 1980s led many economists to believe that the deficits were inextricably linked. Martin Feldstein (1985 & 1987), who at the time was a source of policy advice to the Reagan Administration, is often attributed as having popularised the twin deficits hypothesis.

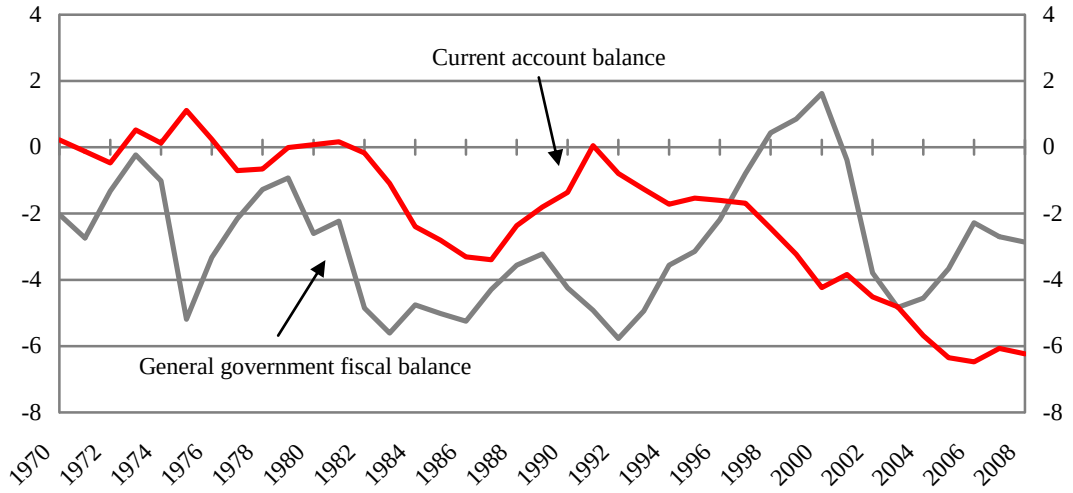
During the first half of the 1980s, the Reagan Administration implemented an expansionary fiscal policy through tax reductions, which was not complemented by a corresponding monetary expansion. This policy action exerted considerable upward pressure on US interest rates, and consequent capital inflows boosted the value of the US dollar. This dollar appreciation resulted in an erosion of the United States' competitiveness on world markets, and a deterioration of the current account balance. Given these circumstances, the deficit on the current account appeared to 'twin' US fiscal deficits. Nguyen and Pagan (1990) note that this view was espoused by observers and US government advisers such as Feldstein, international organisations such as the International Monetary Fund (IMF), the Organisation for Economic Cooperation and Development (OECD), and advisers of European governments. Martin Feldstein (1990) later stated that the deterioration in the US trade balance

during the 1980s was caused by high interest rates (resulting from fiscal deficits) appreciating the US exchange rate. This according to Feldstein should be treated as a special one-off and not as an indication of any long-run phenomenon.

4.2.1 Twin deficits in the United States

Figure 4.1 shows that during the 1970s and 1980s, the US current account and fiscal balance generally moved in the same direction, with the relationship between the two even more pronounced during the 1980s. The empirical literature surveyed in Chapter 2 found evidence for and against twin deficits in the United States.

Figure 4.1 United States fiscal and current account balance (per cent of GDP)



Source: OECD Economic Outlook Database.

During the late 1980s and early 1990s, Figure 4.1 shows that the twin deficit relationship appears to have held during this period. However, over the remainder of the 1990s, and throughout the 2000s, Figure 4.1 shows significant disparities between the US current account and fiscal position. The following paragraphs discuss potential sources of this disparity in greater detail.

After registering a small surplus in 1991, the US current account began to deteriorate from 1992. Improving domestic demand combined with low import prices led to a surge in imports, and throughout the remainder of the 1990s the US trade deficit

widened as the pace of economic growth in the US grew more rapidly than the average rate of growth across the rest of the world.[8]

Following the Asian economic downturn which proceeded from mid 1997, the US current account deficit deteriorated significantly further, where in 1999 the current account deficit had increased to a record 3.7 per cent of GDP (Figure 4.1). In explaining this, many market commentators cited that the growing deficit was caused by factors such as high levels of consumer spending resulting in increased demand for consumer goods, and an appreciation of the US exchange rate due to increased capital inflows. However, Hervey and Merkel (2000) outlined three broad hypotheses to explain the causes and implications of the record deficits. The first hypothesis, the *consumption boom* hypothesis, postulates that US consumers have shifted their preferences from saving for the future, toward purchasing more consumption goods in the present.

The exchange rate crises of Asia, Russia and Brazil have been noted by commentators as having contributed to a 'safe haven' inflow of short-term capital (or 'hot money') into US financial markets during the late 1990s and early 2000s. This capital inflow makes it more difficult for the US to export goods and services to those poorer performing markets, and a stronger US dollar induces the importation of goods and services from these economies. The flight of capital from these foreign markets also detracts from the productive and consuming capacity of these economies. This scenario is termed the *safe haven* hypothesis (Harvey and Merkel: 2000).

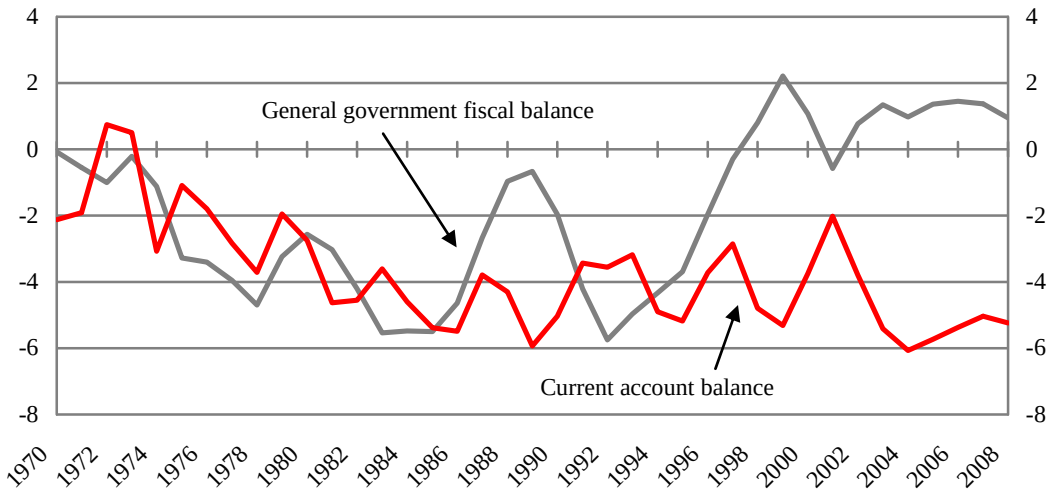
Finally, growth in the US current account deficit may have been due to a technological restructuring of the US economy. The *technological change* hypothesis asserts that a technology shift in the economy has increased the level of productivity and returns on US investments. Investment demand increased in response to the technology shift, which stimulated the inflow of foreign capital to finance the new investment (Harvey and Merkel: 2000).

[8] The OECD (1995) estimated that the United States economy in 1995 was growing at approximately twice the rate of the rest of the OECD.

4.2.2 Twin deficits in Australia

Figure 4.2 shows that the fiscal and current account in Australia have generally moved in similar directions across time.

Figure 4.2 Australia's fiscal and current account balance (per cent of GDP)



Source: OECD Economic Outlook Database.

Over the quarter-century from 1959-60 to 1983-84, the Australian current account averaged around 2¾ per cent of GDP. Over the subsequent two decades to 2006-07, however, it has ranged between 2 and 7 per cent of GDP and averaged 4¾ per cent of GDP. Following the depreciation of the Australian dollar after its float in December 1983, the 1980s saw a widening of the current account deficit and a rapid increase in Australia's net foreign debt – from around 6 per cent of GDP in June 1981 to 32 per cent 5 years later. This marked the beginning of widespread policy and community concern about the large Australian current account and the rising stock of net foreign debt (Gruen and Sayegh: 2005).

During the late 1980s to early 1990s, the Federal Government undertook a programme of fiscal consolidation.[9] Part of the government's rationale for implementing tight fiscal policies during this period came from advice provided by

[9] In its 1985-86 budget, the Federal government set out the 'trilogy' commitments, which committed the government: not to raise tax revenue as a proportion of GDP in 1985-86 and over the [3-year] life of the parliament; not to raise government expenditure as a proportion of GDP in 1985-86 and over

Treasury, which sought to justify tight fiscal policy as a means of solving perceived problems with the current account deficit and Australia's rising stock of foreign debt.

The 1988-89 Budget Speech highlighted the channels through which a reduction in the fiscal deficit would improve economic outcomes in Australia:

> '*First it frees up Australian savings to finance the business investment we need to maintain the momentum of our export effort. Second, it cuts public sector demand across the board, thereby moderating overall demand and reducing import pressures. And third, by enabling repayments, it reduces our overseas debt and our interest bill.*' (Commonwealth of Australia: 1988-89)

The trilogy commitments were adhered to in subsequent budgets, with surpluses accumulated in the late 1980s. However, the 1988-89 Budget continued to emphasise the need for continued fiscal restraint to: '*…guard against excessive import pressures threatening the recovery in our balance of payments*' (Commonwealth of Australia: 1988-89).

Following the onset of recession in 1990, higher transfer payments, and lower tax receipts (through the automatic stabilisers), saw the budget position deteriorate to almost 6 per cent of GDP. Fiscal policy at this time was also directed toward actively supporting economic recovery. Consequently, the budget surpluses achieved in the late 1980s and early 1990s were reversed. As Australia was one of the first OECD nations to recover from the recessions of the early 1990s the current account remained in deficit through to the mid 1990s – in part reflecting the stronger relative cyclical position of the economy (OECD: 1994).

A medium-term framework for fiscal policy was set out by the Howard Government in the 1996 Charter of Budget Honesty (which was ratified in 1998). This charter obliges the government to lay out its medium-term fiscal strategy in each budget together with its shorter-term fiscal objectives and targets. The Howard

---

the life of the parliament; and to reduce the budget deficit in dollar terms in 1985-86 and as a proportion of GDP over the life of the parliament (Gruen and Sayegh: 2005).

Government's Medium-Term Fiscal Strategy sought to achieve fiscal balance, on average, over the course of the economic cycle. Again, part of the rationale for this strategy was directed at the external sector. The strategy also sought to: '*…ensure that, over time, the Commonwealth makes no net call on private sector saving, and so does not directly contribute to the national saving-investment imbalance*' (Commonwealth of Australia: 1999).

The Howard Government's Medium-Term Fiscal Strategy was complemented by a number of other supplementary objectives which included: that surpluses be achieved when economic growth prospects are sound; not increasing the overall tax burden from 1996-97 levels; and improving the Australian Government's net worth over the medium to longer term.

Since the introduction of the Medium-Term Fiscal Strategy in 1996, successive budget surpluses over the past decade (and the proceeds of asset sales) contributed to the elimination of general government net debt for the Federal Government (making it one of only a handful of OECD countries to have a net asset position). In 2007-08 the Federal Government's budget surplus peaked at around 2 per cent of GDP.

The election of the Rudd Government in November 2007 saw a commitment to continue with the medium-term focus of fiscal policy introduced by the Howard Government. The Rudd Government's fiscal strategy involves: achieving budget surpluses, on average, over the medium term; keeping taxation as a share of GDP on average below the level for 2007-08; and improving the Government's net financial worth over the medium term (Commonwealth of Australia: 2008).

While the Federal Government surplus in 2007-08 peaked at $19.7 billion (2 per cent of GDP), by early 2009 the primary budget balance had moved into a deficit position. The deterioration in the global and domestic economies following the sub-prime financial crisis and global recession saw a combination of both the automatic stabilisers and discretionary fiscal stimulus sending the primary budget balance into deficit (Commonwealth of Australia: 2009a).

Despite the significant fiscal consolidation over most of the past two decades, there has been no clear sustained change in the ratio of the current account to GDP over this time. Australia's net foreign liabilities have also risen from about 30 per cent of GDP in the mid-1980s to about 60 per cent currently. The sustained fiscal consolidation since the mid-1990s has, however, left the public sector with almost no or very little foreign debt, so that virtually the entire current net stock of Australia's foreign debt is owed by the private sector (Gruen and Sayegh: 2005). These developments are clearly reflected in Figure 4.2 above, where the once clear relationship between fiscal and current account deficits appears to have broken-down over the past two decades.

Notwithstanding public concerns with Australia's current account and level of foreign debt, academic debate around the late 1980s began to challenge the notion that these were concerns for fiscal policy. Authors such as Makin (1988), Pitchford (1989) and Corden (1991) argued that private sector investment and saving decisions were made by optimising private individuals and companies, with any benefits or costs of these decisions being a matter for these private agents (absent any relevant externalities from their decisions). They further argued that public-sector decisions, and the resulting fiscal balance, should be judged on their own merits, rather than in terms of their influence on the current account. If large current account deficits are a symptom of distortions in the economy, the distortions should be tackled at their source, rather than providing a justification for using monetary or fiscal policy to influence them (Gruen and Sayegh: 2005). Following this train of thought, the fiscal consolidation and elimination of net debt that has occurred by the public sector, and considering that the current stock of net foreign debt that is primarily owned the private sector, this initially indicates that the twin deficits hypothesis does not hold for Australia.

An additional issue for consideration is that while the Howard Government had been running budget surpluses through to the mid to late part of the 2000s, and was accumulating a net asset position, the Federal Government made no substantial calls on domestic capital markets. In this context, the magnitude to which government expenditures were 'crowding out' private sector saving and investment – potentially leading to higher interest rates – was replaced by a need to consider the magnitude of

'crowding in', since the Commonwealth was making a positive contribution to national saving (Kirchner: 2007). The theory of Ricardian equivalence (to be discussed later in this chapter), which is premised on assumptions regarding the substitutability of government debt and future taxes, implies that increased government saving does not necessarily increase national saving because of potentially offsetting dissaving by the private sector.

4.2.3 Twin deficit theory

As noted in the previous section, the rationale for the Australian Government seeking to reduce fiscal deficits in order to improve the external position has stemmed from the twin deficits hypothesis. This hypothesis asserts that assuming an unchanged gap between private savings and investment over time, a reduction in the government budget deficit will be matched by an equal reduction in the current account deficit. The twin deficits hypothesis is derived below from national accounting identities.

Consider the familiar identity which shows that aggregate income is equal to the sum of aggregate expenditures:

$$Y = C + I + G + X - M \qquad 4.1$$

Where: Y, C, I, G, X and M stand for aggregate income, private consumption, private investment, government expenditure, exports and imports respectively. Equation (4.1) states that the total supply of goods and services must equal the sum of all demand components. Alternatively, we may also express income as the sum of the means of its dispersal:

$$Y = C + S + T + F \qquad 4.2$$

where S, T and F represent private savings, government tax revenues and net factor income payments to foreigners. Equation (4.2) can be re-arranged in order to show that the level of private savings is the part of disposable income which is not consumed:

$$S = Y - F - T - C \qquad 4.3$$

Replacing Y in equation (4.3) with $(C + I + G + X - M)$ from equation (4.1) and re-arranging obtains:

$$(S - I) + (T - G) = (X - M - F) \qquad 4.4$$

The left hand side of equation (4.4) represents net lending by both the private and public sectors, while the right hand side represents the current account balance. If the current account registers a surplus, domestic expenditure is less than national income and the home country is lending (investing) overseas. On the other hand, if the home country's private and public sector savings is falling short of domestic investment, the shortfall must be met my borrowing in the form of a current account deficit. If the gap between domestic investment is invariant over time, equation (4.4) implies that a reduction in the government budget deficit necessarily implies a reduction in the current account deficit of the same amount. Changes in the current account balance would then tend to 'twin' changes in the government budget balance.

Equation (4.4) can be re-written in order to emphasise this deficit interpretation:

$$(I - S) + GBD = CAD \qquad 4.5$$

The twin deficits hypothesis is grounded within the traditional Mundell-Fleming paradigm. As Karunaratne (1992) notes, the Mundell-Fleming method of analysis explains the causal link between the budget deficit and current account deficit asserted by the twin deficits hypothesis. As also noted in the previous chapter, under the assumptions of flexible exchange rates and perfect capital mobility, an increase in the budget deficit will increase the exchange rate, which in turn will attract an inflow of foreign capital. Additionally, if the budget deficit occurs as the result of either reduced taxation or an issue of bonds to the private sector (assuming that bonds are perceived as net wealth) overall increased incomes will raise the demand for imports, which will result in a deterioration of the trade balance. High capital inflows result in an appreciation of the exchange rate, which in turn crowds out net exports – leading to a deterioration of the current account.

The above discussion notes that from the perspective of the Mundell-Fleming method of analysis, causality between fiscal and trade deficits runs primarily from the stance of fiscal policy to the current account. Dornbusch (et al: 1996) note that causality between the fiscal and current account deficit may in fact be bidirectional. For example, exports for small open economies such as Australia are primarily dependent upon the economic stance of its major trading partners. Should a major trading partner reduce its demand for a country's exports, production in the export producing industries is likely to be scaled down, resulting in unemployment. This situation will then result in reduced taxation revenue for the government while government transfer payments are increased. Consequently, the government may then run a fiscal deficit, or increase an existing deficit.

Nguyen and Pagan (1990) noted that the twin deficit hypothesis is a strong proposition in that it asserts that a decrease in the budget deficit will guarantee a fall in the current account balance (sufficient condition), but also the government budget deficit must fall in order for the current account deficit to fall (necessary condition). As noted above, it can be seen from equations (4.4) and (4.5) that in order for this relationship to hold, the gap between private investment and savings must remain invariant over time.

However, the findings of Feldstein and Horioka (1980) suggested that national savings and investment are highly correlated and that the investment deficit in equation (4.4) above is constant. This conclusion implies that capital is immobile, thus negating one of the fundamental assumptions of the Mundell-Fleming twin deficits transmission mechanism. It must also be borne in mind that in terms of equation (4.4), the findings of Feldstein and Horioka do not necessarily mean that private investment and saving are correlated (Nguyen and Pagan: 1990).

More recently, Chaudhri and Wilson (2000) have presented evidence suggesting that there is no long-run relationship between savings and investment in Australia. If domestic investment and savings were perfectly correlated, equation (4.4) above indicates that the current account deficit would be constant, and there would be no correlation at all between budget and trade deficits.

4.2.4 The twin deficits and Keynesian macroeconomics

Being grounded within the Mundell-Fleming IS-LM model, the twin deficits hypothesis is often regarded as being somewhat Keynesian in its approach to analysing the affects of fiscal policy on the current account. Bernheim (1989) notes that under the Keynesian view of budget deficits, a significant fraction of the population is thought to be either myopic or liquidity constrained, and have very high propensities to consume out of current income. Given this, a temporary tax reduction (for example) will have an immediate and quantifiable affect on aggregate demand. As fiscal policy under the Keynesian model has such a quantifiable affect on output, the Keynesian view supposes that the government can 'fine tune' fiscal policy as a means of activist macroeconomic management. This view influenced the policy actions in both Australia and the United States during the 1980s, with contractionary fiscal policies implemented with a goal of reducing current account deficits. However, the empirical evidence on the efficacy of fiscal policy in Chapter 2 however suggests that fiscal policy's ability to fine-tune aggregate demand is somewhat limited.

In contrast to the short-run Keynesian view, the neoclassical (or Diamond-Samuelson) paradigm asserts that farsighted individuals plan consumption over their own life cycles. Budget deficits raise total lifetime consumption by shifting taxes to future generations. If economic resources are fully employed, increased consumption implies increased saving, and interest rates must rise in order to restore equilibrium in capital markets. Accordingly, persistent budget deficits crowd out private capital accumulation (Bernheim: 1989). In the neoclassical world, individuals respond only to changes in lifetime resources. A neoclassical consumer spreads additional resources over his or her lifetime so that the immediate impact of resources on consumption is small.

4. 3 The Ricardian equivalence theorem

The theoretical foundation of Robert Barro's Ricardian equivalence theorem can be attributed, in part, to the work of David Ricardo. The article titled, *Funding System*, was written by Ricardo for the Supplement to the Fourth, Fifth and Sixth editions of the Encyclopaedia Britannica, which was published between 1814 and 1824

(Ricardo: 1966). In this article Ricardo discussed deficit financing and its implications for the wider economy, with particular reference to the British Sinking Fund, which was established in 1716.

With relevance to the Ricardian equivalence theorem, Ricardo discussed an example where a country, initially assumed to be debt free, in the event of war financed a fiscal deficit. Given a perpetual tax[10] (Ricardo focused upon financing a deficit through higher taxation) which represented a small proportion of an individual's income as opposed to a large one off tax to finance deficit expenditure, Ricardo argued that it would be difficult to convince individuals that both taxes are equally burdensome (Ricardo: 1966). The individual may be aware that a small perpetual tax would be paid by posterity not by the individual. But if the individual were to bequeath a lump sum fortune to his or her descendants, it may be argued that he or she would be indifferent to the perpetual tax reducing the amount bequeathed to the succeeding generation (Ricardo: 1966). Ricardo saw no weight in this argument and further noted that if an individual was required to pay a one off lump sum tax, he or she would probably endeavour to save the whole of it from his or her income. Lump sum war taxes in order to finance a war-induced fiscal deficit were deemed by Ricardo to be the most economical. When payment is required, an effort is made to save the whole expenditure of the war, leaving the national capital undiminished (Ricardo: 1966).

The central proposition of the Ricardian equivalence theorem is that for a given path of government spending, a deficit financed cut in current taxes leads to higher future taxes that have the same present value as the initial tax cut (Barro: 1989). Given a specific set of circumstances (discussed below), it makes no difference to the level of aggregate demand throughout the economy if the government finances its outlays by debt or by taxation (Leiderman and Blejer: 1988). Because debt financing is perceived by individuals only as a change in the timing of taxation, the Ricardian equivalence theorem asserts that such a change has no impact on private sector wealth and consumption so long as the present value of the stream of taxation remains unchanged (Barro: 1974). As noted by Seater (1993), Ricardian equivalence

[10] This would be equivalent to income taxation.

in its modern from can be regarded as a straightforward generalisation of the permanent income life-cycle hypothesis.

Buchanan (1976) was the first to note the close relationship between the Barro proposition and work by Ricardo (Ricciuiti: 2003). Feldstein (1982) proposed calling the proposition pre-Ricardian equivalence as it was claimed by people before Ricardo and then falsified by him. Ricciuiti (2003) notes that prior to Barro's 1974 work, others who suggested that the means of funding government expenditures was not important included: Patinkin (1965), Bailey (1971) and Kochin (1974).

The following derivation of the Ricardian equivalence theorem has been drawn from Barro (1974, 1989), Leiderman and Blejer (1988) and Seater (1993).

Consider a two-period model where 0 represents the present, period 1 the future, and period –1 represents historically given conditions. For notational purposes: G represents government spending (nominal) on goods and services; T is government lump-sum tax collections (nominal); B' is government debt; i is the nominal interest rate; C is private sector consumption (nominal); B is private sector debt; Y is non-asset income; and P is the price level. The lowercase notations g, τ, b', c, b and y denote the corresponding real values of the variables considered here.

The government's budget in period 0 and 1 respectively, can be represented in nominal terms:

$$G_0 - T_0 + i_{-1}B'_{-1} = B'_0 - B'_{-1} \qquad 4.6$$

$$G_1 - T_1 + i_0 B'_0 = -B'_0 \qquad 4.7$$

The left hand side of equations (4.6) and (4.7) represent the government budget deficit inclusive of interest payments. Dividing equation (4.6) by the price level, P_0, and equation (4.7) by P_1 gives:

$$g_0 - \tau_0 + (1+i_{-1})\frac{P_{-1}}{P_0}\frac{B'_{-1}}{P_1} = B'_0 \qquad 4.8$$

$$g_1 - \tau_1 = -(1+r_0)\frac{P_0}{P_1}\frac{B'_0}{P_0} \qquad 4.9$$

Substituting (4.9) into (4.8) yields:

$$g_0 + g_1(1+r_0)^{-1} + (1+r_{-1})b'_{-1} = \tau_0 + \tau_1(1+r_0)^{-1} \qquad 4.10$$

where:

$$1+r_0 \equiv (1+i_0)\left(\frac{P_0}{P_1}\right) \qquad \text{and} \qquad 1+r_{-1} \equiv (1+i_{-1})\left(\frac{P_{-1}}{P_0}\right)$$

with the real interest rate represented by r.

Importantly, equation (4.10) represents the government's intertemporal budget constraint, and states that the present value of spending (plus initial government debt) must equal the present value of government tax revenue. Equation (4.10) is also a solvency requirement on the government. Private agents lend to the government and ensure that it has sufficient funds to cover its spending and debt servicing obligations.

The nominal budget constraints for the private sector over the periods 0 and 1 are:

$$C_0 = Y_0 + B_0 - (1+i_{-1})B_{-1} - T_0 \qquad 4.11$$

$$C_1 = Y_1 - (1+i_0)B_0 - T_1 \qquad 4.12$$

Expressing equation (4.11) and (4.12) in real terms and consolidating into a single equation gives:

$$c_0 + c_1(1+r_0)^{-1} = y_0 + y_1(1+r_0)^{-1} - \tau_0 - \tau_1(1+r_0)^{-1} - (1+r_{-1})b_{-1} \qquad 4.13$$

Equation (4.13) represents the intertemporal budget constraint of the private sector. The present value of the private sector's spending must equal the present value of net income minus initial debt commitments. Individuals may optimise their consumption by choosing (c_0, c_1) so as to maximise $U(c_0, c_1)$ subject to the constraint of equation (4.13), where U is the consumer's utility function.[11]

For Ricardian equivalence to be derived by the series of equations above, substituting the expression for taxes in equation (4.10) into the private sector's intertemporal constraint (4.13) gives:

$$c_0 + c_1(1+r_0)^{-1} = y_0 - g_0 + (y_1 - g_1)(1+r_0)^{-1} \qquad 4.14$$

This constraint holds under the assumption that the private sector fully internalises the budget constraint of the public sector. For a closed economy, a public sector debt must be matched by saving in the private sector, $b = -b'$; consequently, these debt terms drop from the analysis. Given a combination of government spending (g_0, g_1), and any two debt-tax patterns (b'_0, τ'_0) and $(\hat{b}'_0, \hat{\tau}'_0)$ that satisfy the government budget constraint will imply the same equilibrium quantities and prices. Essentially, the two debt-tax patterns are equivalent economically, implying that the timing of taxes and the size of the government debt do not influence private sector behaviour.

From Barro's (1989) perspective, under Ricardian equivalence, a decrease in the government's saving leads to an offsetting increase in desired private saving, and hence to no change in desired national saving. Similarly, a current tax cut must be assumed by individuals to signal an increase in future taxes and to a change in government spending. Since desired national saving does not change, the real interest

[11] It is assumed that government spending does not affect private sector utility. Because Ricardian equivalence is concerned with how a path of government consumption is financed, this assumption does not affect the analysis considered here.

rate does not have to rise in a closed economy to maintain balance between desired national saving and investment demand (Barro: 1989).

The Ricardian equivalence theorem is based upon four key assumptions which include: perfect capital markets with no borrowing constraints; nondistortionary taxes; perfect foresight concerning the path of future taxes and fiscal policies; and identical planning horizons for both the private and public sectors. Much of the criticism directed at Ricardian equivalence has been based upon questioning the above assumptions, which critics often note as being unrealistic.

4.3.1 Ricardian equivalence in an open economy

In an open economy, the real interest rate is determined on world capital markets. This interest rate is denoted by r^*, and agents within the economy can freely borrow and lend at this interest rate. Given that the international interest rate faced by both the public and private sectors is the same, the same set of assumptions which give rise to Ricardian equivalence in a closed economy will also yield the same results in the open economy. A tax cut that results in an increase in the government's foreign debt will have no effect on private sector consumption and wealth. As occurs in the closed economy, the increase in the government's external debt is fully internalised by the private sector which accounts for the taxes to be paid back to lenders. In this open economy setting there would be no effect on the current account balance because private saving rises by enough to avoid having to borrow from abroad (Barro: 1989).

From the model developed above we can assume for simplicity that all borrowing by the government and the private sector in the domestic economy is made from foreign lenders. Internalising the intertemporal budget constraint into that of the private sector gives:

$$c_0 + c_1(1+r_0^*)^{-1} = y_0 - g_0 + (y_1 - g_1)(1+r_0^*)^{-1} - (1+r_0^*)(b_{-1} - b_{-1}^{'}) \qquad 4.15$$

Equation (4.15) tells us that the net present value of consumption expenditures must equal the net present value of real resources available to the private sector minus the

initial value of the economy's external debt commitment. A higher debt commitment will lower the level of wealth and consumption. For a given value of the predetermined level of debt commitment, neither taxes nor the government's level of foreign borrowing has an effect on wealth, which is affected by the government spending variables g_0 and g_1 and not by the form of finance.

4.3.2 Ricardian equivalence and alternative paradigms

Ricardian equivalence is grounded in the neoclassical paradigm from the perspective that individuals are both farsighted and plan consumption across their own life cycles. While the model outlined above was based upon a two period framework, each period cold also be considered as generation 0 and generation 1, with generation 0 representing the present generation and generation 1 the proceeding generation. Bernheim (1989) noted that consumption in the Ricardian model is determined as a function of dynastic resources (the total resources of both the taxpayer and his or her descendants).

Under both the neoclassical and Keynesian paradigms, budget deficits have real effects, with the neoclassical view focusing on the long-run effects of deficits on capital accumulation, while the Keynesian paradigm considered short-run affects and the ability of deficits to stimulate consumption and national income. However, the key difference separating the two paradigms is that while individuals under Ricardian equivalence plan consumption across their own life cycle, they are also altruistically motivated and consider the welfare of successive generations. Ricardian equivalence asserts that deficits merely postpone taxes, and through the actions of the altruistically motivated individuals, budget deficits have no real affects on the economy – including the current account.

Considering current account dynamics, the Ricardian equivalence theorem is more closely aligned with models such as the intertemporal approach discussed in the previous chapter, where individuals optimise consumption over long time horizons, and the current account ultimately reflects the outcome of forward-looking dynamic saving and investment decisions. This is also consistent with the recent consensus concerning the Australian current account, in that it ultimately reflects private saving and investment decisions, and may also explain why earlier linkages between fiscal

deficits and the current account appear to have broken down (as evidenced by Figure 4.2 considered earlier in the chapter). The integration of Australia into global capital markets, combined with fiscal consolidation and other market-oriented economic reforms, may have seen the current account move toward a model more closely aligned with the intertemporal representation discussed in the previous chapter.

4. 4 Financial market liberalisation

Both financial deregulation in Australia, and the subsequent development of deeper and more sophisticated capital markets, warrants some further consideration. Deeper financial markets may lessen the effect of government borrowing on domestic interest rates, in which case there will be less crowding out of investment. Cabarello and Krishnamurthy (2004) estimated that crowding out of investment is smaller in industrial countries than developing countries, which the authors attributed to more sophisticated capital markets in the former. As private credit markets become more developed, access to personal credit also improves, and households may in fact find it easier to smooth consumption. In this situation one may observe households behaving in a Ricardian manner, particularly where they may offset a short-term fiscal contraction by increased borrowing.

As noted above, financial deregulation (and integration into global capital markets) may dampen the impact of fiscal policy on domestic interest rates, which also reduces crowding out of investment as the private sector can substitute foreign capital for domestic capital. Empirical evidence also appears to confirm that access to a larger pool of foreign savings has reduced the impact of government deficits on interest rates (see Hauner and Kumar 2006, European Central Bank, 2006 and Aisen and Hauner 2008). Should these affects have also occurred in Australia, this suggests that fiscal policy may not exert a marked influence over both interest rates and subsequent pass through to the exchange rate and the trade balance. However, Chapter 5 will note that measures of financial openness are quite varied within the literature, and are often difficult to calculate.

4. 5 Summary and conclusions

This chapter has considered the underlying theory, and fundamental differences, between the twin deficits hypothesis and Ricardian equivalence. This chapter began

by discussing how the twin deficits hypothesis has influenced policymaking in both Australia and the United States – particularly during the 1980s and into the early part of the 1990s. Twin deficit theory had a major bearing on Australia's fiscal policy in the late 1980s, with the Hawke Government undertaking a deliberate fiscal consolidation as a means of attempting to solve perceived problems with the current account deficit and Australia's rising stock of foreign debt.

In discussing the twin deficits hypothesis, it was noted that this framework is often regarded as being somewhat Keynesian in its approach to analysing the affects of fiscal policy. In contrast, Ricardian equivalence asserts that deficits merely postpone taxes, and through the actions of altruistically motivated individuals, budget deficits have no real affects on the economy – including the current account. This chapter has also demonstrated that the Ricardian equivalence theorem is more closely aligned with the intertemporal approach to the current account considered in Chapter 3.

Structural change in Australia – particularly financial liberalisation – was also discussed. It was briefly noted that financial deregulation, and integration into global capital markets, may have dampened the ability of fiscal policy to influence domestic interest rates, the exchange rate, and potentially lessening crowding out effects. As private credit markets have also become more developed, access to personal credit has improved – providing households with a greater ability to smooth consumption. Under these circumstances households may act in a manner that is more consistent with Ricardian equivalence.

Building upon the theory considered here, the following chapter outlines the analytical model for this thesis. This is a reduced-form savings equation that considers whether private saving responds to offset changes in the government's fiscal stance (consistent with Ricardian equivalence).

CHAPTER 5 ANALYTICAL FRAMEWORK

5. 1 Introduction

Having surveyed the empirical literature in Chapter 2, and discussing the theory regarding the current account, twin deficits and Ricardian equivalence in Chapters 3 and 4, this chapter now considers the construction of the analytical model to be estimated in this thesis. The analytical model considers Ricardian equivalence effects by looking at the relationship between private and public sector saving and other mitigating factors such as changes in household income. This framework builds upon previous work by authors such as Haque (et al: 1999); de Mello (et al: 2004) and Cotis (et al: 2006). The model can also be considered as a broad measure of the impact of fiscal policy on short- and long-run aggregate demand.

Section 5.2 introduces the analytical model, which is followed in section 5.3 with a discussion of statistical measures of saving in Australia. This is important as the model is dependent on a measure of private saving. Previous empirical research in Australia has given little attention to how saving is measured, and it is anticipated that the thesis will be making a contribution to the literature by accounting for this. Section 5.4 then discusses the coefficient on public saving – particularly how this coefficient can be used to test the hypothesis introduced in Chapter 1. The other coefficients are discussed in section 5.5, with a great deal of attention paid to the measurement of proxies for private wealth in Australia. Section 5.6 briefly discusses the sample size and data sources.

5. 2 Analytical model

Standard Keynesian-type models predict that in the short run, the effect of the government reducing taxes is to stimulate consumption – which increases aggregate demand. This boost to consumption is then generally expected to be partly offset by a range of crowding out effects; notably by higher interest rates reducing the level of investment and/or an appreciation of the exchange rate reducing net exports. In the long run, higher interest rates reduce the rate of capital accumulation and economic growth. Notwithstanding these long-run effects on growth, fiscal policy is generally

considered to have some affect on short-term real activity (although the empirical literature surveyed in Chapter 2 suggests that these effects are limited).[12]

However, the standard Keynesian-type example considered above illustrates that fiscal policy may actually elicit private savings responses through a number of different channels. This may occur *ex ante* because the marginal propensity to consumer out of disposable income is less than one, and *ex post* via higher interest rates, and inflation. The model outlined below attempts to identify these other channels of influence on private savings behaviour.

As noted in the previous chapter, Ricardian equivalence challenges the Keynesian view of fiscal policy. Ricardian equivalence suggests that fiscal policy will not alter consumption, savings or growth, and is based on the insight that lower taxes and a budget deficit today require, in the absence of any change in government spending, higher taxes in the future. If individuals are sufficiently forward-looking they will realise that their total expected tax burden is unchanged. As a result they will not increase consumption but save the entire tax cut to meet their expected future tax liability. The decrease in government saving will thus be offset by an increase in private saving – neutralising the impact of the government's attempt at expansionary fiscal policy (Barro: 1989).

However, the previous chapter also noted that perfect (or full) Ricardian equivalence is based upon a very strict set of assumptions including: that individuals' consumption choices follow a life cycle model of consumption; they are far sighted

[12] However in most open, advanced economies with floating exchange rates (such as Australia) monetary policy has assumed the role of being the primary policy tool for short-term aggregate demand management. As noted in the previous chapter, fiscal policy in Australia is focused upon medium-term objectives, most notably sustainability of the government's balance sheet, and not short-term aggregate demand management. Additionally, the short-run focus is to allow fiscal policy's automatic stabilisers to operate – to ensure that the fiscal stance does not jeopardise monetary policy settings. However, activist fiscal policy still has a role to play under some circumstances; such as a deep and protracted economic downturn where monetary policy is faced with the zero-bound constraint on interest rates (see Krugman: 2005). This has been the case seen since late 2008 where most developed economies have pursued a range of fiscal stimulus measures.

and have access to perfect information; are not credit constrained; and are 'infinitely lived' through bequest motives.

The set of assumptions required for full Ricardian equivalence to hold is clearly unrealistic. However, the key issue for the model outlined below is whether there is some partial offsetting savings behaviour that may reduce the demand impact of fiscal policy (suggesting that there is at least some partial Ricardian response). As noted in the literature review, previous empirical studies suggest that a decrease in public saving tends to raise private saving with an offset coefficient of around one third to one half (which also implies a fiscal multiplier of two thirds to one half).

The relationship between private and public saving can be estimated through a model with the following functional form:

$$S_t^{priv} = \alpha_0 + \beta_0 S_t^{pub} + \phi_0 Z_t + e_t \qquad 5.1$$

where S_t^{priv} and S_t^{pub} denotes the ratio of net household plus net corporate saving (which gives total net private saving) to GDP, and the ratio of net general (Commonwealth, local and state) government saving to GDP, while Z_t is a vector of control variables. This reduced-form saving equation allows for the estimation of a private savings offset with a large number of control variables, and is similar to that used in previous empirical studies by Haque (et al: 1999); Masson (et al: 1998); Loayza (et al: 2000); Comley (et al: 2002); de Serres and Pelgrin (2003); and de Mello (et al: 2004). A similar specification of this model was also applied to the United States by Cotis (et al: 2006).

Based upon the references cited above, the vector Z_t of control variables often includes conventional determinants of private saving, such as the real interest rate, inflation, household income, social assistance payments to households, changes in the terms of trade, and employment. Specifically:

$$Z_t = \{Y_t, AS_t, U_t, R_t, INF_t, TOT_t, FLIB_t, H_t, EQ_t\} \qquad 5.2$$

Where:

Y_t = Household gross disposable income;

AS_t = Social assistance benefits to household gross disposable income;

U_t = Unemployment rate;

R_t = Real interest rate;

INF_t = Inflation rate;

TOT_t = Terms of trade;

$FLIB_t$ = Net foreign liabilities (proxy for financial openness);

H_t = Australian house price index (proxy for wealth); and

EQ_t = Australian share price index (proxy for wealth).

Before considering each of the explanatory variables in greater detail, there are a number of issues to be mindful of when considering measures of private saving in Australia. These warrant a good deal of consideration as they have often not been discussed in any great detail in the past, and most empirical researchers are unaware of the caveats surrounding Australian savings data.

5. 3 The measurement of household and total private saving in Australia

There are two fundamental approaches to the measurement of saving. It can be measured in terms of 'flows', which is the difference between current income and expenditure. Alternatively, saving can be measured as the change in the 'stocks' of accumulated net wealth (assets minus liabilities) from one period to the next. Even though both measures should conceptually provide the same outcome, this does not always hold true.

Saving rates in Australia and elsewhere are generally measured in terms of flows and are derived from the System of National Accounts (SNA93, United Nations 1993):

> *Saving represents that part of disposable income that is not spent on final consumption goods and services. It may be positive or negative depending on whether disposable income exceeds final consumption expenditure, or vice versa (SNA93, 9.19).*

Saving can be further differentiated between gross and net saving. Gross saving is calculated as gross disposable income less household final consumption expenditure, whereas net saving is defined as gross saving less the consumption of fixed capital, and is a measure of what is available for capital formation over and above that required for capital replacement. This makes the net concept more relevant for analysing the adequacy for new capital formation and the change in wealth.

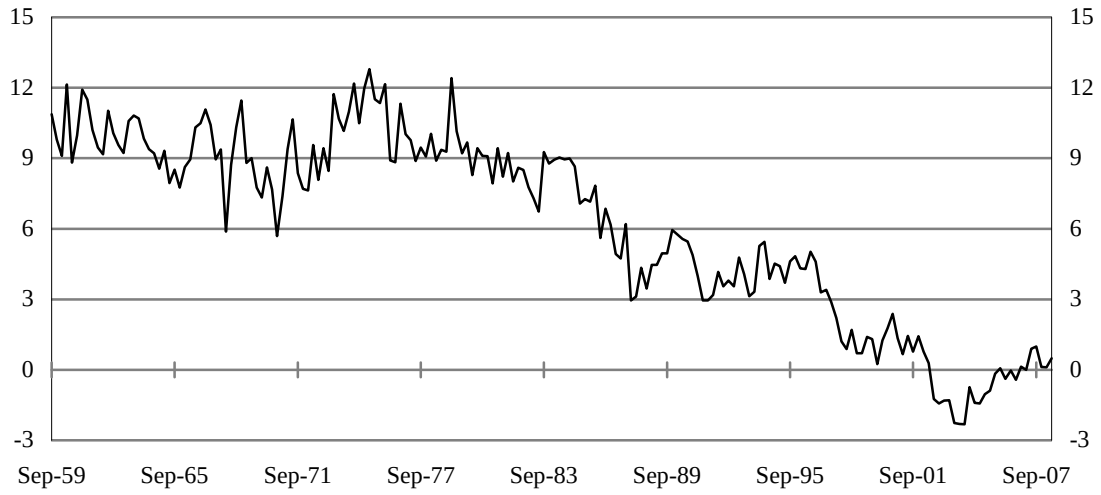
Having considered these definitions, the most commonly quoted measure of household saving in Australia is the net household saving ratio published as a memorandum item by the Australian Bureau of Statistics (ABS) in its National Accounts publications (Commonwealth Treasury: 1999). The net household saving ratio is defined by the ABS as the proportion of the net disposable income of all households that is not consumed by households in that period. In this context, net disposable income is the gross disposable income of the household sector net of depreciation on the capital assets of the household sector in that period.[13]

As seen in Figure 5.1 below, net household savings to GDP ratio has consistently declined over the past few decades. The net household saving ratio averaged around 11 per cent of net household disposable income in the 1960s, rising to a peak around 13 per cent in the mid-1970s. According to this measure, the net household saving ratio fell from an average around 6 per cent over the course of the 1980s to an average of 3 per cent over the 1990s. Over the first half of this decade the net savings measure was negative.

---

[13] Even though the net saving concept is conceptually better it does run into practical problems as the household net saving ratio can be affected by the approach used for the measurement of consumption of fixed capital. The method for calculating consumption of fixed capital varies significantly across countries – making the net measure less reliable for international comparisons (Commonwealth Treasury: 1999).

Figure 5.1 Net household saving ratio (per cent of GDP)



Source: Australian Bureau of Statistics.

Chart 5.1 indicates a significant decline in the ABS net household saving ratio since the mid-1970s. However, as will be discussed below, this decline partly reflects measurement and classification limitations rather than a significant change in saving behaviour.

A reason for the apparent decline in the net household savings ratio may be a potential piercing of the 'corporate veil' by households. The household sector is defined as including both individuals and unincorporated enterprises. Consequently, changes in the structure of the business sector, particularly small business, can have a significant effect on whether income (and hence saving) is classified as belonging to the household or the corporate sector.[14] The trend towards incorporation over recent decades suggests that some of the saving that was previously measured as accruing to the household sector would now be measured as accruing to the corporate sector. Considering these factors, it may be more accurate to assess trends in private saving as a whole rather than the saving of the household sector. The measure of private saving that is derived from the National Accounts for this thesis[15] takes into account

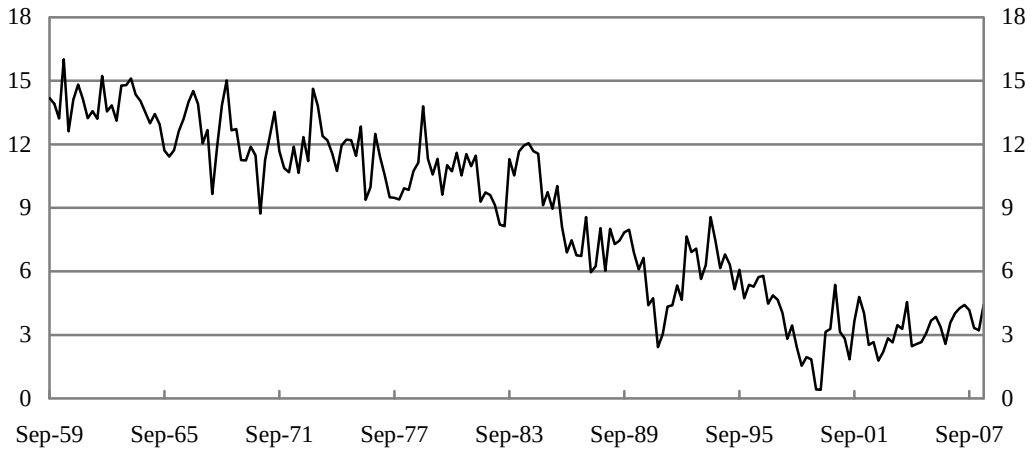
[14] This can also be seen as occurring directly through increased levels of equity ownership by households, particularly indirectly through households' growing superannuation portfolios.

[15] Net private saving here is equal to net national saving (ABS Cat No. 5206-32B) minus net government saving (ABS Cat No. 5206-38).

household saving and the undistributed income of private corporations. However, it generally does not include the effect of asset price movements.

Figure 5.2 shows the net private saving ratio for Australia. This ratio averaged around 12 per cent over the 1960s and 1970s, before declining over the past two decades.

Figure 5.2 Net private saving ratio (per cent of GDP)



Source: Australian Bureau of Statistics.

The pure economic definition of saving is the change in the wealth or net worth of households from one period to the next. In this context, an important limitation of flow measures of saving considered so far is that they typically do not incorporate capital gains and losses as part of income and hence saving (Commonwealth Treasury: 1999).[16] Hiebert (2006) noted that gains in household wealth in Australia have increasingly been used as a substitute for personal saving. This is a particularly salient point, as it could be argued that many Australian households have typically viewed the family home as a form of saving. Household wealth in the form of superannuation could also be another important factor here as it has become an important savings vehicle over the past two decades or so. While this has also led to large gains in household wealth, changes in the value of this asset portfolio will also be excluded from flow measures of saving.

[16] Further, saving as measured in the national accounts may not perfectly correspond to the theoretical concept of saving because of problems around classification, valuation and the exclusion of the effects of inflation.

While the ABS measure of net saving does have some limitations and caveats, it is the most widely recognised measure of saving in Australia and has a long historical time series.[17] However, in the 2002-03 Australian System of National Accounts publication the ABS provided an alternative household saving measure which augmented the conventional net savings measure with other changes in real net wealth.[18] Unfortunately this measure of saving is only available for data spanning back to 1988-89. To the extent that wealth effects do have a significant impact on private saving, consumption and investment, the analytical model of private saving being considered in this chapter includes a household price index, and an equity price index as a means of attempting to account for changes in wealth.

5. 4 Coefficient on public saving

The hypothesis of a strict private savings offset (Ricardian equivalence) would be supported if the coefficient on public saving in (5.1) above, $\beta_0 = -1$, controlling for the other private saving determinants. A negative coefficient on public savings, but less than 0, that is $(-1 < \beta_0 < 0)$ would indicate a partial savings offset, and that changes in the general government sector's fiscal stance has measurable impacts on the wider economy. Further, with $\beta_0 = 0$, changes in the government sector's fiscal stance have no impact on domestic saving, implying that twin deficits may actually be a relevant proposition. The possibility that $\beta_0 = 0$, has not been considered by previous authors including de Mello (et al: 2004), who were only concerned with the situation where $\beta_0 = -1$ (implying full private savings offsets and Ricardian equivalence).

Where $\beta_0 = 0$, a fiscal expansion (such as a tax cut) financed through bond issuance lowers private saving by increasing private disposable income and consumption. Under a floating exchange rate this shortfall in domestic saving is matched by

[17] The ABS net savings measures are available back to 1959.

[18] A deficiency with the use of net worth is due to the practical limitations in obtaining the broadest set of assets and liabilities, some of which may be difficult to measure or may not even have a market value (such as natural resources and human capital).

foreign capital inflows, a higher exchange rate, and a subsequent rise in the current account deficit.

Cotis (et al: 2006) discuss a number of reasons which could give rise to a positive coefficient on public saving, that is, where $\beta_0 > 0$. Sources of changes in the fiscal position arise not only from changes to taxation arrangements, but also from changes in expenditures. For a positive private savings offset, public expenditures need to be considered complimentary, with a clear distinction between expenditures which are permanent, and those which are transitory. Permanent changes will tend to generate negative private savings offsets through the restrictions imposed by the intertemporal budget constraint considered in the Chapter 3. Temporary shocks in government spending, however, could generate positive private saving responses, particularly when households see public and private consumption as complements.[19]

5. 5 Other coefficients

The coefficient on household disposable income, Y_t, is expected to be positive. As household income may be considered a proxy for labour income in a standard life-cycle model of consumption, an increase in household disposable income is expected to increase private saving. Alternatively, households may suffer from consumption inertia and therefore take time to change their consumption patterns to new levels of income.

Social assistance payments to households, AS_t, are expected to negatively impact private savings. The existence of a welfare safety net in Australia is expected to crowd out precautionary motives for saving, and other privately-run alternatives that would encourage thrift.

Increasing levels of unemployment lowers disposable incomes, and, through a greater incidence of liquidity constraints, lowers saving. However, increases in unemployment may increase the need for precautionary saving. But as noted above

[19] Specifically, this arises when the marginal utility of private consumption is positively affected by public spending. Government-subsidised health and education programmes, and government co-payment incentives, could provide examples of public and private complements in consumption.

the existence of welfare safety nets in Australia may crowd out precautionary motives for saving. Overall, the coefficient on the unemployment rate, U_t, is expected to negative.

The effects of inflation, INF_t, and the real interest rate, R_t, are somewhat ambiguous, and depend largely on the extent of credit constraints and on the relative magnitude of income and substitution effects. Also, higher, and/or accelerating inflation erodes the real value of debt and raises private saving, but may also discourage holdings of assets that are not inflation-indexed.

Terms of trade shocks, TOT_t, are particularly relevant for Australia given a high reliance on commodity-based exports. This coefficient is expected to be positively correlated with private saving to the extent that terms of trade shocks are viewed as being temporary[20] through the Laursen-Harberger-Metzler effect.[21] Permanent shocks should not affect private saving.

As noted in earlier chapters, there has been a considerable amount of economic reform undertaken over the past three decades, most notably the reform of Australia's financial sector. Financial liberalisation in Australia occurred over a decade beginning in the early 1980s, with removals of restrictions on bank deposit rates and lending, and progressed to other significant reforms of which the most notable were the floating of the Australian dollar in December 1983, and deregulation of home mortgage interest rates. This period of financial deregulation lead to a marked structural shift in the Australian economy and the development of sophisticated private markets for credit and financial risk management. As noted in Chapter 4, this development of the financial sector and associated integration into global capital markets may dampen the impact of fiscal policy. More sophisticated

[20] This historically has been the case with terms of trade shocks experienced with the Korean War, 1970s oil price shocks, and most recently the rapid industrialisation of China.

[21] According to the Laursen-Harberger-Metzler effect, an adverse (beneficial) transitory movement in the terms of trade results in a decrease (increase) in a country's current level of income which is larger than the decrease (increase) in its permanent income, causing a fall (rise) in aggregate saving (Cashin and McDermott: 2002).

private credit markets also enables greater access to personal credit, allowing households to smooth consumption.

As noted by de Mello (et al: 2004), the effect of financial liberalisation on private saving is ambiguous, because improved access to credit may boost consumption but the removal of bank portfolio allocation constraints, which often accompanies financial liberalisation, may result in higher real interest rates, which encourages saving. Given the large increase in foreign capital inflows over the past two decades following financial market deregulation, it may be reasonable to expect that any coefficient representing financial openness in Australia will have a negative sign.

Adequate proxies for financial openness are difficult to measure, and somewhat subjective in nature. However, such proxies may include variables such as growth in M2 money and the ratio of household wealth to disposable income (as used by Comley et al: 2002). However, long time series for these variables are generally not available, with most measures only dating back to around the early 1980s at best. Alternative measures of financial openness have been suggested by Lane and Milesi-Ferretti (2001), and include measures based around countries' foreign assets and liabilities. Given this, Australia's level of net foreign liabilities may provide a good proxy for financial openness, particularly as foreign debt has increased substantially since the financial market reforms of the 1980s. Data on Australia's net foreign liabilities is also available back to the late 1950s.

Household wealth is expected to affect consumption/saving decisions based on permanent income considerations. Given that most Australian households have historically tended to hold their wealth through the family home, a house price index is used here as it is expected to provide a good proxy for household wealth in Australia.[22]

A share price index is also considered as an additional measure of private wealth. Historically, the proportion of Australian households participating directly in the

[22] Around 70 per cent of Australian households owned their home in 2003-04 (Australian Bureau of Statistics: 2006).

sharemarket had been relatively low – until rising markedly over the past two decades. In 2006, approximately 38 per cent of the Australian population owned shares directly (Australian Securities Exchange: 2007),[23] which places Australia as having some of the highest (direct) share ownership rates in the world.

The expected sign of the coefficients representing wealth affects, *H* and *EQ*, warrant further consideration. Changes in the prices of household assets (and the returns derived from these) will flow through to household balance sheets – affecting household consumption and saving.

There are four channels through which changes in asset prices can be considered to affect activity: wealth effects on consumption; the Tobin's Q effect on investment; balance sheet effects on private spending (via credit channels); and the confidence effect on private spending (Altissimo et al: 2005). For private saving, changes in house prices can be expected to flow through the wealth affect on consumption, and through confidence affects. Equity prices could potentially affect private saving (the measure of savings used here also includes corporate saving) through any one of the above channels.

The logic of budget constraints dictates that, when an individual's wealth rises, the individual must either spend that wealth while living, or bequest the wealth to other individuals or organisations. Considering an intertemporal utility maximising framework, current consumption is proportional to total wealth:

$$C = mpc_W \left[A + H(Y) \right] \approx mpc_W A + mpc_Y Y \qquad 5.3$$

where *C* is consumption, *A* is real non-human wealth and *H* is real human wealth, i.e. the present value of expected labour income (net of taxes) *Y*. The proportionality coefficients *mpc* measure the marginal propensity to consume (MPC) out of wealth

[23] Australian households have also been undertaking greater ownership of equities indirectly through their superannuation savings. The Australian Securities Exchange (2007) estimates that in 2006, approximately 46 per cent of the Australian population owned shares either directly via shares or indirectly via a managed fund or self-managed superannuation fund.

and income. The wealth channel from a macroeconomic perspective can be considered by transforming (5.3) into elasticities:

$$\frac{\Delta C}{C} = \underbrace{\left[mpc_W \frac{A}{C} \right]}_{e_W} \frac{\Delta A}{A} + \underbrace{\left[mpc_Y \frac{Y}{C} \right]}_{1-e_W} \frac{\Delta Y}{Y}$$

$$= \sum \underbrace{mpc_W \frac{A_j}{C}}_{e_{W,j}} \frac{\Delta A_j}{A_j} + \left[mpc_Y \frac{Y}{C} \right] \frac{\Delta Y}{Y} \qquad 5.4$$

Equation (5.4) shows that the size of the wealth elasticity of consumption e_W depends, in addition to the mpc_W, on the size of the wealth consumption ratio. If it is differentiated across wealth components, then it is dependent upon the wealth consumption ratio of each wealth component j. The elasticity e_W is constant only if the wealth to consumption ratio is constant.

Considering wealth affects within the household budget constraint:

$$A_{t+1} = R_{a,t+1} \left[A_t + Y_t + C_t \right] \qquad 5.5$$

Where A_t is the aggregate level of real and financial assets at the end of period t, Y_t is labour income, C_t is consumption and $R_{a,t+1} (= 1 + R_{a,T+1})$ is a time-varying return on total assets. If A_t contains both riskless and risky assets, then $R_{a,t}$ can be interpreted as a weighted average of the returns derived from these assets. Solving forward and imposing the transversality condition that at the end of a finite horizon the limit of discounted future wealth is zero, gives:

$$E_t \sum_{i=1}^{T} \left(\prod_{j=0}^{i} R_{a,t}^{-1} R_{a,t+j} \right)^{-1} C_{t+i} = A_t + \underbrace{E_t \sum_{i=1}^{T} \left(\prod_{j=0}^{i} R_{a,t}^{-1} R_{a,t+j} \right)^{-1}}_{H_t} Y_{t+i} \qquad 5.6$$

Equation (5.6) above notes that today's total wealth, which is the sum of real assets, financial assets, and the discounted sum of expected future labour income $W_t = (A_t + H_t)$, equals the present discounted value of planned future consumption.

In response to a permanent unanticipated wealth shock the discounted sum of future consumption must rise by an equal amount:

$$\Delta A_t = E_t \sum_{i=1}^{T} \left(\prod_{j=0}^{i} R_{a,t}^{-1} R_{a,t+j} \right)^{-1} \Delta C_{t+i} \approx \left(\frac{1 - \bar{R}_a^{-T}}{1 - \bar{R}_a^{-1}} \right) \Delta \bar{C} \;\Leftrightarrow$$

$$\Delta \bar{C} = \underbrace{\frac{\bar{r}_a}{1+\bar{r}_a} \left[\frac{\left(1+\bar{r}_a\right)^T}{\left(1+\bar{r}_a\right)^T - 1} \right]}_{mpc_W} \Delta A_t \qquad 5.7$$

where:

$$mpc_W = \left(\frac{\bar{r}_a}{1+\bar{r}_a} \right) \text{ when } T \to \infty$$

and:

$$mpc_W = 1 \text{ when } T \to \infty$$

Where Δ indicates the difference between the post-shock and pre-shock values, $\Delta \bar{C}$ refers to the average level shift in consumption over the horizon from t to T and $1 + r_a = \bar{R}_a$ is the average return on non-human wealth over the horizon from t to T. Equation (5.7) therefore defines the long-run MPC out of wealth mpc_W conditional on the positive wealth shock being permanent.

The above analysis suggests that permanent rises in household wealth raise total household lifetime income, and thus consumption. This suggests that positive

coefficients on both housing (*H*) and equity prices (*EQ*) are expected in the estimations.

Considering housing wealth in more detail, Altissimo (et al: 2005) have outlined a number of arguments as to why a higher MPC out of housing wealth may be expected. First, as equity prices are more volatile than house prices, households may find it difficult to assess whether a change in their equity wealth is permanent or temporary. If this occurs, households are likely to be more cautious in adapting consumption plans to changes in equity wealth than housing wealth. Second, as house purchases are usually financed, increases in property values result in a higher net return on this investment than on other assets, implying that the MPC out of housing wealth may be larger than for assets with lower expected returns. Tax considerations are also important. Differential tax treatment of equity holdings and residential property may lower the MPC out of equity wealth because stock holdings have to be retained to receive a more favourable tax treatment. This is particularly true for Australia, where the family home is not subject to capital gains tax. Additionally, Australian shares must be held for a fixed period of time in order to receive capital gains tax concessions.

5. 6 Data

Detailed descriptions of each variable contained in the reduced-form savings equation are contained in Appendix A. Most data has been sourced from the Australian Bureau of Statistics and the Reserve Bank of Australia. The sample size is large in both the number of observations (188) and the time period which is considered: 1959:3 – 2006:2.

5. 7 Summary and conclusions

The analytical model considered in this chapter attempts to explain the extent to which private saving responds to changes in government saving. While this framework suggests that the model lends itself towards explaining Ricardian equivalence effects, it can also be considered as a broad measure of the impact of fiscal policy on short- and long-run aggregate demand. Other variables included in the model that may explain changes in private saving include household disposable income, social assistance payments to households, the real interest rate, inflation, the

terms of trade, net foreign liabilities (a proxy for financial openness) and indexes for house prices and equities (to account for wealth effects).

Measures of saving in Australia, particularly how these relate to the economic concept of saving, were also discussed. The measurement of financial openness and wealth effects was also considered. Previous empirical studies, particularly those that focus on Australia, have not paid a great deal of attention to the measurement of these variables, and this thesis is making an original contribution to the literature by providing a more detailed consideration of these factors.

The following chapter will consider the time series properties of the data series used to estimate the analytical model. Attention will be given to the issue of structural breaks, with attention given to the timing of any structural breaks that may exist in the data and how this accords with major economic events in Australia.

CHAPTER 6 STATIONARITY TESTING

6. 1 Introduction

Before proceeding with the estimation of the analytical model considered in the previous chapter, the time series properties of the data need to be investigated. As the theoretical framework presented in the previous chapter will be examined and tested using cointegration techniques, it is essential that the time series properties of the data are considered. The question to be answered in this chapter is whether the variables are stationary[24] or non-stationary.

Traditional Augmented Dickey-Fuller tests are discussed in section 6.2. This is followed by a discussion on the development of single structural break tests in section 6.3, which includes the Zivot and Andrews test, the Innovational Outlier Model and the Additive Outlier model. Section 6.4 considers the development of more advanced multiple structural break tests. Section 6.5 applies the data to the Augmented Dickey-Fuller test, and the Lee and Strazicich one and two break testing procedures. Results from the stationary tests are summarised in section 6.6. Finally, inferences regarding the timing of structural breaks are examined in section 6.7 to see whether they concord with significant historical policy changes and economic developments.

6. 2 Stationarity tests

Considering the stationarity of the data is important, since if economic time series are characterised by non-stationarities then the classical t-test and F-test are inappropriate because the limiting distribution of the asymptotic variance of the parameter estimates is infinite (Fuller: 1985). This often leads to spurious results in conventional regression analysis. The underlying data generating process of a series (whether the series is stationary or non-stationary) can be uncovered through tests for stationarity. Conventional tests for stationarity were first developed by Fuller (1976) and Dickey and Fuller (1979).

[24] A series is stationary if its mean, variance and covariance are independent of time.

Consider the time series *X*. In order to test if this series is stationary and if not, to what order it is integrated, first estimate the equation:

$$\Delta X_t = b_0 + b_1 t + b_2 X_{t-1} + \sum_{i=1}^{k} b_{2+i} \Delta X_{t-i} + e_t \qquad 6.1$$

where k is chosen so that the residual e_t is approximately white noise. The hypothesis $H_0 : b_2 = 0$ is tested by comparing the calculated *t*-ratio with critical values. If $k = 0$, the test is known as the Dicky-Fuller (DF) test and if $k \geq 1$, it is known as the Augmented Dicky-Fuller (ADF) test. If the null hypothesis is rejected, the series X is stationary. If we cannot reject the null hypothesis, the next step is to test whether the first difference is stationary, implying $X \sim I(1)$. The same testing procedure can be used after re-estimating equation (6.1) by substituting ΔX for X.

There was a considerable amount of debate in the late 1980s surrounding the efficacy and relevance of the stationarity tests considered above. Importantly, Perron (1989) challenged the earlier findings of Nelson and Plosser (1982), who argued that random shocks to many important macroeconomic time series have permanent effects on the long-run level of these series (i.e. non-stationary). Perron argued that most macroeconomic series are in fact not characterised by a unit root, and that persistence arises only from large and infrequent shocks. Such shocks would eventually see the economy returning to a deterministic trend. According to Perron:

> '*Most macroeconomic time series are not characterised by the presence of a unit root. Fluctuations are indeed stationary around a deterministic trend function. The only 'shocks' which have had persistent effects are the 1929 crash and the 1973 oil price shock*' (Perron: 1989).

Perron (1989) further argued that failing to account for at least a one-time structural break in a series may bias unit root tests towards non-rejection of the null – leading to the (incorrect) conclusion that the series contains a unit root, when in fact the series may be stationary around a one-time structural break (also see Perron: 1997, and Leybourne and Newbold: 2003). Therefore, conventional unit root tests, such as

the Augmented Dickey-Fuller procedure discussed above, may have little power in the presence of structural breaks. Structural change can occur in a range of economic time series for a variety of reasons, including changes in institutional arrangements, policy shifts and external (exogenous) shocks.

Earlier stationarity tests in the presence of structural breaks, such as that used by Perron (1989), relied upon visually inspecting a series to determine the starting point for a structural break. Test statistics were then constructed by adding dummy variables representing different intercepts and slopes, thereby extending the standard Dickey-Fuller testing methodologies. However, these techniques have been subject to criticism (most notably by Christiano: 1992) as specific dates may be chosen which support the researcher's results and *a priori* expectations (i.e. data mining).

Perron's (1989) procedure is characterised by a single exogenous (known) break in accordance with the underlying asymptotic distribution theory. Perron uses a modified Dickey-Fuller (DF) unit root test that includes dummy variables to account for one known, or exogenous structural break. The break point of the trend function is fixed (exogenous) and chosen independently of the data. Perron's (1989) unit root test allows for a break under both the null and alternative hypothesis. These tests have less power than the standard DF-type test when there is no break. However, Perron (2006) points out that they have a correct size asymptotically and are consistent whether there is a break or not. Moreover, they are invariant to the break parameters and thus their performance does not depend on the magnitude of the break (Glynn et al: 2007).

The following sections discuss the literature concerning stationarity testing in the presence of one structural break, which is followed by a discussion of tests where more than one structural break is present.

6. 3 Single structural break tests

Failing to account for at least a one-time structural break in a series may bias unit root tests towards non-rejection of the null – leading to the (incorrect) conclusion that the series contains a unit root, when in fact the series may be stationary around a one-time structural break. Given this Perron (1989) re-examined the Nelson and Plosser

(1982) data and found that 11 of the 14 US macroeconomic variables examined by these researchers were in fact stationary when known exogenous structural breaks are included in the unit root test. From visually inspecting plots of the various data series to determine where the most significant structural break is likely to have occurred, Perron (1989) ran the following models which allow for a one-time structural change at time $TB(1 < TB < T)$,where T is the number of observations.

Model A

$$y_t = \mu + dD(TB)_t + y_{t-1} + e_t \qquad 6.2$$

Model B

$$y_t = \mu + y_{t-1} + (\mu_2 - \mu_1) DU_t + e_t \qquad 6.3$$

Model C

$$y_t = \mu + y_{t-1} + dD(TB)_t + (\mu_2 - \mu_1) DU_t + e_t \qquad 6.4$$

Model A allows for a one time (exogenous) change in the level of the series, Model B for a change in the rate of growth, and Model C for a change in level and slope.

It is important to note that Perron's (1989) model cannot be applied where the timing of the structural change is unknown. This assumption of choosing the break date has been criticised as 'data mining'. Christiano (1992) argued that the data-based procedures are typically used to determine the most likely location of the break and this approach invalidates the distribution theory underlying conventional testing. Since then, several procedures have been developed using different methodologies for endogenously determining the break date. Some of these include Banerjee, Lumsdaine and Stock (1992), Zivot and Andrews (1992), Perron and Vogelsang (1992), Perron (1997) and Lumsdaine and Papell (1997). The next section considers the most popular models for examining stationarity in the presence of a single structural break: the Zivot and Andrews (1992) endogenous break test; the

Innovational Outlier (IO) model, which is relevant when structural change occurs gradually over time; and the Additive Outlier (AO) model, which is relevant when a series exhibits a sudden change in the mean.

6.3.1 Zivot and Andrews test

Zivot and Andrews (1992) proposed a variation of Perron's (1989) test where the time of the structural break in a data series is endogenised (as opposed to being assumed exogenously prior to undertaking the testing procedure). The null hypothesis of the Zivot and Andrews test is that the variable contains a unit root with drift under the presence of no structural breaks; with the alternative hypothesis being that the series is a trend-stationary process with a single breakpoint; with the break being allowed by either a shift in the level or the growth rate of a series. The time of the break is chosen to minimise the one-sided t-statistic of $\hat{\alpha} = 1$ in the equations outlined below.

Zivot and Andrews proposed three models for determining a structural break:

Model A

$$y_t = \hat{\mu}^A + \hat{\theta}^A DU_t\left(\hat{T}_b\right) + \hat{\beta}^A t + \hat{\alpha}^A y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^A \Delta y_{t-j} + \hat{e}_t \qquad 6.5$$

Model B

$$y_t = \hat{\mu}^B + \hat{\beta}^B t + \hat{\gamma}^B DT_t\left(\hat{T}_b\right) + \hat{\alpha}^B y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^B \Delta y_{t-j} + \hat{e}_t \qquad 6.6$$

Model C

$$y_t = \hat{\mu}^C + \hat{\theta}^C DU_t\left(\hat{T}_b\right) + \hat{\beta}^C t + \hat{\gamma}^C DT_t\left(\hat{T}_b\right) + \hat{\alpha}^C y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^C \Delta y_{t-j} + \hat{e}_t \qquad 6.7$$

Model A allows for a single change in the intercept, Model B allows for a broken trend function and Model C allows for a structural change in both the intercept and

trend. DU_t represents a dummy variable capturing a shift in the intercept, while DT_t captures a shift in the trend occurring at time TB. As noted above, the alternative hypothesis under the Zivot and Andrews test is that the series, y_t, is $I(0)$ with one structural break. TB represents the break date, and $DU_t = 1$ if $t > TB$ and zero otherwise, DT_t is equal to $(t - TB)$ if $t > TB$ and zero otherwise. The null hypothesis is rejected if the coefficient, α, is statistically significant. For the Zivot and Andrews test, the time of the break point, TB, is endogenously determined by running models A through C and sequentially allowing for TB to be any data point with the only exceptions being the first and last observations. The optimal lag length is selected through a general-to-specific procedure.

6.3.2 Innovational outlier models

The Zivot and Andrews (1992) work was extended by Perron and Vogelsang (1992), and Perron (1997), who proposed a class of test statistics that allows for two different forms of structural break. These are the Additive Outlier (AO) and Innovational Outlier (IO) models. The AO model allows for a sudden change in mean (crash model) while the IO model allows for more gradual changes. Perron and Vogelsang (1992) argue that these tests are based on the minimal value of t-statistics on the sum of the autoregressive coefficients over all possible breakpoints in the appropriate autoregression. While Perron (1997), argues that: '*…if one can still reject the unit root hypothesis under such a scenario it must be the case it would be rejected under a less stringent assumption*'. Perron and Vogelsang (1992) applied these two models for non-trending data (raw data), while Perron (1997) modified them for use with trending data (Glynn et al: 2007).

The IO1 model below (6.8) allows for gradual changes in the intercept, and the IO2 model (6.9) accommodates gradual changes in both the intercept and slope of the trend function, such that:

$$x_t = \mu + \theta DU_t + \beta t + \delta D(T_b)_t + \alpha x_{t-1} + \sum_{i=1}^{K} c_i \Delta x_{t-i} + e_t \qquad 6.8$$

$$x_t = \mu + \theta DU_t + \beta t + \gamma DT_t + \delta D(T_b)_t + \alpha x_{t-1} + \sum_{i=1}^{K} c_i \Delta x_{t-i} + e_t \qquad 6.9$$

where T_b denotes the time of break $(1 < T_b < T)$ which is unknown, $DU_t = 1$ if $t > T_b$ and zero otherwise, $DU_t = T_t$ if $t > T_b$ and zero elsewhere, $D(T_b)_t = 1$ if $t = T_b + 1$ and zero otherwise, x_t is any general ARMA process and e_t is the residual term which is assumed to be white noise. The null hypothesis of a unit root is rejected if the absolute value of the t-statistic for testing $\alpha = 1$ is greater than the corresponding critical value.[25]

For the Innovational Outlier model, Perron (1997) suggested two methods for determining the timing of the structural break. Firstly, equations (6.8) and (6.9) can be sequentially estimated assuming different T_b, with T_b chosen to minimise the t-ratio for $\alpha = 1$. The second method involves choosing T_b from among all other possible break point values, such that the t-ratio on the estimated slope coefficient (γ) is minimised. The lag parameter, k, is determined using Perron's (1997) data-dependent method. Under this procedure the choice of k depends upon whether the t-ratio on the coefficient associated with the last lag in the estimated autoregression is significant. The optimum lag length (k^*) is selected such that the coefficient on the last lag in an autoregression of order (k^*) is significant, and that the last coefficient in an autoregression of order greater than (k^*) is insignificant, up to a maximum order k (Perron: 1997).

6.3.3 Additive outlier model

While the Innovational Outlier model allows for gradual structural change, the Additive Outlier model assumes structural changes occur instantaneously. Perron (1994) developed a two-stage procedure for implementing the AO model. The first step involves de-trending the series:

[25] The alternative hypothesis under both the IO and AO models is a trend stationary process with a single breakpoint.

$$y_t = \mu + \beta t + \gamma DT_t^* + \tilde{y}_t \qquad 6.10$$

where $\tilde{y}$ is the de-trended series. As equation (6.10) assumes that the structural break only affects the slope coefficient, the following specification is then estimated to test for a change in the slope coefficient:

$$\tilde{y} = \sum_{i=0}^{k} w_i D(T_b)_{t-i} + \alpha \tilde{y}_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-1} + e_t \qquad 6.11$$

These equations are estimated sequentially for all possible values of $T_b (T_b = k+2, \ldots, T-1)$ where T is the total number of observations so as to minimise the t-statistic for $\alpha = 1$. A general-to-specific procedure is used to determine the appropriate lag length, with the break date assumed to be unknown and endogenously determined by the data. The null hypothesis of a unit root with no structural break is rejected if the t-statistic for α is larger in absolute value than the corresponding critical value.

As a general note, accounting for structural breaks when testing the unit root hypothesis has a number of advantages. First, it prevents a test result which is biased towards non-rejection, as suspected by Perron (1989). Since this procedure can also identify when the possible presence of a structural break occurred, the tests can also provide valuable information for analysing whether a structural break on a certain variable is associated with a particular government policy, economic crisis or other factors. In fact, the results of these tests can also be judged against known priors about where structural breaks are likely to have occurred in a time series.

However, questions have been raised by Perron and others – particularly that there is a trade-off between the power of these tests and the amount of information incorporated with regard to the selection of the break point (Perron 1997). Second, these tests only incorporate a single break in each variable. For most economic time series, particularly those spanning more than one decade, it is conceivable that more than one structural break exists.

6. 4 Multiple structural break tests

While ignoring one structural break may bias unit root tests towards non-rejection of the null, considering just one structural break may not be sufficient. Ben-David (et al: 2003) argued that failure to allow for two breaks can cause non-rejection of the unit root null by previous tests that only incorporate only one break.

Most post-war macroeconomic time series are likely to have been subject to more than one structural break. For Australia, obvious examples of where the economy is likely to have experienced structural change are the 1970s terms of trade (oil price) shocks and subsequent high inflation periods, and the 1990-91 recession. Other break-points may have occurred around the financial market reforms of the 1980s and the introduction of the Goods and Services Tax in 2001.

The following sections consider multiple structural break tests, beginning with the Lumsdaine and Papell (1998) test for two structural breaks. This then follows on to other two-break tests developed by Atkins (2002), and Lee and Strazicich (2003). At present it appears that the literature has only considered two break tests, with multiple break tests in their infancy – largely due to computational difficulties.

6.4.1 Two break tests

The first test to consider two structural breaks was developed by Lumsdaine and Papell (1998). The Lumsdaine and Papell (LP) test is based upon a modified version of the Augmented Dickey-Fuller test and specifies two structural breaks:

$$\Delta x_t = \mu + \beta_t + \theta DU1_t + \gamma DT1_t + \omega DU2_t + \psi DT2_t + \alpha x_{t-1} + \sum_{t=1}^{k} c_t \Delta x_{t-1} + e_t \qquad 6.12$$

where $DU1_t = 1$ if $t > TB1$ and zero otherwise: $DU2_t = 1$ if $t > TB2$ and zero otherwise; $DT1_t = t - TB1$ if $t > TB1$ and zero otherwise; and $DT2_t = t - TB2$ if $t > TB2$ and zero otherwise. When $DU2_t$ and $DT2_t$ are excluded from (6.12), the LP model is equivalent to Zivot and Andrews Model C. Further, if $DT1$ is omitted, then this is equivalent to Zivot and Andrews Model A, and omitting $DU1$ yields their Model B.

The two structural breaks in the LP test are allowed for in both the time trend and intercept, which occur at $TB1$ and $TB2$. Breaks in the intercept are represented by $DU1_t$ and $DU2_t$, while changes in slope are represented by $DT1_t$ and $DT2_t$. The optimal lag length (k) is selected by following a general-to-specific procedure. The null hypothesis of a unit root and no structural breaks is rejected if the t-statistic, α, is larger in absolute value than the corresponding critical value. Rejection of the null hypothesis under the LP test requires careful interpretation as it does not necessarily imply rejection of a unit root per se, but implies rejection of a unit root without breaks.

It is important to note here that the endogenous break tests of Zivot and Andrews (1992) and Lumsdaine and Papell (1998) assume no breaks under the unit root null, and derive critical values based upon this (Lee and Strazicich: 2003).[26] The corresponding alternative hypothesis is usually that structural breaks are present in the data, which can include a unit root with structural breaks. While rejection of the null does not necessarily imply rejection of a unit root, it implies rejection of a unit root without structural breaks. Where a structural break is present under the null hypothesis, rejection of the null could lead to the (incorrect) conclusion that a series is trend-stationary with breaks (Lee and Strazicich: 2003). However, the series could in fact be non-stationary with breaks.

To overcome the problems noted above, Lee and Strazicich (2003) developed a two-break minimum Lagrange Multiplier (LM) unit root test where the alternative hypothesis implies trend stationarity (referred to by the authors as 'trend-break stationarity').[27] First consider the following data-generating process:

$$y_t = \delta' Z_t + e_t \qquad 6.13$$

[26] Nunes et al (1997) showed that this assumption leads to size distortions in the presence of a unit root with a structural break, with Lee and Strazicich (2003) demonstrating that the Zivot and Andrews (1992) and Perron (1997) tests tend to select the break point where bias and size distortions are the greatest.

[27] The null hypothesis is a unit root with breaks.

$$e_t = \beta e_{t-1} + u_t \qquad 6.14$$

where y_t is the data series in period t, δ is a vector of coefficients, Z_t is a matrix of exogenous variables, and u_t is a standard white noise error term with zero mean and constant variance $u_t \sim \text{iid } N\left(0, \sigma^2\right)$, Z_t is described by $\left[1, t, D_{1t}, D_{2t}, DT_{1t}^*, DT_{2t}^*\right]'$, to allow for a constant term, linear time trend, and two structural breaks in level and trend where T_{Bj} denotes the time period of the breaks. Under the trend-break-stationary alternative, the D_{jt} terms describe an intercept shift in the deterministic trend, where $D_{jt} = 1$ for $t \geq T_{Bj} + 1$, $j = 1, 2$, and zero otherwise; DT_{jt} describes a change in slope of the deterministic trend, where $DT_{jt} = 1$ for $t \geq T_{Bj} + 1$, $j = 1, 2$, and zero otherwise.

The two-break minimum LM unit root test statistic is obtained from the following regression:

$$\Delta y_t = d' \Delta Z_t + \phi \tilde{S}_{t-1} + \sum y_i \Delta \tilde{S}_{t-i} + \varepsilon_t \qquad 6.15$$

where $\tilde{S}_t = y_t - \tilde{\psi}_x - Z_t \tilde{\delta}$, $t = 2, ..., T$ and $\tilde{\psi}_t = y_1 - Z_1 \tilde{\delta}$. $\tilde{S}_t$ is a de-trended series of y_t using the coefficients in $\tilde{\delta}_t$, which are estimated from the regression in first differences of Δy_t on $\Delta Z_t = \left[1, \Delta D_{1t}, \Delta D_{2t}, \Delta DT_{1t}, \Delta DT_{2t}\right]$, y_1 and Z_1 are the first observations of y_t and Z_t, respectively, and Δ is the first difference operator. The standard white noise error term is represented by ε_t. To correct for serial correlation, $\Delta \tilde{S}_{t-1}$, $I = 1, ..., k$ terms are included. The unit root hypothesis in equation (6.15) is equivalent to $\phi = 0$, and the test statistics are defined as:

$$\tilde{\rho} = T \cdot \tilde{\phi} \qquad 6.16$$

$\tilde{\tau}$ = t-statistic for the null hypothesis $\phi = 0$. 6.17

To determine (endogenously) the location of the two breaks $\left(\lambda_j = T_{Bj}/T, j = 1,2\right)$, the minimum LM unit root test uses a grid search procedure:

$$\mathrm{LM}_{\rho} = \mathrm{Inf}_{\lambda}\tilde{\rho}(\lambda) \quad 6.18$$

$$\mathrm{LM}_{\tau} = \mathrm{Inf}_{\lambda}\tilde{\tau}(\lambda) \quad 6.19$$

The LM test is corrected for autocorrelated errors by including lagged augmentation terms $\Delta\tilde{S}t - j, j = 1,...,k$ as per the standard Augmented Dickey-Fuller test. The optimal lag length, k, is determined through the general-to-specific procedure of Perron (1989). For small samples, Westerlund (2006) has criticised the Lee and Strazicich test, noting that the test is biased towards rejecting the unit root null. He further notes that the precision of the estimated breakpoints is likely to be poor.

In addition to the two-break LM unit root test discussed above, Lee and Strazicich (2004) have also developed a one-break LM unit root test where the structural break is determined endogenously (in intercept and trend). The one-break LM test is similar to that discussed in (6.15) above, with Lee and Strazicich (2004) specifying two models: Model A, also referred to by the authors as the 'crash' model, and allows for a one-time change in the intercept under the alternative hypothesis; and Model C which allows for a shift in intercept and change in trend slope under the alternative hypothesis. Model A is described by $Z_t = \left[1, t, D_t\right]'$, where $D_t = 1$ for $t \geq T_B + 1$, and zero otherwise, with T_B being the time period of the structural break. Model C is described by $Z_t = \left[1, t, D_t, DT_t\right]'$, where $DT_t = t - T_B$ for $t \geq T_B + 1$, and zero otherwise. In each model the location of the structural break (T_B) is determined through searching all possible break points for the minimum (i.e. most negative) unit root t-statistic as follows:

$$\text{Inf}\ \tilde{\tau}\left(\tilde{\lambda}\right) = \underset{\lambda}{\text{Inf}}\ \ \tilde{\tau}\left(\tilde{\lambda}\right) \qquad 6.20$$

where $\lambda = T_B / T$.

6.4.2 Other procedures

Lee and Strazicich (2006) note that there are a number of technical difficulties in obtaining relevant asymptotic distributions and corresponding critical values of endogenous break unit root tests with three or more breaks. For these reasons the literature has primarily been concerned with single and two-break testing procedures. In addition to Lee and Strazicich (2003, 2004) there have been a number of other one and two-break unit root tests developed.[28] These include procedures by Clemente, Montañés and Reyes (1998), Ohara (1999), Atkins (2002), Papell and Prodan (2003), Harvey and Mills (2004), and more recently Kapetanois (2005) and Kim and Perron (2008). These procedures are discussed here briefly.

Clemente, Montañés and Reyes (1998) based their approach on Perron and Vogelsang (1992) allowing for two breaks. Ohara (1999) developed an approach based on sequential t-tests of Zivot and Andrews to examine the case on *m* breaks with unknown break dates. Ohara's evidence suggested that unit root tests with multiple trend breaks are necessary for both asymptotic theory and empirical applications. Papell and Prodan (2003) proposed a test based on restricted structural change – explicitly allowing for two structural breaks.

The endogenous break tests that allow for the possibility of one or multiple breaks; Zivot and Andrews (1992), Banerjee (et al: 2002), Perron (1997), Lumsdaine and Papell (1997) and Ohara (1999) do not allow for break(s) under the unit root null and derive their critical values accordingly. Nunes (et al: 1997) showed that this assumption leads to size distortions in the presence of a unit root with at least one structural break, and Perron (2006) suggests that there may be some loss of power. Lee and Strazicich (2003) demonstrate that when applying these endogenous break

[28] A useful summary of various testing procedures and potential pitfalls and limitations is provided in Perron (2005).

tests, researchers might conclude that the time series is trend-stationary when in fact the series is non-stationary with break(s). In this regard "spurious rejections" may occur. Thus, as pointed out by Lee and Strazicich (2003), a careful interpretation of results in empirical work is required.

Despite the computational difficulties, Atkins (2002) extended the Lumsdaine and Papell (1997) test to include three structural breaks. As noted above, by following the Lumsdaine and Papell methodology, Atkins' test does not consider the possibility of structural breaks under the null hypothesis. While this may be criticised in itself, a major shortcoming of the Atkins procedure is that the author did not publish any simulations that estimated the robustness of the three-break test.

Harvey and Mills (2004) conduct unit root tests with endogenously determined structural breaks where a single break occurs either instantaneously or gradually over time. Harvey and Mills noted that the assumption of an instantaneous break may be unrealistic for many economic time series. They considered variations of models used by authors such as Lee and Strazicich, but changed the specification to allow for structural breaks that occur with a smooth transition over time. The null hypothesis under their models is that of stationarity, with the alternative hypothesis being a unit root with structural breaks.

Kapetanois (2005) examined the unit root hypothesis with drift, and similar to Lee and Strazicich (2003, 2004) developed a testing procedure with no breaks under the null hypothesis against a trend-stationary alternative. For reasons discussed above, the omission of structural breaks under the null hypothesis (similar to that of Lumsdaine and Papell 1997) may bias this test. Multiple breaks are allowed for in the constant and/or trend. Kapetanois (2005) argues that this procedure is computationally efficient, which is important given the argument by Lee and Strazicich (2006) that the computational burden of tests with more than two breaks (for example via a grid search) would increase significantly with three or more breaks.

Carrion-I-Silvestrie and Sanso (2006) proposed several test statistics that improve existing procedures by Zivot and Andrew (1992) and Perron (1997) that allow for

estimation of a single unknown structural break under both the null and alternative hypotheses. The authors found their test statistics to be more powerful than existing test with good size properties. Liu and Rodriguez (2006) developed unit root tests with single structural breaks using GLS de-trended data. Their null hypothesis is that the series contains a unit root, against the alternative of a stationary series with a single structural break.

Kim and Perron (2009) emphasised that the literature assumes that if a break occurs, it does so only under the alternative hypothesis of stationarity. Importantly, they present a test that allows for a single break under both the null and alternative hypotheses. Where a break is present, they note that the limit distribution is the same for tests where the break date is known (i.e. Perron: 1989) – allowing for increased power. They also note that this procedure offers an improvement over existing procedures in small samples.[29]

6. 5 Estimation results

The following sections test the time series properties of the data by first using the Augmented Dickey-Fuller test, followed by the Lee and Strazicich one- and two-break testing procedures. While a brief discussion is provided for the results of each testing procedure, these are considered more thoroughly later in the chapter. The sample size issues regarding the Lee and Strazicich test that have been identified by Westerlund (2006) should not be a problem here as we are using a sample size of 188 variables.

The data for each variable is taken as inflation-adjusted levels, with a base-year of 2005. Where possible, the data are then converted to natural logarithms. However, for a number of variables this is not possible due to the series containing negative values.[30]

[29] Kim and Perron are yet to provide GAUSS codes for this procedure.

[30] These are government saving (*GS*), the real interest rate (*R*), and inflation (*INF*).

6.5.1 Augmented Dickey-Fuller test

The Augmented Dickey-Fuller tests were conducted in E-views. Lag selection was automatic (based upon the Schwartz-Bayesian criterion), and each equation contained a constant and linear trend.

The null hypothesis (Table 6.1) of a unit root cannot be rejected at the 1 per cent level for all series. However, private saving (*PS*) appears to be an exception, with the Augmented Dickey-Fuller test indicating that this series is in fact stationary.

Table 6.1 Results of the Augmented Dickey-Fuller test

Variable	Lag *k*	*t*	Inference
lnPS	0	-4.9656**	Stationary
ΔlnPS	na	na	na
GS	1	-2.0836	Non-stationary
ΔGS	0	-19.4727**	Stationary
lnY	1	-1.7841	Non-stationary
ΔlnY	0	-16.8579**	Stationary
lnFLIB	3	-0.9811	Non-stationary
ΔlnFLIB	2	-5.9628**	Stationary
lnU	1	-1.7693	Non-stationary
ΔlnU	0	-9.2032**	Stationary
R	0	-2.6858	Non-stationary
ΔR	0	-14.1111**	Stationary
INF	4	-1.9453	Non-stationary
ΔINF	3	-7.7521**	Stationary
lnAS	4	-1.0264	Non-stationary
ΔlnAS	3	-5.8379**	Stationary
lnTOT	5	-1.8400	Non-stationary
ΔlnTOT	6	-6.7852**	Stationary
lnH	2	-1.8929	Non-stationary
ΔlnH	1	-4.5548**	Stationary
lnEQ	0	-2.472394	Non-stationary
ΔlnEQ	0	-11.9522**	Stationary

The ADF equations contain a constant and linear trend. Automatic lag selection in E-views (Schwartz-Bayesian criterion) * Denotes significance at the 5% level. ** Denotes significance at the 1% level.

6.5.2 Lee and Strazicich one-break test

The Lee and Strazicich one-break LM unit root tests were conducted in GAUSS for Models A and C. Lag selection was conducted through a general-to-specific procedure.

Critical values for the one-break LM unit root test vary depending on the location of the breaks $\lambda = (T_{B1} / t)$ and are symmetric around λ and $(1-\lambda)$. Critical values for the two-break minimum LM unit root test[31] for Model C (intercept and trend break) are shown in Table 6.2 below, and are drawn from Table 1 in Lee and Strazicich (2004). Critical values for the two-break LM unit root test with change in intercept (Model A) at the 1, 5 and 10 per cent levels respectively are -4.24, -3.57, and -3.21.

Table 6.2 Critical values for the one-break LM unit root test (Model C)

Break points $\lambda = (T_B/T)$	Critical values		
	1%	5%	10%
$\lambda = (0.1)$	-5.11	-4.50	-4.21
$\lambda = (0.2)$	-5.07	-4.47	-4.20
$\lambda = (0.3)$	-5.15	-4.45	-4.18
$\lambda = (0.4)$	-5.05	-4.50	-4.18
$\lambda = (0.5)$	-5.11	-4.51	-4.17

Results for Model A (Table 6.3) are broadly consistent with the Augmented Dickey-Fuller test, with results indicating that private saving (*PS*) is a stationary series with one structural break. For the remaining series, the null hypothesis of a unit root with one structural break cannot be rejected.

[31] Critical values are provided by Lee and Strazicich for T = 100. Unfortunately the authors do not provide critical values for larger or smaller sample sizes.

Table 6.3 Results of the one-break LM unit root test (Model A)

Variable	K	T_B	$T\,\phi = 0$	Inference
lnPS	7	1991:1#	-4.1100*	Stationary
GS	1	1976:2#	-2.7142	Non-Stationary
lnY	8	1987:3#	-1.6446	Non-Stationary
lnFLIB	7	1971:4#	-3.2093	Non-Stationary
lnU	4	1974:4	-2.0550	Non-Stationary
R	4	1983:4#	-2.5866	Non-Stationary
INF	8	1975:3#	-2.0981	Non-Stationary
lnAS	7	1998:3#	-2.5827	Non-Stationary
lnTOT	7	1974:1#	-2.2454	Non-Stationary
lnH	2	1990:3	-1.8754	Non-Stationary
lnEQ	3	1988:1#	-3.1185	Non-Stationary

A maximum of 8 lags was specified in GAUSS. # Denotes significance at the 5% level for the break-point dummy variable. Critical value for T $\phi = 0$ is -3.57 at the 5% level.
* Denotes significance at the 5% level.

The stationarity inferences from Model C (Table 6.4) are also consistent with the Augmented Dickey-Fuller test. However when compared with Model A, this test infers that household disposable income (*Y*) is a stationary series with one structural break.

Table 6.4 Results of the one-break LM unit root test (Model C)

Variable	k	T_B	$T\,\phi = 0$	Critical value break points	Inference
lnPS	7	1981:3	-5.5960*	$\lambda = (0.5)$	Stationary
GS	7	1991:1	-4.0140	$\lambda = (0.7)$	Non-Stationary
lnY	6	1973:2#	-5.7774*	$\lambda = (0.3)$	Stationary
lnFLIB	7	1996:4	-3.2478	$\lambda = (0.2)$	Non-Stationary
lnU	8	1975:3#	-3.7627	$\lambda = (0.3)$	Non-Stationary
R	4	1983:4	-2.7683	$\lambda = (0.5)$	Non-Stationary
INF	8	1976:3#	-3.5163	$\lambda = (0.4)$	Non-Stationary
lnAS	7	1974:2#	-4.2009	$\lambda = (0.3)$	Non-Stationary
lnTOT	7	1993:4	-4.0380	$\lambda = (0.7)$	Non-Stationary
lnH	1	1982:1	-2.4931	$\lambda = (0.7)$	Non-Stationary
lnEQ	3	1979:4#	-3.9379	$\lambda = (0.4)$	Non-Stationary

A maximum of 8 lags was specified in GAUSS. # Denotes significance at the 5% level for the break-point dummy variable. Critical values for $T\,\phi = 0$ are contained in Table 6.2. * Denotes significance at the 5% level.

6.5.3 Lee and Strazicich two-break test

The Lee and Strazicich two-break LM unit root test was conducted in GAUSS using code provided by the authors. Again Models A and C were run, with lag lengths generated automatically through a general-to-specific procedure.

Critical values for the two-break LM unit root test also vary depending on the location of the breaks $\lambda = (T_{B1}/T,\ T_{B2}/T)$ and are symmetric around λ and $(1-\lambda)$. Critical values for the two-break minimum LM unit root test[32] for Model C (intercept and trend break) are shown in Table 6.5 below, and are drawn from Table 2 in Lee and Strazicich (2003). Critical values for the two-break LM unit root test with change in intercept (Model A) at the 1, 5 and 10 per cent levels respectively are -4.55, -3.84, and -3.50.

Table 6.5 Critical values for the two-break LM unit root test (Model C)

Break points $\lambda = (T_{B1}/T, T_{B2}/T)$	Critical values		
	1%	5%	10%
λ = (0.2,0.4)	-6.16	-5.59	-5.27
λ = (0.2,0.6)	-6.41	-5.74	-5.32
λ = (0.2,0.8)	-6.33	-5.71	-5.33
λ = (0.4,0.6)	-6.45	-5.67	-5.31
λ = (0.4,0.8)	-6.42	-5.65	-5.32
λ = (0.6,0.8)	-6.32	-5.73	-5.32

Results from Model A (Table 6.6) are broadly consistent with the Augmented Dickey-Fuller test. However, the coefficients for both break points are only significant on private saving (*PS*), government saving (*GS*), the real interest rate (*R*), social assistance payments (*AS*), and net foreign liabilities (*FLIB*). For private saving (*PS*), and house prices (*H*), Model A has selected different break dates when compared with the one-break test.

The one-break model of Lee and Strazicich is likely to be more appropriate for the series where only one break-point coefficient is statistically significant. Where both

[32] Critical values are provided by Lee and Strazicich for T = 100. Unfortunately the authors do not provide critical values for larger or smaller sample sizes.

breaks are not statistically significant (for both the one and two-break tests) the Augmented Dickey-Fuller test would be the most appropriate testing procedure.

Table 6.6 Results of the two-break LM unit root test (Model A)

Variable	k	T_B	$T\,\phi = 0$	Inference
lnPS	0	1997:4#, 2001:1#	-5.4227*	Stationary
GS	4	1976:2#,1999:2#	-3.4204	Non-Stationary
lnY	8	1966:2,1987:3#	-1.7050	Non-Stationary
lnFLIB	7	1971:4#,1976:4#	-3.3650	Non-Stationary
lnU	4	1971:4,1974:4	-2.1289	Non-Stationary
R	4	1977:3#,1983:4#	-3.0836	Non-Stationary
INF	8	1975:3#,1983:2	-2.2589	Non-Stationary
lnAS	7	1992:1#, 1998:3#	-2.8172	Non-Stationary
lnTOT	7	1974:1#,1974:3	-2.4932	Non-Stationary
lnH	2	1973:3, 1980:4#	-1.9984	Non-Stationary
LnEQ	3	1983:2, 1988:1#	-3.3574	Non-Stationary

A maximum of 8 lags was specified in GAUSS. # Denotes significance at the 5% level for the break-point dummy variables. Critical value for $T\,\phi = 0$ is -3.84 at the 5% level.

* Denotes significance at the 5% level.

When allowing for a break in both the level and trend of the series, Model C (Table 6.7) produces quite different results. In contrast to the Augmented Dickey-Fuller test and Model C of the one-break test, the results in Table 6.7 suggest that inflation (*INF*) and the terms of trade (*TOT*) are also stationary series.

Table 6.7 Results of the two-break LM unit root test (Model C)

Variable	k	T_B	$T\ \phi = 0$	Critical value break points	Inference
lnPS	0	1997:4[#], 2001:1	-6.5213*	λ = (0.8,0.9)	Stationary
GS	7	1974:3[#],1997:2[#]	-4.8116	λ = (0.3,0.8)	Non-Stationary
lnY	6	1973:2[#], 1992:3	-6.7481*	λ = (0.3,0.7)	Stationary
lnFLIB	8	1973:1[#],1986:1[#]	-4.3292	λ = (0.2,0.7)	Non-Stationary
lnU	6	1974:2[#],1988:1[#]	-4.5601	λ = (0.3,0.6)	Non-Stationary
R	4	1973:2,1985:3	-4.9872	λ = (0.3,0.6)	Non-Stationary
INF	7	1973:2[#],1991:4[#]	-6.6046*	λ = (0.3,0.7)	Stationary
lnAS	7	1970:1, 1976:1[#]	-5.4113	λ = (0.2,0.4)	Non-Stationary
lnTOT	4	1969:4[#],1995:4[#]	-6.0485*	λ = (0.2,0.8)	Stationary
lnH	2	1972:2[#], 1993:1[#]	-3.9289	λ = (0.3,0.7)	Non-Stationary
lnEQ	3	1973:2[#], 1986:4[#]	-5.2620	λ = (0.3,0.6)	Non-Stationary

A maximum of 8 lags was specified in GAUSS. # Denotes significance at the 5% level for the break-point dummy variables. Critical values for $T\ \phi = 0$ are contained in Table 6.5. * Denotes significance at the 5% level.

6. 6 Summary of the stationarity tests

The results from each unit root test are summarised in Table 6.8. As noted above, the results from the Lee and Strazicich tests have been inconsistent for a number of variables. To overcome this inconsistency *a priori* economic theory, the time of the identified break points, and inspection of data plots are used to help determine whether a series is non-stationary or stationary around structural breaks. Comparison is also made with previous studies, particularly Narayan and Smyth (2004) who applied unit root tests with structural breaks to a number of Australian macroeconomic time series.

Table 6.8 Summary of the unit root test results

		One-break test		Two-break test		
	ADF test	Model A	Model C	Model A	Model C	Conclusion
lnPS	Stationary	Stationary[#]	Stationary	Stationary[#]	Stationary	Stationary
GS	Non-Stationary	Non-Stationary[#]	Non-Stationary	Non-Stationary[#]	Non-Stationary[#]	Non-Stationary
lnY	Non-Stationary	Non-Stationary[#]	Stationary[#]	Non-Stationary	Stationary	Non-Stationary
lnFLIB	Non-Stationary	Non-Stationary[#]	Non-Stationary	Non-Stationary[#]	Non-Stationary[#]	Non-Stationary
lnU	Non-Stationary	Non-Stationary	Non-Stationary[#]	Non-Stationary	Non-Stationary[#]	Non-Stationary
R	Non-Stationary	Non-Stationary[#]	Non-Stationary	Non-Stationary[#]	Non-Stationary	Non-Stationary
INF	Non-Stationary	Non-Stationary[#]	Non-Stationary[#]	Non-Stationary	Stationary[#]	Stationary
lnAS	Non-Stationary	Non-Stationary[#]	Non-Stationary[#]	Non-Stationary[#]	Non-Stationary	Non-Stationary
lnTOT	Non-Stationary	Non-Stationary[#]	Non-Stationary	Non-Stationary	Stationary[#]	Non-Stationary
lnH	Non-Stationary	Non-Stationary	Non-Stationary	Non-Stationary	Non-Stationary[#]	Non-Stationary
lnEQ	Non-Stationary	Non-Stationary[#]	Non-Stationary[#]	Non-Stationary	Non-Stationary[#]	Non-Stationary

# Denotes significance at the 5% level for all break-point dummy variables.

The unit root hypothesis is unanimously rejected by all tests for the level of private saving (*PS*), while all models accept that the level of government saving (*GS*), net foreign liabilities (*FLIB*), the unemployment rate (*U*), social assistance payments to households (*AS*) and house prices (*H*) are non-stationary variables.

There have been mixed conclusions in the literature as to whether the Australian unemployment rate (*U*) is non-stationary. Smyth (2003) applied panel unit root tests to quarterly Australian state unemployment rates (1982:2 to 2002:1) and found evidence to support the unit root hypothesis. Papell (et al: 2000) were unable to reject the unit root null with annual data over the period 1955-1997. All the tests considered here indicate that the unemployment rate contains a unit root, however, Narayan and Smyth (2004) rejected the unit root hypothesis at the 10 per cent level with the one-break LM test and at the 5 per cent level using the Lumsdaine and Papell (1997) two-break test. However, using the Zivot and Andrews (1992) test and the two-break LM test, they were unable to reject the unit root null for the unemployment rate. While all these results are somewhat mixed, inspection of a plot of the unemployment rate suggests that this variable is non-stationary.

All of the tests considered here indicate that the real interest rate (*R*) is non-stationary. Pahlavani (et al: 2005) failed to reject the unit root hypothesis for both short- (90-day bank bills) and long-term (10-year Treasury bonds) interest rates, while Narayan and Smyth (2004) rejected the unit root null for short-term interest rates with the one-break LM unit root test.

A non-stationary real interest rate contradicts a number of important economic theories. The Fisher effect (Fisher: 1930) states that changes in inflation expectations are fully reflected in nominal interest rate adjustment. For this to hold, the *ex ante* real interest rate should be mean reverting over the long run. Models such as the Black-Scholes options pricing formula and various asset pricing models (such as Lucas-type consumption-based models) are grounded upon the assumption of a constant *ex ante* real interest rate. While theory suggests that the real interest rate

should be mean reverting, this has rarely been observed empirically, with the hypothesis of a constant *ex ante* real interest rate being rejected for many countries.[33]

While debate continues as to whether the real interest rate is non-stationary or stationary, structural break models could shed more light on this issue. Garcia and Perron (1996) concluded that the average value of the US *ex ante* real interest rate is subject to occasional jumps caused by important structural events. Testing the US *ex ante* real interest rate with the Innovational and Additive Outlier models, Lai (2004) found this series to be stationary around one structural break. Revisiting the long-run real interest rate puzzle, Lai (2008) re-emphasises the importance of structural breaks as lending previous support for a unit root in the real interest rate when conventional unit root tests are applied, and conducts various tests on the real interest rate for both industrial and developing countries with conventional unit root tests (the Dickey-Fuller Generalised Least Squares test and the additive outlier and innovational outlier models). Lai subsequently rejects the unit root null for Australia and other developed countries.[34]

At this stage the evidence regarding stationarity of the Australian real interest rate could best be regarded as ambiguous. Despite the one- and two-break tests unanimously suggesting that the Australian *ex ante* real interest rate contains a unit root, visual inspection of the series suggests that similar to the United States, the real interest rate is mean reverting – subject to occasional (large) structural movements around historically significant (and unanticipated) inflation events (such as the 1970s oil price shocks). While the one- and two-break LM unit root tests failed to reject the unit root hypothesis, further investigation as to whether the series is stationary around a number of (potentially more than two) statistically significant structural breaks is an area for further research.

---

[33] Rose (1988) failed to reject the unit root hypothesis for the real interest rate across a number of countries.

[34] The unit root null was only rejected by the additive outlier model. The innovational outlier model did not reject the unit root null for Australia.

Similar to the real interest rate, the average rate of inflation (*INF*) should be a mean reverting series. While episodes of hyperinflation have been observed in developing countries, these have not persisted, with inflation eventually declining to some long-run average level. For Australia, the Reserve Bank of Australia's monetary policy objective of maintaining inflation within a target band of 2-3 per cent should see inflation fluctuating around this band over the medium to longer term. In fact, since this inflation target was formally adopted in 1996 the average annual inflation rate has averaged around 2.5 per cent. While the Augmented Dickey-Fuller test and one-break LM unit root test failed to reject the unit root hypothesis, the two-break LM test (Model C) does, with both statistically significant break points corresponding with the 1970s oil price shocks and 1990-91 recession. Similar to the real interest rate, this is another macroeconomic series which may be subject to further research. Multiple structural break tests (i.e. more than two structural breaks) could potentially yield more information on this issue.

The terms of trade index (*TOT*) appears to be a non-stationary series, while all models unanimously suggest that Australian house prices (*H*) and equity prices (*EQ*) are also non-stationary.

6. 7 Timing of the structural breaks

When interpreting results from the LM unit root tests, the timing of structural breaks could be a useful guide for discerning the reliability and effectiveness of each model. Judgement of each model based upon economic theory and historical events, such as policy changes and economic shocks (for example), can help to determine the timing of structural breaks, and whether these changes have been sudden or gradual. As noted in Chapter 4, the results from these stationarity test could also indicate the significance of the economic reforms undertaken during the 1980s, particularly those in financial markets. A number of data series thus far have indicated structural breaks around the 1980s, and these will be discussed in greater detail below.

However, some discretion is required as significant statistical revisions to a data series (such as changes in collection techniques and data sources) could also substantially change the properties of a series – leading to the interpretation of a structural break by a researcher unaware of such changes and/or revisions. Other

issues to consider are lags between announcements of significant policy changes and any actual (observed) changes which may occur in the economy.

Table 6.9 notes a number of events that could correspond with the break points identified by the one- and two-break LM unit root tests. It is important to note here that the break dates are only reported where the t-statistic on the break-point coefficient is statistically significant. Results indicate that structural changes have generally coincided with a number of significant events over the past few decades, including:

- the 1960s resources boom;
- the expansion of social welfare programmes (Whitlam Government);
- oil price (terms of trade) and inflation shocks in the 1970s;
- the extensive period of financial deregulation in the 1980s; and
- the 1990-91 recession.

Table 6.9 Timing of the structural breaks

	One-break test		Two-break test		
Variable	Model A	Model C	Model A	Model C	Event(s)
lnPS	1991:1#	1981:3	1997:4#	1997:4#	Recession (1990-91).
			2001:1#	2001:1	Asian Financial Crisis (1997).
					Taxation reform (2000).
GS	1976:2#	1991:1	1976:2#	1974:3#	Expansion of social welfare
			1999:2#	1997:2#	programmes by the Whitlam
					Government (1972-75).
					Howard Government Charter of
					Budget Honesty (1996 onwards).
lnY	1987:3#	1973:2#	1966:2	1973:2#	Expansion of social welfare
			1987:3#	1992:3	programmes by the Whitlam
					Government (1972-75).
					Oil price, inflation shocks (1970s).
					Stock market boom (1987).
lnFLIB	1971:4#	1996:4	1971:4#	1973:1#	Oil price, inflation shocks (1970s).
			1976:4#	1986:1#	Entry of foreign banks into
					Australia (1985).
lnU	1974:4	1975:3#	1971:4	1974:2#	Oil price, inflation shocks (1970s).
			1974:4	1988:1#	Recession (1990-91).
R	1983:4#	1983:4	1977:3#	1973:2	Oil price, inflation shocks (1970s).
			1983:4#	1985:3	Australian dollar floated
					(Dececmber 1983).
					Controls on bank deposit rates
					lifted (1984).
lnAS	1975:3#	1976:3#	1975:3#	1973:2#	Expansion of social welfare
			1983:2	1991:4#	programmes by the Whitlam
					Government (1972-75).
					Recession (1990-91).
INF	1998:3#	1974:2#	1992:1#	1970:1	Oil price, inflation shocks (1970s).
			1998:3#	1976:1#	Recession (1990-91).
lnTOT	1974:1#	1993:4	1974:1#	1969:4#	Resources boom (1960s).
			1974:3	1995:4#	Oil price, inflation shocks (1970s).
					Recession (1990-91).
lnH	1990:3	1982:1	1973:3	1972:2#	Oil price, inflation shocks (1970s).
			1980:4#	1993:1#	Recession (1990-91).
lnEQ	1988:1#	1979:4#	1983:2	1973:2#	Oil price, inflation shocks (1970s).
			1988:1#	1986:4#	Stockmarket crash (1987).

# Denotes significance at the 5% level for the break-point dummy variables.

6.7.1 The 1960s resources boom

Significant investment took place in the development of Australia's minerals and resources sector during the 1960s. This was partly fuelled by strong demand from Japan for Australian minerals and bulk commodity exports. Results here indicate that structural changes occurred in household disposable incomes (*Y*), and the terms of trade (*TOT*) over this period.

6.7.2 Expansion of social welfare programmes

The election of the Whitlam Government in December 1972 saw a marked expansion in social welfare programmes during its term through to 1975. This resulted in a large increase in transfer payments (direct and indirect) to households through the introduction of policies such as: pensions for single parent families and the homeless; abolition of fees on tertiary education; indexation of pensions; welfare housing initiatives; and the expansion of various other services including health (Medibank), transport and communications.

Both the one- and two-break LM unit root tests indicate structural breaks in government saving (*GS*), household disposable incomes (*Y*) and social assistance payments to households (*AS*) over the period spanning 1973-76.

6.7.3 The 1970s oil price shocks and inflation

Following an average annual inflation rate around 2.5 per cent during the 1960s, high energy prices saw inflation rise markedly in the early 1970s, peaking at almost 18 per cent in 1975. This high inflation period also eroded the return on capital, with the real interest rate turning negative over this period. Output and employment also fell, with the unemployment rate rising from 2.1 per cent in March 1974 to 6.7 per cent in March 1978. Not surprisingly, both the one- and two-break LM tests indicate structural breaks in household disposable income (*Y*), the unemployment rate (*U*), real interest rates (*R*), inflation (*INF*) the terms of trade (*TOT*), and house prices (*H*) over this period.

Narayan and Smyth (2004) found structural breaks in inflation (corresponding with the first oil price shock in 1974) consistently across the Zivot and Andrews, Lumsdaine and Papell, and two-break LM tests.

6.7.4 Financial deregulation

In the early 1980s, The Committee of Inquiry into the Australian Financial System (the Campbell Committee) recommended deregulatory measures to promote competition between existing banks and increasing the overall efficiency of the financial system. Following the Campbell Committee's recommendations, there were two broad themes associated with the financial market reform programme of the 1980s. The first had a wide macroeconomic focus, and included the floating of the exchange rate (and associated abolition of exchange controls) in December 1983, and the implementation of the tender system for selling debt (Treasury bonds) to the public – meaning budget deficits were financed at market interest rates. The second aspect of financial deregulation was directed at financial intermediaries, mainly banks, with a view to increasing competition. The major policy changes were the abolition of both interest rate controls and credit guidelines, and the entry of foreign banks (Macfarlane: 1995).

Model A for both the one- and two-break LM unit root test indicates that the real interest rate (*R*) had a structural break in the fourth quarter of 1983, which corresponds with the floating of the Australian dollar and the removal of controls on banks' deposit rates in 1984. Model C of the two-break test indicates that net financial liabilities (*FLIB*) contains a structural break in 1986 – which is consistent with *a priori* expectations of this series containing structural breaks that correspond with the period of financial deregulation (after which Australia's level of net foreign liabilities increased markedly).

Testing the short- and long-term real interest rates with the Innovational Outlier model, Pahlavani (et al: 2005) found single break points around 1980 and 1979. These dates roughly correspond with the establishment of the Campbell Committee and the lifting of the ceiling on bank deposit interest rates.

Following leads off overseas markets, Australian share prices (*EQ*) took sharp falls in October 1987. Model A of the one-break test, and models A and C of the two-break test indicate breaks in the equity price series around this point. In part, this large fall on equity markets was one of the precursors to the recession of 1990-91 as

it had a direct impact on household wealth, consumer confidence and business investment (through Tobin's q).

6.7.5 The 1990-91 recession

In July 1990 the Australian economy entered a severe recession. Real GDP slowed in the first half of 1990, and then began to fall in the second half of the year. The rate of unemployment in mid 1990 was around 6.25 per cent but rose sharply over the following year and peaked at almost 11 per cent in 1993. Unemployment then remained above 10 per cent for the next twelve months. The rate of inflation was around 7 per cent in 1990, but soon after declined to a level not seen since the early 1960s. Real GDP did not begin to grow until the March quarter of 1992.

Not surprisingly, the sharp fall in output and prices over this recession (and corresponding rise in unemployment) contributed to a major structural change in the economy. This is reflected in both the one- and two-break LM unit root tests indicating structural breaks in private saving (*PS*), employment (*U*), social assistance payments (*AS*), inflation (*INF*), the terms of trade (*TOT*), and house prices (*H*) during this recession. A structural break in the unemployment series (*U*) in 1988 also broadly coincides with this period (the unemployment rate started to rise sharply in 1989). Additional support for structural breaks over this period is provided by Narayan and Smyth (2005), with these authors finding breaks in the unemployment rate.

6.7.6 Other break points

A number of other break points not covered under the major events above are also worthy of some discussion. For government saving (*GS*), both model A of the two-break LM test indicates a structural break in this series during the second quarter of 1999. This roughly correlates with the Howard Government's Charter of Budget Honesty and accumulation of fiscal surpluses.

For private saving (*PS*), models A and C of the two-break LM test both indicate structural breaks in this series during the fourth quarter of 1997 and first quarter of 2001. These dates could be associated with the Asian Financial Crisis (1997), and the introduction of the Goods and Services Tax (and income tax cuts) in 2000.

6. 8 Summary and conclusions

This chapter has considered the time series properties of the data – particularly with reference to structural changes that have shaped the Australian economy over recent decades. Before undertaking the testing procedures in the chapter, econometric developments in unit root testing that account for the presence of structural breaks were discussed. This included the methodologies of the Zivot and Andrew's (1992) test, Perron's (1997) Innovational Outlier (IO) and Additive Outlier (AO) models; along with the Lee and Strazicich (2003) Minimum Lagrange Multiplier Unit Root Tests (which endogenously tests for two structural breaks).

Results from the Dickey-Fuller test, and the Lee and Strazicich one- and two-break unit root tests unanimously concluded that the ratio of private saving to GDP in Australia (*PS*) is a stationary time series. While the other series all appear to contain a unit root in the presence of at least one structural break, there is some ambiguity as to whether the real interest rate and inflation should be non-stationary time series. The timing of the structural breaks also appears to coincide with major economic and policy developments in Australia. A number of the variables contain structural breaks around the 1980s (consistent with the broad financial market reforms over that decade), while other significant structural breaks appear to coincide with the 1970s oil price (terms of trade) shocks and high inflation periods, and the sharp economic downturn of the early 1990s.

Conventional cointegration procedures (such as that of Johansen (1991, 1995), usually require that all data entering into an equation be non-stationary. As the unit root tests undertaken in this chapter unanimously suggest that the ratio of private saving to GDP is a stationary time series, conventional cointegration techniques cannot be used to estimate the analytical model. Further, the unit root tests also suggested that each data series contains at least one structural break. This further complicates the use of cointegration techniques as conventional cointegration methods cannot account for endogenous structural breaks. While recent econometric developments allow for cointegration testing in the presence of structural breaks, these techniques are currently in their early stages of development and often can only accommodate one structural break (earlier techniques such as that of Gregory and

Hansen (1996) also require all data to be non-stationary). To overcome these difficulties, the analytical model will be estimated through the autoregressive distributed lag (ARDL) approach to cointegration. This technique allows for a greater degree of flexibility – allowing for both stationary and non-stationary data, and can accommodate additional variables that can represent structural breaks.

CHAPTER 7 ESTIMATION AND HYPOTHESIS TESTING

7. 1 Introduction

This chapter estimates the analytical model that was discussed in Chapter 5. The model will be estimated using the ARDL approach to cointegration, which will provide the necessary flexibility to accommodate the structural breaks identified in the previous chapter, and can also accommodate stationary data. The ARDL procedure will provide estimates of the long-run relationship between private saving and movements in fiscal policy, while also incorporating short-run dynamics through the error correction mechanism (ECM).

Section 7.2 describes the ARDL approach to cointegration, which is followed by a discussion in section 7.3 as to how the structural breaks identified in the previous chapter will be incorporated into the analysis. Section 7.4 estimates the analytical model, which begins by looking at results over the full sample (1959:3-2006:2), after which the analytical model is then estimated over two periods: the first subsample estimated prior to the float of the Australian dollar in December 1983 (1959:3-1983:4); and the second subsample estimated over the remaining period (1984:1-2006:2). Considering the discussion in earlier chapters regarding structural change in Australia, particularly how more open financial markets may have impacted on the efficacy of fiscal policy, the floating of the Australian dollar in December 1983 was chosen as the most appropriate point to split the sample (despite financial market reforms occurring over the early to late 1980s). Results from the estimations are summarised in section 7.5, while section 7.6 tests the hypothesis established in Chapter 1.

7. 2 The autoregressive distributed lag approach (ARDL)

Commonly used methods for cointegration testing include the residual-based Engle-Granger (1987) test, the Johansen (1991, 1995), and Johansen-Juselius (1990) maximum likelihood-based testing procedures, and the Gregory and Hansen (1996) method. While the Johansen procedure is the most popular of these approaches, it is not without limitations – notably low power in small samples, and the requirement that all variables entering the regression be integrated of order one. In order to

estimate the analytical model presented in Chapter 5, the autoregressive distributed lag (ARDL) modelling approach (see Pesaran and Shin 1998; Pesaran et al 1996; and Pesaran et al 2001) will be employed.

The ARDL modelling procedure enables the estimation of both long- and short-run (error correction) coefficients within one equation – regardless of the order of integration of the variables being considered. This is particularly relevant here as the stationarity testing undertaken in the previous chapter indicated some ambiguity over a number of the data series.[35] The inclusion of the error correction mechanism in the single equation specification integrates the short-run dynamics with the long-run equilibrium relationship. Another advantage of this technique is the inclusion of lagged variables to capture the data generating process – which is undertaken through a general-to-specific framework.

The primary test statistic in the ARDL procedure for determining the existence of cointegration is the Wald or F-statistic in a generalised Dickey-Fuller regression. This F-statistic is used to test the significance of lagged levels of the variables in a conditional unrestricted equilibrium error correction model. The ARDL approach involves estimating the conditional error correction version of the ARDL model. The augmented ARDL $(p, q_1, q_2, \ldots, q_k)$ is provided by the following equations (see Pesaran 1997, and Pesaran et al 2001):

$$\theta(L, p) y_t = a_0 + \sum_{i=1}^{k} \eta_i (L, q_i) x_{it} + \lambda' w_t + \varepsilon_t \qquad \forall t = 1, \ldots, n \qquad 7.1$$

where

$$\theta(L, p) = 1 - \theta_1 L - \theta_2 L^2 - \ldots - \theta_p L^p$$

and

[35] While tests unanimously indicated that private savings (*PS*) is a stationary time series, there was some ambiguity over the real interest rate (*R*) and inflation (*INF*).

$$\eta_i(L, q_i) = \eta_{i0} + \eta_{i1}L + \eta_{i2}L^2 + \ldots + \eta_{iq}L^{qi} \qquad \forall_i = 1, 2, \ldots, k$$

Where y_t is the dependent variable, a_0 is the constant term, L is the lag operator such that $Ly_t = y_t - 1$, w_t is a $s \times 1$ vector of deterministic variables which may include intercepts, time trends, or endogenous variables with fixed lags. The long-run elasticities of the variables in the ARDL model are estimated by:

$$\phi_i = \frac{\hat{\eta}_i(1, \hat{q}_i)}{\theta(1, \hat{p})} = \frac{\hat{\eta}_{i0} + \hat{\eta}_{i1} + \ldots + \hat{\eta}_{i\hat{q}}}{1 - \hat{\theta}_1 - \hat{\theta}_2 - \ldots - \hat{\theta}_{\hat{p}}} \qquad \forall_i = 1, 2, \ldots, k \qquad 7.2$$

where $\hat{p}$ and $\hat{q}_i, i = 1, 2, \ldots, k$ are the estimated values of $\hat{p}$ and $q_i, i = 1, 2, \ldots, k$. The long-run coefficients are given by:

$$\pi = \frac{\hat{\lambda}(\hat{p}, \hat{q}_1, \hat{q}_2, \ldots, \hat{q}_k)}{1 - \hat{\theta}_1 - \hat{\theta}_2 - \ldots - \hat{\theta}_{\hat{p}}} \qquad 7.3$$

where $\hat{\lambda}(\hat{p}, \hat{q}_1, \hat{q}_2, \ldots, \hat{q}_k)$ are the OLS estimates of λ in equation (7.1) for the selected ARDL model.

The ECM derived from the ARDL $(\hat{p}, \hat{q}_1, \hat{q}_2, \ldots, \hat{q}_k)$ is obtained by writing equation (7.1) in terms of lagged levels of the first differences of $y_t, x_{1t}, x_{2t}, \ldots, x_{kt}$ and w_t:

$$\Delta y_t = \Delta a_0 - \theta(1, \hat{p}) ECM_{t-1} + \sum_{i=1}^{k} \eta_{i0} \Delta x_{it} + \lambda' \Delta w_t - \sum_{j=1}^{\hat{p}-1} \theta^* j \Delta y_{t-1} -$$

$$\sum_{i=1}^{k} \sum_{j=1}^{\hat{q}_{i-1}} \eta_{ij} \Delta_{i,t-j} + \varepsilon_t \qquad 7.4$$

where ECM is the error correction model, which is defined as:

$$ECM_t = y_t - \hat{a} - \sum \hat{\eta}_i x_{it} - \lambda' w_t \qquad 7.5$$

where x_t is the k-dimensional forcing variables that are assumed to be not cointegrated among themselves, and ε_t is an vector of stochastic error terms, with zero mean and constant variance $(0, \sigma^2)$.

The inclusion of the error correction term with the cointegrating variables implies that changes in the dependent variable are a function of both the level of disequilibrium in the cointegrating relationship and the changes in other explanatory variables. This is consistent with the Granger Representation Theorem, which establishes that any cointegrated series has an equivalent error correction representation.

Following Pesaran (et al: 2001) the ARDL technique involves two steps for estimating the cointegrating relationship. Under the first step, the existence of a long-run cointegrating relationship is tested. If a long-run cointegrating relationship is found, the second step involves estimating both the long- and short-run coefficients. For the model of private saving considered in Chapter 5, an intercept and trend will be added to this model – particularly as all stationarity tests considered in the previous chapter indicated that the dependent variable (*PS*) is stationary – and a visual inspection of the ratio of private saving to GDP indicates a considerable downward trend in the data series. Therefore, the ARDL model is a general ECM with unrestricted intercept and trend:

$$\Delta y_t = a_0 + a_1 t + \pi_{yy} y_{t-1} + \pi_{yx.x} x_{t-1} + \sum_{i=1}^{p-1} \Psi_i' \Delta z_{t-i} + w' \Delta x_t + \varepsilon_t \qquad 7.6$$

where $a_0 \neq 0$ and $a_1 \neq 0$. As noted above, the first step of the ARDL procedure involves testing for a cointegrating relationship. This step tests for the absence of any level relation between y_t and x_t via the exclusion of the lagged level variables y_{t-1} and x_{t-1} in equation (7.6). Persaran (et al: 2001) define the F-statistic tests for the null hypotheses as $H_0^{\pi_{yy}} : \pi_{yy} = 0$, $H_0^{\pi_{yx.x}} : \pi_{yx.x} = 0'$ and the alternative hypotheses as $H_1^{\pi_{yy}} : \pi_{yy} \neq 0$, $H_1^{\pi_{yx.x}} : \pi_{yx.x} \neq 0'$. The joint null hypothesis for (7.6) is given by:

$$H_0 = H_0^{\pi_{yy}} \cap H_0^{\pi_{yx.x}} \qquad 7.7$$

and the alternative hypothesis is correspondingly stated as:

$$H_1 = H_1^{\pi_{yy}} \cup H_1^{\pi_{yx.x}} \qquad 7.8$$

The asymptotic distribution of the F-statistics are non-standard under the null hypothesis of no cointegrating relationship between the variables, regardless of the order of integration of the variables being considered. The calculated F-statistic is compared with the critical values provided in Pesaran (et al: 2001). The null hypothesis of no cointegration is rejected if the calculated F-statistic is greater than the upper bound critical value. If the calculated F-statistic falls below the lower bound, then the null hypothesis of no cointegration cannot be rejected. The result is inconclusive if the calculated F-statistic lies between the upper and lower bound critical values. In this situation, cointegration may be established by applying the ECM version of the ARDL model (see Kremers et al: 1992, and Bahmani-Oskooee and Nasir: 2004).[36]

7. 3 Structural breaks

Similar to the conventional unit root tests considered in the previous chapter (the Dickey-Fuller and Augmented Dickey-Fuller test), most popular tests for cointegration assume that the cointegrating vector remains constant over the sample period. Structural changes arising from changes in institutional arrangements, policy shifts and external (exogenous) shocks, for example, are likely to mean that over a long time series the assumption that any underlying cointegrating vector is constant will in most cases be violated.

Considering situations where the cointegrating vector is not constant over time, Gregory and Hansen (1996) found that the power of standard tests for cointegration is very low in the presence of structural breaks, and subsequently introduced a

[36] Kremers (et al: 1992) noted that a relatively efficient method of establishing cointegration is to test the significance of the lagged error correction coefficient.

procedure that alleviates this problem. Their method provided a suggested point for an unknown structural break and gives cointegration test statistics that take the structural break into account. However, the Gregory and Hansen (1996) method takes into account only one structural break and assumes that all data series are integrated of order one. More recently Hatemi-J (2008) has extended Gregory and Hansesn's (1996) methodology to include two endogenous structural breaks, however this model still operates under the assumption that all variables are integrated of order one.[37]

Results from the stationarity tests in Chapter 6 confirmed a number of significant structural breaks in the Australian economy over the past several decades. Based upon those results, and as the literature has not yet provided a test for cointegration with multiple structural breaks, a number of structural breaks may be accounted for by the inclusion of break-point dummy variables in the ARDL model. Chapter 6 indicated the existence of the following structural breaks in the time series being considered here:

B1969:1 = 1960s resources boom;
B1973:3 = expansion of social welfare programmes (Whitlam Government); oil price shocks and inflation[38];
B1984:1 = floating of the Australian dollar[39], including broader financial market liberalisation; and
B1990:1 = onset of recession in the early 1990s.

7. 4 Cointegration and error correction modelling

This section applies the ARDL procedure to the analytical framework considered in Chapter 5. After testing for the presence of cointegration, both the long- and short-run parameter values will be estimated. Ideally, the cointegration and error correction

[37] Additional literature regarding cointegration tests with multiple structural breaks has been scant.

[38] While two breaks may have been included for each of these effects, the close proximity of both breaks would mean that the inclusion of separate dummy variables for each could increase the likelihood of serial correlation in the regression estimates.

[39] The floating of the Australian dollar is considered to be the most significant of the broader financial market reforms undertaken over the decade from the late 1970s though to the late 1980s.

modelling should be undertaken with the data as logarithms. However, a number of the time series contain negative values.[40] Consequently the data considered here are taken as ratios to GDP.

The estimations below will first consider the entire sample (1959:3-2006:2), and will then split the sample into two periods – the first sample ending in 1983:4, and the second sample beginning in 1984:1. This will attempt to account for the effect of financial market liberalisation, of which the most significant reform was the floating of the Australian dollar in December 1983. Since the floating of the Australian dollar and associated financial market reforms, foreign capital inflows into Australia have increased markedly, and there has been a commensurate increase in financial market innovation. These reforms are generally regarded as having increased the integration of the Australian economy into the global financial system (Lowe: 1994).

7.4.1 Private saving offsets – full sample (1959:3-2006:2)

Reconsidering the discussion in Chapter 5, the analytical model considers the relationship between private and public sector saving, and other explanatory variables such as changes in household income. The model can also be considered as a broad indicator of the impact of fiscal policy on short- and long-run aggregate demand:

$$S_t^{priv} = \alpha_0 + \beta_0 S_t^{pub} + \phi_0 Z_t + e_t \qquad 7.9$$

where S_t^{priv} and S_t^{pub} denotes the ratio of net household plus net corporate saving (which gives total net private saving) to GDP, and the ratio of net general (Commonwealth, local and state) government saving to GDP, and Z_t is a vector of control variables – consisting of the following series:

$$Z_t = \{Y_t, AS_t, U_t, R_t, INF_t, TOT_t, FLIB_t, H_t, EQ_t\} \qquad 7.10$$

[40] Series containing negative values include government savings (*GS*), the real interest rate (*R*) and inflation (*INF*).

Where:

Y_t = Household gross disposable income;

AS_t = Social assistance benefits to household gross disposable income;

U_t = Unemployment rate;

R_t = Real interest rate;

INF_t = Inflation rate;

TOT_t = Terms of trade;

$FLIB_t$ = Net foreign liabilities (proxy for financial openness);

H_t = Australian house price index (proxy for wealth); and

EQ_t = Australian share price index (proxy for wealth).

Before proceeding with the ARDL estimations, it is important to note that while the ARDL procedure is well-equipped to deal with stationary and non-stationary data, the combination of a stationary left-hand side variable (*PS*) in equation (7.9) with non-stationary variables on the right-hand side of the equation could produce a model that is unbalanced. For (7.9) to be a reliable model, the non-stationary variables should cointegrate to form a stationary relationship. The Johansen cointegration test was applied to the variables on the right-hand side of (7.9). The trace and maximum eigenvalue tests indicated that the combination of these variables do in fact form a single cointegrating vector.

The ARDL specification for equation (7.9) is as follows:

$$\Delta PS_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \delta_i \Delta PS_{t-i} + \sum_{i=1}^{p} \beta_i \Delta GS_{t-i} + \sum_{i=1}^{p} \phi_i \Delta Y_{t-i} + \sum_{i=1}^{p} \varphi_i \Delta AS_{t-i} +$$
$$\sum_{i=1}^{p} \gamma_i \Delta U_{t-i} + \sum_{i=1}^{p} \tau_i \Delta R_{t-i} + \sum_{i=1}^{p} \upsilon_i \Delta INF_{t-i} + \sum_{i=1}^{p} \rho_i \Delta TOT_{t-i} + \sum_{i=1}^{p} \psi_i \Delta FLIB_{t-i} +$$
$$\sum_{i=1}^{p} \xi_i \Delta H_{t-i} + \sum_{i=1}^{p} \omega_i \Delta EQ_{t-i} + \lambda_1 PS_{t-1} + \lambda_2 GS_{t-1} + \lambda_3 Y_{t-1} + \lambda_4 AS_{t-1} + \lambda_5 U_{t-1} +$$
$$\lambda_6 R_{t-1} + \lambda_7 INF_{t-1} + \lambda_8 TOT_{t-1} + \lambda_9 FLIB_{t-1} + \lambda_{10} H_{t-1} + \lambda_{11} EQ_{t-1} + u_t \qquad 7.11$$

where S_t^{priv} and S_t^{pub} have been shortened to *PS* and *GS* respectively. In the ARDL specification above, the summation signs represent the short-run error correction dynamics, while the second section of the equation, denoted by λ_i, represents the long-run relationship. The null hypothesis of no cointegration in equation (7.11) is given by:

$$H_0 : \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = \lambda_7 = \lambda_8 = \lambda_9 = \lambda_{10} = \lambda_{11} = 0$$

or equivalently as:

$$F_{PS}(PS \,|\, GS, Y, AS, U, R, INF, TOT, FLIB, H, EQ)$$

The corresponding alternative hypothesis is:

$$\lambda_1 \neq 0, \lambda_2 \neq 0, \lambda_3 \neq 0, \lambda_4 \neq 0, \lambda_5 \neq 0, \lambda_6 \neq 0, \lambda_7 \neq 0, \lambda_8 \neq 0, \lambda_9 \neq 0, \lambda_{10} \neq 0, \lambda_{11} \neq 0$$

As noted earlier, the relevant test statistic here is the F-statistic for the joint significance of the coefficients, and as we are dealing with quarterly data, a maximum of four lags is included.

Table 7.1 Results from bounds test on equation (7.11) – 1959:3 to 2006:2

Dep. Var.	F-statistic	Probability	Conclusion
$F_{PS}(PS \mid GS, Y, AS, U, INF, R, TOT, FLIB, H, EQ)$	3.4906*	0.000	Cointegration
$F_{GS}(GS \mid PS, Y, AS, U, INF, R, TOT, FLIB, H, EQ)$	2.4126	0.009	Inconclusive
$F_{Y}(Y \mid PS, GS, AS, U, INF, R, TOT, FLIB, H, EQ)$	2.2677	0.015	No cointegration
$F_{AS}(AS \mid PS, GS, Y, U, INF, R, TOT, FLIB, H, EQ)$	2. 4465	0.008	Inconclusive
$F_{U}(U \mid PS, GS, Y, AS, INF, R, TOT, FLIB, H, EQ)$	3.0196	0.001	Inconclusive
$F_{R}(R \mid PS, GS, Y, AS, U, INF, TOT, FLIB, H, EQ)$	2.1676	0.020	No cointegration
$F_{INF}(INF \mid PS, GS, Y, AS, U, R, TOT, FLIB, H, EQ)$	2. 0838	0.026	No cointegration
$F_{TOT}(TOT \mid PS, GS, Y, AS, U, INF, R, FLIB, H, EQ)$	3.5018*	0.000	Cointegration
$F_{FLIB}(FLIB \mid PS, GS, Y, AS, U, INF, R, TOT, H, EQ)$	1.7875	0.063	No cointegration
$F_{H}(H \mid PS, GS, Y, AS, U, INF, R, TOT, FLIB, EQ)$	3.1870	0.001	Inconclusive
$F_{EQ}(EQ \mid PS, GS, Y, AS, U, INF, R, TOT, FLIB, H)$	1.8996	0.045	No cointegration

Asymptotic critical value bounds are obtained from Table CI(iii), Case V: unrestricted intercept and unrestricted trends for k=10 (Persaran et al: 2001). Lower bound I(0)=2.33 and Upper bound I(1)=3.46 at the 5% significance level. * Denotes significance at the 5% level. ** Denotes significance at the 1% level.

Where private saving is the dependent variable, the calculated F-statistic of 3.4906 is greater than the upper bound critical value at the 5 per cent level, which rejects the null hypothesis of no cointegration – implying a long-run level relationship between the variables (Table 7.1). Considering the possibility of reverse causation, where government saving is the long-run dependent variable, the calculated F-statistic of 2.4126 falls into the inconclusive region. Consequently, reverse causation cannot be ruled-out.[41] Where the cointegration tests are undertaken with different dependent variables, the results also suggest a long-run relationship between the variables, and that *Y*, *R*, *INF*, *FLIB*, and *EQ* act as the long-run forcing variables for private saving. While results in Table 7.1 show inconclusive results for social assistance payments (*AS*), unemployment (*U*), and house prices (*H*), the subsequent estimations of the short- and long-run parameters may yield further information on the significance of these variables.

[41] The possibility of reverse causality will be considered in greater detail in section 7.4.2.

Table 7.2 Estimated long-run coefficients for equation (7.11)

ARDL (1,0,1,2,0,0,0,0,0,0,0) selected lags based on Schwartz Bayesian Criterion

Variable	Coefficient	Standard Error	T-Ratio	Probability
Constant	-0.2564	0.1157	-2.2152*	0.028
Trend	0.0003	0.0003	0.9729	0.332
GS	-0.4438	0.1178	-3.7673**	0.000
Y	0.4241	0.1409	3.0100*	0.003
U	0.1571	0.2082	0.7542	0.452
R	0.0301	0.0729	0. 4128	0.680
INF	-0.1460	0.1094	-1.3340	0.184
AS	-0.4579	0.2145	-2.1342*	0.034
TOT	0.0008	0.0002	3.9830**	0.000
FLIB	-0.0364	0.0155	-2.3410*	0.020
H	-0.0066	0.0127	-0.5153	0.607
EQ	0.0179	0.0106	1.6806	0.095
B1969	0.0029	0.0062	0.4685	0.640
B1973	-0.0161	0.0106	-1.5082	0.133
B1984	-0.0035	0.0066	-0.5388	0.591
B1990	-0.0151	0.0078	-1.9209	0.056

* Denotes significance at the 5% level. ** Denotes significance at the 1% level.

The estimated long-run coefficient estimates are provided in Table 7.2.[42] With the exception of the unemployment rate (*U*), all variables have the expected sign, although the wealth variables will be discussed in greater detail below. For the level of government saving (*GS*), the results suggest that over the long run, changes in general government saving are offset by changes in private savings by almost half (-0.44). This implies that the behavioural response of households and corporations is not fully Ricardian, and that fiscal policy has a (partial) flow through to the real economy – potentially impacting output, real interest rates, the exchange rate, and subsequently the current account. The value of this coefficient is similar to the results of Comley (et al: 2002), who estimated a long-run private savings offset coefficient for Australia of -0.5. However, it is important to note here that Comley's estimated

[42] The appropriate lag length was chosen according to the Schwartz Bayesian Criterion, which Pesaran and Smith (1998) have noted as being more preferable than other model selection criteria.

long-run coefficient was not statistically significant, possibly due to having a much smaller sample (1981:1-2002:2).[43]

The estimated Australian private savings offset of -0.44 is however lower than some estimates derived through international panel studies. Considering private saving across a panel of 21 OECD countries, de Mello (et al: 2004) estimated a long-run private savings offset coefficient of around -0.75; implying that changes in the fiscal stance are almost fully offset by corresponding changes in private saving. Following an analytical model similar to that used here, and to that employed by de Mello (et al: 2004), Cotis (et al: 2006) estimated a long-run private savings offset of around two thirds for a panel of 16 OECD countries. Isolating impacts on the United States, Cotis (et al: 2006) estimated a positive long-run private savings coefficient – implying that US households behave in a non-Ricardian manner.[44]

For the remaining variables in Table 7.2, the results indicate that for a one per cent rise in household gross disposable income (*Y*), the ratio of private saving to GDP increases by 0.42 per cent. This also implies a marginal propensity to consume of approximately 0.6 – which is consistent with National Account data that indicates a consumption share of GDP in Australia of 60 per cent. Rising levels of social assistance payments to households (*AS*) are estimated to have a negative impact on private saving over the long-run, with the ratio of private saving to GDP declining by around 0.46 per cent for each one per cent increase in social assistance payments to households. Australia's terms of trade (*TOT*) is estimated to have a small, although statistically significant, positive impact on private savings over the long run. As expected, financial liberalisation has a negative impact on private saving over the long run. For the unemployment rate (*U*), the real interest rate (*R*), and inflation (*INF*), the results in Table 7.2 indicate that these variables do not have a statistically significant long-run impact on the level of private saving in Australia.

---

[43] This study also did not consider the implications of structural change.

[44] As noted in Chapter 5, changes in public savings result from both taxation and expenditure. While permanent expenditures will generate an increase in private saving through the intertemporal budget constraint, temporary expenditure shocks can generate positive private saving offsets (particularly when households see public and private consumption as complements; for example, rebates and co-payments).

Both of the wealth variables present some interesting results. As noted in Chapter 4, changes in the prices of household assets (and the returns derived from these) will affect household consumption and saving. Additionally, as the dependent variable is private saving (which includes corporate saving), changes in wealth will also affect business borrowing and investment decisions. Results here indicate that wealth from housing does not exert a statistically significant impact on private saving over the long run, although it is of the expected sign. Given that most Australian's hold wealth through the family home, this is somewhat surprising. Equity prices appear to have had a statistically significant (albeit at the 10 per cent level) impact on private saving over the long run. The positive sign of this coefficient is curious, and suggests that for a one per cent rise in equity prices, the ratio of private saving to GDP rises by around 0.02 per cent. This positive response may be somewhat indicative of the broad shift toward equity investment, particularly the indirect investment occurring through households' accumulation of assets in superannuation. Considering the United States, Cotis (et al: 2006) found both coefficients on housing and equity prices to be negative, and statistically significant at the one per cent level over both the short and long run.

Of the dummy variables included in the estimation, only the structural break coinciding with the early 1990s recession (*B1990*) is estimated to have had a statistically significant (at the 10 per cent level) long-run impact on the private savings ratio. For the other break-point dummy variables coinciding with the 1969 resources boom (*B1969*), oil price shocks and the expansion of social welfare programmes in the 1970s (*B1973*), and the floating of the Australian dollar and subsequent period of financial deregulation (*B1984*), the results indicate that these structural breaks have not had a statistically significant impact on the long-run level of private saving in Australia.

The short-run error correction estimates are presented in Table 7.3. In the short run, the error correction equation indicates a private saving offset of one quarter (-0.25) to changes in government saving. The error correction term, $ecm(-1)$, is of the correct sign and statistically significant – indicating that deviations from the long-run rate of private saving are corrected by over 50 per cent in the next period, which is a

relatively fast pace of adjustment back to equilibrium.[45] While the unemployment rate (*U*) was statistically insignificant in the long-run relationship, the estimated coefficient here is of the correct sign, and significant at the 10 per cent level, whilst the lagged value of unemployment is significant at the one per cent level. This suggests that the unemployment rate only negatively impacts private saving in the short run only, which would be consistent with the impact of temporary shocks to output.

Short-run coefficient estimates for household gross disposable income (*Y*), social assistance payments to households (*AS*), the terms of trade (*TOT*), and financial openness are significant at the one per cent level, while financial openness (*FLIB*) is significant at the five per cent level. Similar to the long-run results, the estimated short-run coefficients for the real interest rate (*R*), inflation (*INF*) and break-point dummy variables *B1969*, *B1973*, and *B1984* are statistically insignificant. The short-run results also indicate that housing wealth is statistically insignificant, while wealth from equities appears to bear a statistically significant influence (at the 10 per cent level) on the ratio of private saving to GDP in Australia (although the sign of this coefficient remains positive).

[45] The statistical significance of this coefficient also confirms the existence of a cointegrating relationship.

Table 7.3 Error correction representation of equation (7.11)

ARDL (1,0,1,2,0,0,0,0,0,0,0) selected lags based on Schwartz Bayesian Criterion

Variable	Coefficient	Standard Error	T-Ratio	Probability
Constant	-0.1469	0.0692	-2.1224*	0.035
Trend	0.0002	0.0002	0.9838	0.327
ΔGS	-0.2544	0.0675	-3.7637**	0.000
ΔY	0.5249	0.0747	7.0231**	0.000
ΔU	-0.3919	0.2228	-1.7593	0.080
$\Delta U(-1)$	-0.7711	0.2184	-3.5302**	0.001
ΔR	0.0172	0.0419	0.4119	0.681
ΔINF	-0.0804	0.0593	-1.3568	0.177
ΔAS	-0.2624	0.1208	-2.1718*	0.031
ΔTOT	0.0004	0.0001	3.8787**	0.000
$\Delta FLIB$	-0.0208	0.0086	-2.4049*	0.017
ΔH	-0.0037	0.0072	-0.5176	0.605
ΔEQ	0.0102	0.0060	1.7059	0.090
$\Delta B1969$	0.0016	0.0036	0.4645	0.643
$\Delta B1973$	-0.0092	0.0061	-1.5230	0.130
$\Delta B1984$	-0.0020	0.0038	-0. 5415	0.589
$\Delta B1990$	-0.0087	0.0047	-1.8481	0.066
$ecm(-1)$	-0.5732	0.0597	-9.6020**	0.000

* Denotes significance at the 5% level. ** Denotes significance at the 1% level.

$$ecm = PS + 0.444 * GS - 0.424 * Y - 0.157 * U - 0.03 * R + 0.160 * INF + 0.458 * AS - 0.0007 * TOT + 0.036 * FLIB + 0.007 * H - 0.018 * EQ + 0.256 * \text{Constant} - 0.0003 * \text{Trend} - 0.003 * B1969 + 0.016 * B1973 + 0.004 * B1984 + 0.015 * B1990$$

$R^2 = 0.6249$ $\quad \bar{R}^2 = 0.5844$ $\quad$ F-stat $F(17,168) = 17.3865\left[0.000\right]$ $\quad$ SER $= 0.0082$

RSS $= 0.011$ $\quad$ DW-statistic $= 2.0817$

Diagnostic statistics from the estimations are positive (Table 7.4), indicating that the error terms do not suffer from serial correlation, and are normally distributed. The model specification also satisfies the RESET test for omitted variables and functional form.

Table 7.4 Diagnostic tests on equation (7.11)

LM Test Statistics	χ^2 **statistic**	**Probability**
Serial correlation [a] $\chi^2(4)$	3.3784	0.497
Normality [b] $\chi^2(2)$	1.5196	0.468
Functional form [c] $\chi^2(1)$	0.0038	0.951
Heteroscedasticity [d] $\chi^2(1)$	0.0179	0.893

* Denotes significance at the 5% level. ** Denotes significance at the 1% level.

a Breusch-Godfrey LM test for serial correlation. **b** Jarque-Bera normality test.

c Ramsey RESET test for omitted variables/functional form. **d** White test for heteroscedasticity.

While the diagnostic tests above indicate that the estimations satisfy standard tests for serial correlation and functional form, there were a number of insignificant variables in both the short- and long-run representations. The ARDL model was subsequently re-estimated, eliminating the real interest rate (*R*), the rate of inflation (*INF*), and the three insignificant break-point dummy variables: (*B1969*); (*B1973*); and (*B1984*). Although housing wealth was found to be statistically insignificant in the estimations above, this variable was not eliminated (given strong *a priori* expectations regarding housing as a source of household wealth and as a potential mode of saving). Eliminating the other insignificant variables leaves the following model:

$$\Delta PS_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \delta_i \Delta PS_{t-i} + \sum_{i=1}^{p} \beta_i \Delta GS_{t-i} + \sum_{i=1}^{p} \phi_i \Delta Y_{t-i} + \sum_{i=1}^{p} \varphi_i \Delta AS_{t-i} +$$
$$\sum_{i=1}^{p} \gamma_i \Delta U_{t-i} + \sum_{i=1}^{p} \rho_i \Delta TOT_{t-i} + \sum_{i=1}^{p} \psi_i \Delta FLIB_{t-i} + \sum_{i=1}^{p} \xi_i \Delta H_{t-i} +$$
$$\sum_{i=1}^{p} \omega_i \Delta EQ_{t-i} + \lambda_1 PS_{t-1} + \lambda_2 GS_{t-1} + \lambda_3 Y_{t-1} + \lambda_4 AS_{t-1} + \lambda_5 U_{t-1} +$$
$$\lambda_6 TOT_{t-1} + \lambda_7 FLIB_{t-1} + \lambda_8 H_{t-1} + \lambda_9 EQ_{t-1} + u_t \qquad 7.12$$

The estimated long-run coefficient estimates for equation (7.12) are provided in Table 7.5. All the coefficient estimates are of the expected sign, with the exception of the unemployment rate. For the ratio of government saving to GDP (*GS*), the estimated coefficient is now slightly higher, suggesting that over the long run, a

one per cent change in the general government's fiscal position is offset by a corresponding change in the private savings ratio to GDP by 0.49 per cent.

For the remaining variables the results are broadly unchanged from the previous estimation. A one per cent rise in household gross disposable income (*Y*) is estimated to raise the ratio of private saving to GDP by 0.34 per cent over the long-run, while an increase in social assistance payments to households (*AS*) of the same magnitude is estimated to have a negative impact on private saving, with the ratio of private saving to GDP declining by 0.40 per cent.

Both measures of household wealth are now statistically significant at the 10 per cent level. For housing wealth, the estimated negative coefficient is consistent with the theoretical presentation in Chapter 5. This implies that the private saving response is consistent with intertemporal utility maximisation, where rising levels of private wealth from housing induce a rise in consumption (stemming from the marginal propensity to consume out of housing wealth). The coefficient on equity prices does however remain positive, and significant at the 10 per cent level. The break-point dummy variable coinciding with the 1990 recession (*B1990*) is statistically significant at the 10 per cent level, with the negative sign of this coefficient indicating that this sharp economic downturn has permanently lowered, albeit only modestly, long-run growth in the ratio of private saving to GDP.

Table 7.5 Estimated long-run coefficients for equation (7.12)

ARDL (1,0,1,2,0,0,0,0,0) selected lags based on Schwartz Bayesian Criterion

Variable	Coefficient	Standard Error	T-Ratio	Probability
Constant	-0.1831	0.1043	-1.7555	0.081
Trend	0.0002	0.0003	0.9178	0.360
GS	-0.4851	0.1164	-4.1678**	0.000
Y	0.3380	0.1300	2.6001**	0.010
U	0.0738	0.1776	0.4156	0.678
AS	-0.4025	0.1972	-2.0408*	0.043
TOT	0.0008	0.0002	4.0125**	0.000
FLIB	-0.0265	0.0141	-1.8752	0.062
H	-0.0178	0.0101	-1.7657	0.079
EQ	0.0180	0.0101	1.7750	0.078
B1990	-0.0140	0.0078	-1.8119	0.072

* Denotes significance at the 5% level. ** Denotes significance at the 1% level.

The error correction estimates (Table 7.6) indicate a private saving offset of around one quarter (-0.28) to changes in government saving in the short-run, and the error correction term, $ecm(-1)$, is of the correct sign and statistically significant at the one per cent level. Again the unemployment rate (U) is statistically significant in the short-run relationship, confirming that a rise in unemployment negatively impacts private saving over a relatively short time period (after which private saving returns to its long-run equilibrium rate). Diagnostic statistics for the error correction mechanism (Table 7.7) suggest that the model is correctly specified.

Table 7.6 Error correction representation of equation (7.12)

ARDL (1,0,1,2,0,0,0,0,0) selected lags based on Schwartz Bayesian Criterion

Variable	**Coefficient**	**Standard Error**	**T-Ratio**	**Probability**
Constant	-0.1045	0.0613	-1.7034	0.090
Trend	0.0001	0.0001	0.9256	0.356
ΔGS	-0.2768	0.0665	-4.1608**	0.000
ΔY	0.4975	0.0727	6.8392**	0.000
ΔU	-0.4393	0.2215	-1.9835*	0.049
$\Delta U(-1)$	-0.7280	0.2083	-3.4938**	0.001
ΔAS	-0.2297	0.1127	-2.0383*	0.043
ΔTOT	0.0005	0.0001	3.9156**	0.000
$\Delta FLIB$	-0.0151	0.0078	-1.9281	0.055
ΔH	-0.0101	0.0055	-1.8211	0.070
ΔEQ	0.0102	0.0056	1.8224	0.070
$\Delta B1990$	-0.0080	0.0046	-1.7355	0.084
$ecm(-1)$	-0.5707	0.0585	-9.7435**	0.000

* Denotes significance at the 5% level. ** Denotes significance at the 1% level.

$ecm = PS + 0.485 * GS - 0.338 * Y - 0.074 * U + 0.402 * AS - 0.0007 * TOT + 0.027 * FLIB + 0.018 * H - 0.018 * EQ + 0.183 * \text{Constant} - 0.0002 * \text{trend} + 0.014 * B1990$

$R^2 = 0.6163$ $\bar{R}^2 = 0.5847$ F-stat $F(12,172) = 22.7559\left[0.000\right]$ SER $= 0.0082$

RSS $= 0.0116$ DW-statistic $= 2.0028$

Table 7.7 Diagnostic tests on equation (7.12)

LM Test Statistics	χ^2 **statistic**	**Probability**
Serial correlation [a] $\chi^2(4)$	2.8192	0.589
Normality [b] $\chi^2(2)$	3.6449	0.162
Functional form [c] $\chi^2(1)$	0.1716	0.679
Heteroscedasticity [d] $\chi^2(1)$	0.0860	0.769

* Denotes significance at the 5% level. ** Denotes significance at the 1% level.

a Breusch-Godfrey LM test for serial correlation. **b** Jarque-Bera normality test.

c Ramsey RESET test for omitted variables/functional form. **d** White test for heteroscedasticity.

7.4.2 Reverse causality

As noted in the previous section, results on the bounds test on equation 7.11 where government saving (*GS*) was the dependent variable were inconclusive – suggesting that reverse causation from private saving to government saving may exist (Table 7.1). To determine whether reverse causation does in fact exist, this section estimates the ARDL model with government saving (*GS*) as the dependent variable.

After initially estimating equation 7.11 with government saving (*GS*) as the dependent variable (no time trend was included for *GS*), insignificant coefficients were dropped (including the constant term), leaving the following specification:

$$\Delta GS_t = \sum_{i=1}^{p} \delta_i \Delta GS_{t-i} + \sum_{i=1}^{p} \beta_i \Delta PS_{t-i} + \sum_{i=1}^{p} \phi_i \Delta Y_{t-i} + \sum_{i=1}^{p} \varphi_i \Delta R_{t-i} +$$

$$\sum_{i=1}^{p} \gamma_i \Delta INF_{t-i} + \sum_{i=1}^{p} \rho_i \Delta TOT_{t-i} + \sum_{i=1}^{p} \xi_i \Delta H_{t-i} + \sum_{i=1}^{p} \omega_i \Delta EQ_{t-i} + \lambda_1 GS_{t-1} +$$

$$\lambda_2 PS_{t-1} + \lambda_3 Y_{t-1} + \lambda_4 R_{t-1} + \lambda_5 INF_{t-1} + \lambda_6 TOT_{t-1} + \lambda_7 H_{t-1} + \lambda_8 EQ_{t-1} + u_t \qquad 7.13$$

The estimated long-run coefficient estimates for equation (7.13) are provided in Table 7.8. The long-run coefficient for private saving (*PS*) is negative and statistically insignificant – suggesting no reverse causality from private saving to government saving over the long run. The coefficient on gross disposable income (*Y*) is negative, suggesting that rising household incomes detract from government saving. As rising household incomes would likely result in greater income tax receipts to the government (and potentially also lower transfer payments), this

coefficient appears to have the wrong sign (and is only statistically significant at the 10 per cent level).

Table 7.8 Estimated long-run coefficients for equation (7.13)

ARDL (2,1,2,0,0,0,0,0) selected lags based on Schwartz Bayesian Criterion

Variable	Coefficient	Standard Error	T-Ratio	Probability
PS	-0.0053	0.2784	-0.0189	0.985
Y	-0.1243	0.0706	1.7611	0.080
R	-0.6141	0.2015	-3.0470**	0.003
INF	-0.4423	0.1937	-2.2837*	0.024
TOT	0.0008	0.0004	2.2854*	0.024
H	-0.0216	0.0133	-1.6301	0.105
EQ	0.0382	0.0138	2.7672**	0.006
B1990	-0.0296	0.0162	1.8247	0.070

* Denotes significance at the 5% level. ** Denotes significance at the 1% level.

The negative sign on the coefficient for private saving is also questionable (Table 7.8), as it suggests that rising private saving detracts from government saving. A result like this could be reasonable where governments derive a significant portion of their revenue base through consumption taxes. However in Australia, wages and company profits are the major sources of government revenue. The coefficient on household disposable incomes (*Y*) was also of the wrong sign – lending further support against reverse causality. As the long-run coefficient on private saving (*PS*) is statistically insignificant in the long-run estimations, there is no need to consider the error correction results, and it is reasonable to conclude that reverse causality does not exist.[46] [47]

As noted earlier, two subsample estimations for equation (7.11) will now be undertaken. These cover the period 1959:3 – 1983:4, while the second period is over 1984:1 – 2006:2. This will attempt to account for the effects of financial market liberalisation, and a move toward a greater integration of the Australian economy

[46] Diagnostic tests on the ARDL also suggested that this specification suffered from serial correlation.

[47] However, as the equations in this chapter are reduced-form, it may not be possible to fully rule-out the existence of reverse causality.

into the global financial system – particularly as the break-point dummy variable (*B1984*) was not statistically significant in the earlier analysis.[48]

Over the first subsample period, the Australian economy was highly regulated, with a fixed exchange rate, tariff controls, and other regulations over the financial system such as controls on bank lending, deposits, and some interest rates (such as mortgage interest rates, overnight money market rates, and deposit rates). Since the floating of the Australian dollar and associated financial market reforms, foreign capital inflows into Australia have increased markedly, and there has been a commensurate increase in financial market innovation. As noted in Chapter 4, this integration into global capital markets may have dampened the impact of fiscal policy on the economy. These reforms have also occurred in concert with other reforms in the labour market, tariff reform, the establishment of free trade arrangements with some countries, a national competition policy agenda, fiscal consolidation, privatisation of government business enterprises, and the introduction of inflation targeting.

7.4.3 Private saving offsets – 1959:3 to 1983:4

Cointegration tests where private saving (*PS*) is the dependent variable yield an F-statistic of 3.7095, which is greater than the upper bound critical value at the 5 per cent level – implying that the long-run level relationship between these variables is still observed over the first subsample period (Table 7.9). However, where government saving is the dependent variable, the calculated F-statistic again falls into the inconclusive zone.

[48] As the financial reforms were phased over the 1980s, with the floating of the Australian dollar one of several major reforms, the insignificance of this dummy variable is not that surprising. This implies that a gradual structural change may have been occurring as opposed to a sudden level shift.

Table 7.9 Results from bounds test on equation (7.11) – 1959:3 to 1983:4

Dep. Var.	F-statistic	Probability	Conclusion
$F_{PS}(PS \mid GS, Y, AS, U, INF, R, TOT, FLIB, H, EQ)$	3.7095*	0.001	Cointegration
$F_{GS}(GS \mid PS, Y, AS, U, INF, R, TOT, FLIB, H, EQ)$	2.5843	0.016	Inconclusive
$F_{Y}(Y \mid PS, GS, AS, U, INF, R, TOT, FLIB, H, EQ)$	1.1575	0.349	No cointegration
$F_{AS}(AS \mid PS, GS, Y, U, INF, R, TOT, FLIB, H, EQ)$	3.2765	0.003	No cointegration
$F_{U}(U \mid PS, GS, Y, AS, INF, R, TOT, FLIB, H, EQ)$	2.1103	0.045	No cointegration
$F_{R}(R \mid PS, GS, Y, AS, U, INF, TOT, FLIB, H, EQ)$	2.1373	0.043	No cointegration
$F_{INF}(INF \mid PS, GS, Y, AS, U, R, TOT, FLIB, H, EQ)$	1.6689	0.121	No cointegration
$F_{TOT}(TOT \mid PS, GS, Y, AS, U, INF, R, FLIB, H, EQ)$	2.4355	0.022	Inconclusive
$F_{FLIB}(FLIB \mid PS, GS, Y, AS, U, INF, R, TOT, H, EQ)$	2.2704	0.032	No cointegration
$F_{H}(H \mid PS, GS, Y, AS, U, INF, R, TOT, FLIB, EQ)$	2.7366	0.011	Inconclusive
$F_{EQ}(EQ \mid PS, GS, Y, AS, U, INF, R, TOT, FLIB, H)$	3.7878	0.001	Cointegration

Asymptotic critical value bounds are obtained from Table CI(iii), Case V: unrestricted intercept and unrestricted trends for k=10 (Persaran et al: 2001). Lower bound I(0)=2.43 and Upper bound I(1)=3.56 at the 5% significance level. * Denotes significance at the 5% level. ** Denotes significance at the 1% level.

For the ARDL estimation over the period 1959:3-1983:4, initial results for equation (7.11) were not positive, and indicated that the errors of the estimated ARDL were serially correlated and not normally distributed. Additionally, the estimated trend coefficient was of the wrong sign. The trend coefficient was dropped, along with estimated coefficients for the real interest rate (*R*), inflation (*INF*), financial openness (*FLIB*), and the break-point dummy variables (*B1969*) and (*B1973*) as these variables were all statistically insignificant. Serial correlation was still apparent in the model, and despite theory suggesting that wealth effects may explain some of the variation in private saving behaviour; both the house and equity price series were also dropped from the model. Removing these improved the results markedly, with the Jarque-Bera test indicating that the residuals were normally distributed, while the Breusch-Godfrey LM test suggested that serial correlation had also been alleviated. This left the following specification for the subsample ARDL:

$$\Delta PS_t = \alpha_0 + \sum_{i=1}^{p} \delta_i \Delta PS_{t-i} + \sum_{i=1}^{p} \beta_i \Delta GS_{t-i} + \sum_{i=1}^{p} \phi_i \Delta Y_{t-i} + \sum_{i=1}^{p} \gamma_i \Delta U_{t-i} +$$

$$\sum_{i=1}^{p} \varphi_i \Delta AS_{t-i} + \sum_{i=1}^{p} \rho_i \Delta TOT_{t-i} + \lambda_1 PS_{t-1} + \lambda_2 GS_{t-1} +$$

$$\lambda_3 Y_{t-1} + \lambda_4 U_{t-1} + \lambda_5 AS_{t-1} + \lambda_6 TOT_{t-1} + u_t \qquad 7.14$$

The estimated long-run coefficient estimates for equation (7.14) are provided in Table 7.10. For the ratio of government saving to GDP (*GS*) over the period 1959:3-1983:4, the estimated coefficient is -0.39, which is somewhat lower than the full sample estimation. This potentially suggests that with a lower private saving offset, fiscal policy may have exerted a larger impact on the real economy during this period. Such a result would be consistent with the structure of the economy at that time (markets being subject to a greater degree of regulation, and less exposure to international capital and price movements) and confirms *a priori* expectations regarding these policy impacts.

A one per cent rise in household gross disposable income (*Y*) is estimated to raise the ratio of private saving to GDP by 0.39 per cent over the first subsample, which is slightly higher than for the full sample estimation. The terms of trade (*TOT*) is statistically significant, but is estimated to exert an extremely small impact on the private saving to GDP ratio. As expected, over this subsample the ratio of social assistance payments to household gross disposable income (*AS*) and the unemployment rate (*U*) are estimated to have had a statistically insignificant long-run impact on private saving.

Table 7.10 Estimated long-run coefficients for equation (7.14)

ARDL (1,0,1,0,2,0) selected lags based on Schwartz Bayesian Criterion

Variable	**Coefficient**	**Standard Error**	**T-Ratio**	**Probability**
Constant	-0.2085	0.0648	-3.2159**	0.002
GS	-0.3994	0.1861	-2.1455*	0.035
Y	0.3906	0.0700	5.5746**	0.000
U	-0.1998	0.2475	-0.8075	0.422
AS	-0.2438	0.2855	-0.8539	0.395
TOT	0.0007	0.0003	2.6296**	0.010

* Denotes significance at the 5% level. ** Denotes significance at the 1% level.

The short-run error correction estimates are presented in Table 7.11. In the short run, the error correction equation indicates a private saving offset of -0.23. The error correction term, $ecm(-1)$, is of the correct sign and statistically significant – indicating that deviations from the long-run rate of private saving are corrected by over 50 per cent in the next period. Household gross disposable income, (*Y*), is statistically significant (at the one per cent level) while the estimated coefficient for social assistance payments (*AS*) is markedly higher in the short run, and includes an additional lag coefficient for adjustment. The larger sign of this coefficient in the short run may again be explained by the steep rise in the unemployment rate in 1974, then rising again in 1983 (where the unemployment rate reached 10.2 per cent in the September quarter 1983) – suggesting that households were more dependent on the welfare safety net over this period. However, it is interesting that the results indicate that the unemployment rate is statistically insignificant in both the long- and short-run estimations. Prior to the large rise in unemployment during the 1970s, the unemployment rate averaged 2 per cent over the 1960s. The introduction of expanded social welfare programmes by the Whitlam government almost coincided with a steep rise in unemployment in 1974, which may explain this curio.[49]

Table 7.11 Error correction representation of equation (7.14)

ARDL (1,0,1,0,2,0) selected lags based on Schwartz Bayesian Criterion

Variable	Coefficient	Standard Error	T-Ratio	Probability
Constant	-0.1216	0.0413	-2.9407*	0.004
ΔGS	-0.2329	0.1021	-2.2812*	0.025
ΔY	0.4916	0.0806	6.0980**	0.000
ΔU	-0.1165	0.1462	-0.7968	0.428
ΔAS	-1.4175	0.3407	-4.1602**	0.000
$\Delta AS(-1)$	-0.7800	0.3133	-2.4892*	0.015
ΔTOT	0.0004	0.0002	2.6569*	0.009
$ecm(-1)$	-0.5831	0.0945	-6.1691**	0.000

* Denotes significance at the 5% level. ** Denotes significance at the 1% level.

$ecm = PS + 0.399 * GS - 0.391 * Y + 0.199 * U + 0.244 * AS - 0.0007 * TOT + 0.209 * \text{Constant}$

$R^2 = 0.7104$ $\quad \bar{R}^2 = 0.6800$ $\quad$ F-stat $F(7,88) = 30.1357\left[0.000\right]$ $\quad$ SER $= 0.0078$

RSS $= 0.0053$ $\quad$ DW-statistic $= 1.9847$

[49] In the absence of social welfare arrangements, the coefficient on unemployment could in fact be positive; inferring that a rise in unemployment spurs an increase in precautionary saving.

As mentioned above, diagnostic statistics for the error correction mechanism (Table 7.12) are positive and indicate that the model is correctly specified. The error terms are normally distributed and the Breusch-Godfrey LM test indicates that no serial correlation is present.

Table 7.12 Diagnostic tests on equation (7.14)

LM Test Statistics	χ^2 **statistic**	**Probability**
Serial correlation [a] $\chi^2(4)$	2.8417	0.585
Normality [b] $\chi^2(2)$	3.7570	0.153
Functional form [c] $\chi^2(1)$	0.6502	0.420
Heteroscedasticity [d] $\chi^2(1)$	0.4577	0.499

* Denotes significance at the 5% level. ** Denotes significance at the 1% level.

a Breusch-Godfrey LM test for serial correlation. **b** Jarque-Bera normality test.

c Ramsey RESET test for omitted variables/functional form. **d** White test for heteroscedasticity.

7.4.4 Private saving offsets – 1984:1 to 2006:2

Cointegration tests where private saving is the dependent variable yield an F-statistic of 2.766, which falls within the inconclusive range of the critical values at the 5 per cent level (Table 7.13). Results from the bounds test also suggest reverse causation where government saving is the dependent variable. As the overall sample results presented earlier in the chapter suggested that cointegration exists, the ARDL estimations will still be undertaken. However, it is important to note that given the estimations are dealing with reduced-form equations it may not be possible to fully rule-out the presence of reverse causality.[50] Where reverse causation exists, there is a possibility that the feedback effects between private and public saving may produce short- and long-run coefficient estimates that are somewhat overstated.[51]

[50] The reverse causation implied by the bounds test may in fact lend support to prior expectations that financial liberalisation in Australia, leading to deeper and more open capital markets, has eroded the transmission of changes in the government's fiscal stance through to domestic savings and interest rates.

[51] A summary of the results for the full and subsample estimations in this chapter will present a range for both the long- and short-run coefficient estimates (rather than stating some degree of precision with regard to the short- and long-run impacts).

Table 7.13 Results from bounds test on equation (7.11) – 1984:1 to 2006:2

Dep. Var.	**F-statistic**	**Probability**	**Conclusion**
$F_{PS}(PS \mid GS, Y, AS, U, INF, R, TOT, FLIB, H, EQ)$	2.7660	0.012	Inconclusive
$F_{GS}(GS \mid PS, Y, AS, U, INF, R, TOT, FLIB, H, EQ)$	4.7084	0.000	Cointegration
$F_{Y}(Y \mid PS, GS, AS, U, INF, R, TOT, FLIB, H, EQ)$	2.1220	0.047	Inconclusive
$F_{AS}(AS \mid PS, GS, Y, U, INF, R, TOT, FLIB, H, EQ)$	2.6908	0.014	Inconclusive
$F_{U}(U \mid PS, GS, Y, AS, INF, R, TOT, FLIB, H, EQ)$	3.1875	0.005	Inconclusive
$F_{R}(R \mid PS, GS, Y, AS, U, INF, TOT, FLIB, H, EQ)$	2.6692	0.014	Inconclusive
$F_{INF}(INF \mid PS, GS, Y, AS, U, R, TOT, FLIB, H, EQ)$	2.3367	0.029	No cointegration
$F_{TOT}(TOT \mid PS, GS, Y, AS, U, INF, R, FLIB, H, EQ)$	3.6749	0.002	Cointegration
$F_{FLIB}(FLIB \mid PS, GS, Y, AS, U, INF, R, TOT, H, EQ)$	2.7118	0.013	Inconclusive
$F_{H}(H \mid PS, GS, Y, AS, U, INF, R, TOT, FLIB, EQ)$	2.3422	0.029	Inconclusive
$F_{EQ}(EQ \mid PS, GS, Y, AS, U, INF, R, TOT, FLIB, H)$	4.4042	0.000	Cointegration

Asymptotic critical value bounds are obtained from Table CI(iii), Case V: unrestricted intercept and unrestricted trends for k=10 (Persaran et al: 2001). Lower bound I(0)=2.43 and Upper bound I(1)=3.56 at the 5% significance level. * Denotes significance at the 5% level. ** Denotes significance at the 1% level.

After initially estimating equation (7.11), the results suggested that social assistance payments as a proportion of household disposable income (*AS*), inflation (*INF*), the real interest rate (*R*) and the break-point dummy variable coinciding with the early 1990s recession (*B1990*) were statistically insignificant. The following ARDL was estimated:

$$\Delta PS_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \delta_i \Delta PS_{t-i} + \sum_{i=1}^{p} \beta_i \Delta GS_{t-i} + \sum_{i=1}^{p} \phi_i \Delta Y_{t-i} +$$

$$\sum_{i=1}^{p} \gamma_i \Delta U_{t-i} + \sum_{i=1}^{p} \rho_i \Delta TOT_{t-i} + \sum_{i=1}^{p} \psi_i \Delta FLIB_{t-i} + \sum_{i=1}^{p} \xi_i \Delta H_{t-i} +$$

$$\sum_{i=1}^{p} \omega_i \Delta EQ_{t-i} + \lambda_1 PS_{t-1} + \lambda_2 GS_{t-1} + \lambda_3 Y_{t-1} + \lambda_4 U_{t-1} +$$

$$\lambda_5 TOT_{t-1} + \lambda_6 FLIB_{t-1} + \lambda_7 H_{t-1} + \lambda_8 EQ_{t-1} + u_t \qquad 7.15$$

The estimated long-run coefficient estimates are provided in Table 7.14. For the ratio of government saving to GDP (*GS*) over the period 1984:1-2006:2, the estimated coefficient is -0.39, and statistically significant only at the 10 per cent level. For the other variables, a one per cent rise in household gross disposable income (*Y*) is estimated to raise the ratio of private saving to GDP by 0.43 per cent over the subsample period. Net foreign liabilities (*FLIB*) are significant at the one per cent level – and indicate that Australian financial markets have become more integrated with global capital flows. The long-run coefficient on the terms of trade (*TOT*) is slightly higher than the previous estimations, which possibly indicates that as Australia has become more integrated with the global economy, international price determination for traded goods may be exerting a greater influence over household incomes, consumption and saving. The house price index has changed sign, but is now statistically insignificant, while equity prices remain significant at the 10 per cent level.

Table 7.14 Estimated long-run coefficients for equation (7.15)

ARDL (2,1,0,2,0,1,0,0) selected lags based on Schwartz Bayesian Criterion

Variable	Coefficient	Standard Error	T-Ratio	Probability
Constant	-0.3901	0.2294	-1.7001	0.093
Trend	-0.0006	0.0004	-1.2942	0.200
GS	-0.3855	0.2386	-1.6160	0.110
Y	0.4338	0.2371	1.8295	0.071
U	0.4296	0.3463	1.2407	0.219
TOT	0.0012	0.0003	3.5862**	0.001
FLIB	-0.0700	0.0227	-3.0776**	0.003
H	0.0202	0.0242	0.8328	0.408
EQ	0.0341	0.0187	1.8232	0.072

* Denotes significance at the 5% level. ** Denotes significance at the 1% level.

The short-run error correction estimates are presented in Table 7.15. In the short-run, the error correction equation indicates a private savings offset of -0.40 to changes in government saving, which is both statistically significant and roughly equivalent to the estimated long-run coefficient. The error correction term, $ecm(-1)$, is of the correct sign and statistically significant – indicating that deviations from the long-run rate of private saving are corrected by around 50 per cent in the next period.

Table 7.15 Error correction representation of equation (7.15)

ARDL (2,1,0,2,0,1,0,0) selected lags based on Schwartz Bayesian Criterion

Variable	Coefficient	Standard Error	T-Ratio	Probability
Constant	-0.1816	0.1008	-1.8006	0.076
Trend	-0.0003	0.0002	-1.3609	0.177
$\Delta PS(-1)$	-0.1769	0.0805	-2.1976*	0.031
ΔGS	-0.3977	0.1049	-3.7921**	0.000
ΔY	0.2019	0.1110	1.8187	0.073
ΔU	-0.4623	0.3714	-1.2445	0.217
$\Delta U(-1)$	-1.1101	0.3230	-3.4367**	0.001
ΔTOT	0.0006	0.0002	3.4544**	0.000
$\Delta FLIB$	-0.0776	0.0189	-4.0914*	0.000
ΔH	-0.0094	0.0108	0.8707	0.387
ΔEQ	-0.0158	0.0078	2.0123*	0.048
$ecm(-1)$	-0.4654	0.0906	-5.1340**	0.000

* Denotes significance at the 5% level. ** Denotes significance at the 1% level.

$ecm = PS + 0.385 * GS - 0.434 * Y - 0.429 * U - 0.001 * TOT + 0.070 * FLIB - 0.020 * H - 0.034 * EQ + 0.390 * INPT + 0.006 * \text{Trend}$

$R^2 = 0.6690$ $\bar{R}^2 = 0.6072$ F-stat $F(11, 78) = 13.7805\left[0.000\right]$ SER $= 0.0073$

RSS $= 0.0041$ DW-statistic $= 2.0543$

Diagnostic statistics for the error correction mechanism (Table 7.16) are positive, and indicate that the model is correctly specified.

Table 7.16 Diagnostic tests on equation (7.15)

LM Test Statistics	χ^2 statistic	Probability
Serial correlation **a** $\chi^2(4)$	1.8555	0.762
Normality **b** $\chi^2(2)$	0.4971	0.780
Functional form **c** $\chi^2(1)$	0.4583	0.498
Heteroscedasticity **d** $\chi^2(1)$	0.3776	0.539

* Denotes significance at the 5% level. ** Denotes significance at the 1% level.

a Breusch-Godfrey LM test for serial correlation. **b** Jarque-Bera normality test.

c Ramsey RESET test for omitted variables/functional form. **d** White test for heteroscedasticity.

7. 5 Summary of the estimations

Overall, the results indicate a statistically significant relationship between government and private saving. This result was consistent across the entire sample, and for both of the subsample estimations. The results suggest a long-term private saving offset close to one half, and between -0.25 and -0.40 in the short term. These lower short-run offsets indicate that fiscal policy can have a larger response on short-term economic activity. While this implies that the private sector is not sufficiently forward-looking for Ricardian equivalence to hold, it may also indicate that agents are also liquidity constrained in the short run.

While results demonstrate that there is no full Ricardian response to changes in the fiscal stance, there is some partial offsetting savings behaviour. Moreover, the results suggest that fiscal policy can elicit some impact on the real economy, and the range of private savings offsets above infer a fiscal impact of around 0.5 over the long-run, and between 0.6 and 0.75 in the short term – implying that changes in the fiscal stance only partially impact aggregate demand. Stated more formally, for a one per cent deterioration in the ratio of government saving to GDP, output increases by around 0.5 per cent in the long run, and between 0.6 and 0.75 per cent in the short run. It is important to note that these fiscal impacts are only an indirect estimate of short- and long-run fiscal multipliers in Australia (calculated as $1-\beta_i$) – and are not direct estimates of fiscal multipliers. Nevertheless, these estimated short- and long-run fiscal impacts are broadly consistent with the empirical literature surveyed in Chapter 2.

The lower short-run offsets revealed through the error correction mechanisms indicate that nominal and real frictions and/or rigidities prevent some proportion of the offsetting behaviour occurring more quickly.[52] However this appears to have lessened as the economy has undergone significant economic reform. In fact, the two extreme values estimated on the short-run coefficient on government saving above (-0.25 and 0.40) actually correspond with the two subsamples considered in this chapter. This result is also consistent with the discussion in Chapter 4 which noted

[52] This could also accord with fiscal policy lags.

that financial deregulation, and integration into global capital markets, dampens the impact of fiscal policy on domestic interest rates, and reduces crowding out of investment. More sophisticated capital markets, and greater access to international capital, also mean that private agents have a greater ability to look through short-run aberrations in the economy and smooth consumption over longer time periods. The hypothesis tests to be undertaken in the next section will attempt to see how these results on the long- and short-run coefficients for government saving compare with confidence intervals for the true population values.

The coefficient estimates in this chapter are consistent with those of similar studies, such as such de Mello (2004) and Comley (2002). More recently, Cotis (et al: 2006) considered a panel of 16 OECD countries and found a private savings offset of around two thirds over the long run, and around half in the short term. Considering the United States in isolation, the authors found a positive private savings offset, which implies that not only are US households non-Ricardian, but are not fully consumption-smoothing when faced with long-term shifts in public deficits.

Following the financial sector reforms through the 1980s, the development of the financial sector and integration into global capital markets may have dampened the impact of fiscal policy on the real economy, including domestic interest rates. As noted earlier, more sophisticated private credit markets also enables greater access to personal credit – allowing households and firms to smooth consumption. Looking at the long-run coefficient on government saving over the two subsamples does not provide any indication that this may be occurring (both sets of estimations yielded long-run coefficients around -0.40 per cent). However, the short-run error correction coefficients were markedly different, with the second subsample estimation yielding a short-run private savings offset that was close to that obtained over the long run.

Estimations across the two subsamples also confirm increased linkages between Australia and the global economy, and that greater access to international capital has lowered private saving. This is evident in the coefficient on net foreign liabilities (*FLIB*), which was taken as a proxy for financial market openness. This coefficient was insignificant, and dropped from the first sub sample. The coefficient on the terms of trade (*TOT*) was also higher in the second subsample, potentially indicating

that Australia has derived higher income from commodities over this period, and also that the removal of market distortions (such as tariffs) has delivered greater pass-through of international prices.

The coefficients on real interest rates (*R*) and inflation (*INF*) were not statistically significant in any of the estimations, which is a somewhat curious outcome. One possible explanation is that households see some proportion of their saving occurring through the family home, and more recently through superannuation and equity investments. Having a large proportion of savings in both of these assets is likely to see the theoretical linkages between real interest rates and inflation on savings behaviour being somewhat lessened.

Of the structural breaks considered in this chapter, only the dummy variable on the 1990s recession has proved to have had a statistically significant impact on the level of private saving in Australia. This period saw a particularly marked downturn in economic activity, and a sharp rise in unemployment to above 10 per cent.

Across the estimations, the impact of rising unemployment on private saving appears to be only temporary, as the coefficient on this variable was generally only statistically significant in the error correction results. Additionally, the significant coefficient for the ratio of social assistance payments to household gross disposable income (*AS*) indicates that the welfare safety net lowers the rate of private saving (possibly due to reduced incentives for as precautionary saving).

7. 6 Hypothesis testing

Consistent with the analysis undertaken above, the hypothesis testing will consider the entire sample period, along with the subsamples. The more recent period of economic reform is particularly relevant when considering policy inferences from the results here – and subsequently relating these to current economic and fiscal policy issues.

The central hypothesis for this thesis was stated in Chapter 1 as:

> *Does fiscal policy influence private saving behaviour in a manner that is consistent with Ricardian equivalence, thus mitigating the effects of fiscal policy, or does fiscal policy exert a substantial influence on the Australian economy – invoking effects on the balance of payments consistent with the twin deficits hypothesis?*

When $\beta_i = 0$, changes in the government's fiscal stance have no impact on private saving, implying that the twin deficits hypothesis may operate. Under this situation changes in the fiscal position affect national saving, private disposable incomes and consumption. Under a floating exchange rate any shortfalls in domestic saving are matched by foreign capital inflows and a subsequent rise in the current account deficit. The corresponding null hypothesis, $H_0 : \beta_i = 0$ has been rejected throughout this chapter, albeit indirectly, wherever the coefficient on government saving was shown to be statistically significant. Throughout the estimations the long- and short-run coefficients for β_i were consistently shown to be significant at the five per cent level.[53] Based upon these results, we can reject the hypothesis that ***fiscal policy exerts a substantial influence on the Australian economy – invoking effects on the balance of payments consistent with the twin deficits hypothesis***.

The hypothesis of a strict private saving offset (Ricardian equivalence) would be supported if the coefficient on public saving, $\beta_i = -1$, controlling for the other private saving determinants – stated formally as: $H_0 : \beta_i = -1$. Changes in government saving will thus be offset by an increase in private saving – neutralising the impact of fiscal policy. A negative coefficient on public saving, but statistically less than 0, that is $(-1 < \beta_i < 0)$ would indicate a partial savings offset, and that movements in the fiscal stance have some measurable impacts on the wider economy. As noted in the previous section, the estimations in this chapter indicate

[53] In some instances the coefficient was significant at the 1 per cent level. For the second set of subsample estimations the long-run coefficient for β_i was significant at the 10 per cent level.

that the long-run value of β_i is close to -0.5 (implying a partial savings offset). However, it remains unclear to what extent these estimates represent the true population value for β_i, and whether $\beta_i = -1$. To assess this, Tables 7.17 and 7.18 present confidence intervals for both the short- and long-run coefficients for β_i.

Table 7.17 Confidence intervals – long-run coefficients for government saving

Model	df	$t_{0.025}$	$\hat{\beta}_i$	se $\hat{\beta}_i$	**Confidence interval** [a]
Full sample: 1959:3 – 2006:2 (Equation 7.12, Table 7.5)	177	1.96	-0.4851	0.1164	$(-0.7132 \leq \beta_i \leq -0.2570)$
Subsample: 1959:3 – 1983:4 (Equation 7.14, Table 7.10)	92	1.99	-0.3994	0.1861	$(-0.7697 \leq \beta_i \leq -0.0291)$
Subsample: 1984:1 – 2006:2 (Equation 7.15, Table 7.14)	81	1.99	-0.3855	0.2386	$(-0.8603 \leq \beta_i \leq 0.0893)$

a The 95% confidence interval is given by: $\Pr\left[\hat{\beta}_i - t_{(n-x),\alpha/2}\,\mathrm{se}\left(\hat{\beta}_i\right) \leq \beta_i \leq \hat{\beta}_i + t_{(n-x),\alpha/2}\,\mathrm{se}\left(\hat{\beta}_i\right)\right] = 1-\alpha$

A formal definition for the confidence intervals would be: in the long run, in 95 out of 100 estimations, intervals like those contained in Table 7.17 will contain the true population estimate of the coefficient on government saving, β_i. While the confidence intervals do provide a broad range for the long-run coefficient on government saving, the interval for the second subsample includes the possibility that $\beta_i = 0$. This result accords with the t-statistic on this coefficient being significant only at the 10 per cent level (Table 7.14). For the hypothesis of a full private saving offset, $H_0 : \beta_i = -1$, we reject the null, as the null hypothesised value of -1 does not lie within the estimated confidence intervals. Subsequently, we can reject the hypothesis that: ***fiscal policy influences private saving behaviour in a manner that is consistent with <u>full</u> Ricardian equivalence, thus mitigating the effects of fiscal policy***.

Table 7.18 Confidence intervals – short-run coefficients for government saving

Model	df	$t_{0.025}$	$\hat{\beta}_i$	se $\hat{\beta}_i$	**Confidence interval** [a]
Full sample: 1959:3 – 2006:2 (Equation 7.12, Table 7.6)	175	1.96	-0.2768	0.0665	$(-0.4071 \leq \beta_i \leq -0.1465)$
Subsample: 1959:3 – 1983:4 (Equation 7.14, Table 7.11)	90	1.99	-0.2329	0.1021	$(-0.4361 \leq \beta_i \leq -0.0297)$
Subsample: 1984:1 – 2006:2 (Equation 7.15, Table 7.15)	78	2.00	-0.3977	0.1049	$(-0.6075 \leq \beta_i \leq -0.1879)$

a The 95% confidence interval is given by: $\Pr\left[\hat{\beta}_i - t_{(n-x),\alpha/2}\,\mathrm{se}\left(\hat{\beta}_i\right) \leq \beta_i \leq \hat{\beta}_i + t_{(n-x),\alpha/2}\,\mathrm{se}\left(\hat{\beta}_i\right)\right] = 1-\alpha$

Consistent with the estimates for the long-run coefficients on government saving, the confidence intervals in Table 7.18 have a much narrower band for the true population value of β_i. Again, as the null hypothesised value of -1 does not lie within the estimated confidence intervals, full Ricardian equivalence affects are also rejected in the short run.

The hypotheses which this thesis has sought to examine have been rejected. The results here have indicated a partial private saving offset to changes in the government's fiscal stance, which implies that fiscal policy has some ability to affect national saving, private disposable incomes and consumption.

7. 7 Summary and conclusions

This chapter has estimated the analytical model that was presented in Chapter 5 using the ARDL approach to cointegration, which allows for the calculation of both long- and short-run dynamics. This approach has also accommodated the structural breaks that were identified in the previous chapter.

Results from the estimations suggest that while there is no full Ricardian response in Australia to changes in the fiscal stance, fiscal policy has some ability to impact the real economy. Estimates suggest a long-run private saving offset around one half, and between -0.25 and -0.40 in the short run.

While the lower short-run offsets revealed through the error correction mechanisms indicate that nominal and real frictions and/or rigidities prevent some proportion of

the offsetting behaviour occurring more quickly, this result is consistent with Keynesian models – suggesting that fiscal policy has a greater ability to influence the real economy over the short term (particularly where some households are liquidity constrained). While full Ricardian equivalence has not been observed in the results, they do suggest that over the longer-term, households and organisations are more forward-looking, and exhibit some partial Ricardian behaviour.

Considering the other coefficients, the results in this chapter indicate that a one per cent increase in the ratio of household disposable income to GDP (*Y*) increases the ratio of private saving to GDP by 0.34-0.44 per cent in the long run (implying a marginal propensity to consume around 0.6), and by 0.2-0.5 in the short run. Results suggest that the impact of higher unemployment on private saving appears to be only temporary, as the coefficient on this variable was only statistically significant in the short-term error correction results. Additionally, the significant coefficient for the ratio of social assistance payments to household gross disposable income (*AS*) indicates that the existence of a welfare safety net has lowered the rate of private saving (possibly due to reduced incentives for precautionary saving). Estimates on this coefficient suggest that a one per cent increase in the ratio of household social assistance payments to GDP lowers the ratio of private saving by 0.24-0.44 per cent in the long run.

Results show that the coefficients on real interest rates (*R*) and inflation (*INF*) were not statistically significant in any of the estimations. As noted earlier in this chapter, this could be explained by households allocating a proportion of their saving through the family home, and more recently through superannuation and equity investments. This could result in linkages between real interest rates and inflation on private savings behaviour in Australia being somewhat lessened.

A critical question this chapter has sought to answer is the extent to which the development of the Australian financial sector (and increased integration into global capital markets) may have dampened the impact of fiscal policy on the real economy. Estimates of the long-run coefficient on government saving over the two subsamples (1959:3-1983:4 and 1984:1-2006:2) did not provide any clear indication that this may be occurring (both sets of estimations produced a long-run coefficient on

government saving around -0.39). However, the short-run error correction coefficients were markedly different, with the second subsample estimation yielding a short-run private saving offset that was close to the long-run estimate (-0.40).

Results in this chapter also confirm greater linkages between Australia and the global economy. While the coefficient on net foreign liabilities (*FLIB*), which was taken as a proxy for financial market openness, was statistically insignificant in the first subsample, this coefficient was found to be statistically significant in the second subsample. The negative value of this coefficient (-0.07) suggests that greater access to international capital has lowered private saving. The coefficient on the terms of trade (*TOT*) was also higher in the second subsample, which indicates that Australia may have been deriving higher income from commodities over this period.

Considering the four structural breaks that were identified in Chapter 6, only the dummy variable on the 1990s recession was shown to have had a statistically significant (negative) impact on the level of private saving in Australia. As noted earlier in this chapter, this recession resulted in a sharp downturn in economic activity, and an increase in the unemployment rate to over 10 per cent.

The hypothesis that changes in the government's fiscal stance have no impact on private saving, $\beta_i = 0$, was rejected in this chapter wherever the coefficient on government saving was shown to be statistically significant. As this coefficient was consistently found to be statistically significant, the hypothesis that fiscal policy influences the economy in a manner consistent with the twin deficits hypothesis was rejected.

The hypothesis of a strict private saving offset (Ricardian equivalence) was represented in section 7.5 as: $\beta_i = -1$, controlling for the other private saving determinants. This hypothesis was rejected, as the null hypothesised value of -1 did not lie within any of the confidence intervals calculated for the long- and short-run estimations. Results from the hypothesis tests confirm that only a partial Ricardian savings offset exists in Australia, $(-1 < \beta_i < 0)$, and that movements in the fiscal stance have some measurable impacts on the economy.

The estimation results in this chapter have provided new insights into the impact of fiscal policy in Australia and have made a significant contribution to the literature in a number of ways. First, the application of the ARDL procedure has allowed for the calculation of long- and short-run dynamics – particularly over the long sample considered here (1959:3-2006:2). Previous empirical studies that have considered Australia[54] have not undertaken modelling with such a large sample. Second, the ARDL procedure has also provided the flexibility to incorporate the structural breaks that were identified in Chapter 6. Accounting for these structural breaks is also a new contribution to the empirical literature for Australia. Third, the results from this chapter provide a more up-to-date analysis on the effectiveness of fiscal policy in Australia, and whether private saving behaviour is consistent with Ricardian equivalence. Chapter 2 highlighted that very little research has been produced for Australia with regard to the efficacy of fiscal policy, Ricardian equivalence and the twin deficits hypothesis, and that previous empirical work for Australia is now extremely dated. Finally, results in this chapter make a new contribution to the literature by considering how greater integration into international financial markets may have impacted on the efficacy of fiscal policy in Australia.

[54] Studies cited in Chapter 2 that focus on Australia include: Kearney and Fallick (1987); Eden and Britten-Jones (1990); Lee (1990); Nguyen and Pagan (1990); Parsell (et al: 1991); Karunaratne (1992); Blundell-Wignall and Stevens (1992); Comley (et al: 2002); Fidrmuc (2003); and Kennedy (et al: 2004).

CHAPTER 8 CONCLUSIONS AND POLICY RECOMMENDATIONS

As noted in Chapter 1, fiscal policy has been subject to debate in Australia for a number of decades, with its status as an arm of macroeconomic policy influenced by its perceived ability to affect prices and real economic activity. Over the 1960s and through to the 1980s, fiscal policy was frequently utilised for activist demand management, along with other objectives such as controlling inflation (depending on the prevailing economic circumstances at the time). However, the adoption of monetary policy (inflation targeting) over the past two decades has seen fiscal policy move to a focus on medium-term objectives and the sustainability of government finances. This thesis has sought to assess the efficacy of fiscal policy in Australia as a countercyclical policy tool. Specifically, the thesis has considered whether private saving behaves in a manner that is consistent with Ricardian equivalence, where the actions of far sighted agents mitigate the effects of fiscal policy, or conversely, whether fiscal policy has some ability to influence real economic activity – leading to effects consistent with the twin deficits hypothesis.

A summary of this thesis and major conclusions is contained in section 8.1, which also includes a discussion of the original contribution to the literature. Policy implications are presented in section 8.2, and section 8.3 discusses a number of directions for further research.

8. 1 Summary and conclusions of the study

A review of the relevant literature for this thesis was conducted in Chapter 2, which first considered the empirical research on the size and magnitude of fiscal multipliers. Previous empirical studies on the efficacy of fiscal policy have largely concentrated on the United States, Japan and the European countries. As noted by Kennedy (et al: 2004), the empirical literature regarding Australia has been somewhat scant. The international literature indicates that expenditure multipliers range between 0.5 and 1.5, with large economies such as the United States tending to record higher multipliers.

Empirical research on both the twin deficits hypothesis and the Ricardian equivalence theorem was also considered in Chapter 2. Most of this research was

conducted during the 1980s and early 1990s. While a large proportion of these empirical studies have again focused on the United States, the literature provides evidence both in favour of, and against, Ricardian equivalence and twin deficits. These conflicting results may in fact stem from wide differences in empirical techniques, data measures and samples.

Chapter 2 also noted that a substantial criticism that may be directed at previous research is a lack of consideration for structural change – particularly over long samples. Structural breaks can have permanent effects on the long-run level of many macroeconomic data series, and failing to account for this can lead to results that are biased. This is particularly relevant as the Australian economy has been subjected to a significant amount of structural change over recent decades. The 1980s saw a period of rapid reform, with the floating of the dollar, removal of restrictions on credit creation, interest rates, foreign capital inflows and other broader reforms around market pricing and removal (or lowering) of tariffs and subsidies. A great degree of research on structural change and time series econometrics has been conducted over the past decade, and this thesis has sought to make an original contribution to the literature by applying some of these techniques.

Chapter 3 discussed the construction of the balance of payments – which represents transactions between Australian households and businesses with the rest of the global economy. Following this, the dynamics of the current account were considered, which began by deriving the Mundell-Fleming approach to explaining the current account. It was noted that the short-run comparative statics of this model are conducive to explaining the twin deficits proposition – where an expansionary fiscal policy results in a current account deficit. However, this approach is limited in that it can only describe the short-run effects of economic policies on the current account balance and not the long-run results that arise from the interaction of stocks and flows. Given these deficiencies, more dynamic current account representations have been developed for explaining the long-run evolution of the current account; particularly for situations where countries may run persistent current account surpluses or deficits (such as Australia). Chapter 3 then derived the intertemporal approach to the current account – which views the current account balance as the outcome of forward-looking dynamic saving and investment decisions. In contrast to

the Mundell-Fleming approach, the dynamics of the intertemporal current account model are accommodative of longer-run considerations of public debt and private saving behaviour through the Ricardian equivalence theorem.

The theory underlying the twin deficits hypothesis and Ricardian equivalence was then discussed in Chapter 4. Both theories were popularised during the 1980s, where Martin Feldstein is usually attributed to having raised the possibility of the US fiscal and current account deficits being 'twins', while Robert Barro brought the Ricardian equivalence theorem back into prominence. Australia's current account performance was discussed – particularly with regard to how twin deficit arguments exercised a substantial amount of influence over domestic fiscal policy in the late 1980s and early 1990s.

Chapter 4 also considered the fundamental differences underlying twin deficits and Ricardian equivalence. Under both the neoclassical and Keynesian paradigms, budget deficits have real effects, with the neoclassical view focusing on the long-run effects of deficits on capital accumulation, while the Keynesian paradigm considers short-run affects and the ability of deficits to stimulate consumption and national income. Ricardian equivalence diverges from both views as the theory asserts that deficits merely postpone taxes, and through the action of altruistically motivated individuals, budget deficits have no real affects on the economy – including the current account. It was again noted that the Ricardian equivalence theorem is more closely aligned with the intertemporal approach to the current account, where individuals optimise consumption over long time horizons, and the current account ultimately reflects the outcome of forward-looking saving and investment decisions.

Structural change in Australia – particularly financial liberalisation – was also discussed in Chapter 4. It was noted that financial deregulation, and integration into global capital markets, may have dampened the ability of fiscal policy to influence domestic interest rates, the exchange rate, and potentially lessening investment crowding out effects. As private credit markets have also become more developed, access to personal credit has improved – providing households with a greater ability to smooth consumption.

Chapter 5 outlined the analytical model, which attempts to explain the extent to which private saving responds to changes in government saving. While this framework suggests that the model lends itself towards explaining Ricardian equivalence effects, it can also be considered as a broad measure of the impact of fiscal policy on short- and long-run aggregate demand. The analytical model took the following functional form:

$$S_t^{priv} = \alpha_0 + \beta_0 S_t^{pub} + \phi_0 Z_t + e_t \qquad 8.1$$

where S_t^{priv} and S_t^{pub} denoted the ratios of net household plus net corporate saving (which gives total net private saving) to GDP, and the ratio of net general government saving to GDP, and Z_t is a vector of control variables which included: income; the real interest rate; inflation; unemployment; welfare safety nets; the terms of trade; and proxies for financial openness and wealth.

Chapter 5 also discussed how official measures of saving in Australia relate to the economic concept of saving. Similarly, the measurement of financial openness and wealth effects was also considered. Previous empirical studies, particularly those that focus on Australia, have not paid a great deal of attention to the measurement of these variables, and this thesis is making an original contribution to the literature by providing a more detailed consideration of this.

The time series properties of the data were examined in Chapter 6 – particularly with reference to the structural changes that have shaped the Australian economy. The chapter analysed the recent developments of unit root testing in the presence of structural breaks. Methodologies such as the Zivot and Andrew's (1992) test, Perron's (1997) Innovational Outlier (IO) and Additive Outlier (AO) models; along with the Lee and Strazicich (2003) Minimum Lagrange Multiplier Unit Root Tests were considered. Following this, conventional Dickey-Fuller and the Lee and Strazicich one- and two-break unit root tests were applied to the data. Results from all three tests unanimously concluded that the ratio of private saving to GDP in Australia is a stationary time series, while the other series contained a unit root with at least one structural break.

Regarding the timing of the endogenously-determined structural breaks from the Lee and Strazicich procedure, results indicated that a number of variables contain structural breaks around the 1980s. Other significant structural breaks appeared to coincide with the 1970s oil price (terms of trade) shocks and high inflation periods, and the sharp economic downturn of the early 1990s. The remainder of Chapter 6 considered the timing of these structural breaks in more detail, and how these accord with *a priori* expectations.

The estimation of the analytical model in Chapter 7 was conducted with time series techniques that allow for the calculation of both long- and short-run dynamics. The long-run relationship among the variables was first tested using the bounds testing approach to cointegration. However, conventional methods for estimating cointegrated models typically rely on the assumption that all variables entering a model are integrated of order 1, and also do not account for possible structural breaks in the data. Considering this, the autoregressive distributed lag procedure (ARDL) was then used to estimate the analytical model as this technique enables the estimation of both long- and short-run (error correction) coefficients within one equation – regardless of the order of integration of the variables being considered. This is critical as the stationarity testing undertaken in Chapter 6 unanimously suggested that private saving is a stationary time series.

Results suggested a long-run private saving offset close to one half and between -0.25 and -0.40 in the short run. While this indicates that there is no full Ricardian response to changes in the fiscal stance, there is however evidence to suggest some partial offsetting behaviour. The results also implied that fiscal policy does elicit some impact on the real economy – which will be partly offset by increased private saving or other crowding out effects. Lower short-run offsets revealed through the error correction mechanisms indicate that nominal and real frictions and/or rigidities prevent some proportion of the offsetting behaviour occurring more quickly. However, the results in Chapter 7 also suggested that such rigidities appear to have lessened as the economy has undergone significant economic reform. Two extreme values estimated on the short-run coefficient on government saving (-0.25 and -0.40) correspond with the two subsamples for the periods 1959:3-1983:4 and 1984:1 2006:2 respectively.

Results in Chapter 7 also indicated that fiscal policy can elicit some impact on the real economy, with the range of private saving offsets above inferring a fiscal impact of around 0.5 in the long-run, and between 0.6 and 0.75 in the short term – implying that changes in the fiscal stance only partially impact aggregate demand. Formally, a one per cent deterioration in the ratio of government saving to GDP causes output to increase by around 0.5 per cent in the long run, and between 0.6 and 0.75 per cent in the short run. However, Chapter 7 noted that these fiscal impacts are only an indirect estimate of short- and long-run fiscal multipliers in Australia (derived from the coefficient on government saving). Nevertheless, these indirect estimates of a fiscal multiplier for Australia are consistent with the international studies surveyed in Chapter 2 – which tend to estimate fiscal multipliers between 0.5 and 1.5.

As noted above, the lower short-run offsets revealed through the error correction mechanisms indicate that nominal and real frictions or rigidities in the economy prevent some proportion of the offsetting behaviour occurring more quickly. This would be consistent with Keynesian models, and suggests that fiscal policy has a greater ability to influence the real economy over the short term (particularly where some households are liquidity constrained). While full Ricardian equivalence has not been observed in the results, they suggest that over the longer-term, households and organisations are more forward-looking, and exhibit some partial Ricardian behaviour.

Results in Chapter 7 also indicated that a one per cent increase in the ratio of household disposable income to GDP (*Y*) increases the ratio of private saving to GDP by 0.34-0.44 per cent in the long run (implying a marginal propensity to consume around 0.6), and by 0.2-0.5 in the short run. Across the estimations, the impact of rising unemployment on private saving appears to be only temporary, as the coefficient on this variable was generally only statistically significant in the short-term error correction results. Additionally, the significant coefficient for the ratio of social assistance payments to household gross disposable income (*AS*) indicated that the existence of a welfare safety net has lowered the rate of private saving (possibly due to reduced incentives for precautionary saving). Estimates on this coefficient suggest that a one per cent increase in the ratio of household

assistance payments to GDP lowers the ratio of private saving by 0.24-0.44 per cent in the long run.

Chapter 7 also discovered that the coefficients on real interest rates (*R*) and inflation (*INF*) were not statistically significant in any of the estimations. This finding could be explained by households allocating a proportion of their saving through the family home, and more recently through superannuation and equity investments.

A critical question for this thesis has been the extent to which the development of the financial sector and associated integration into global capital markets may have dampened the impact of fiscal policy on the real economy. The long-run coefficient on government saving over the two subsamples estimated in Chapter 7 did not provide any clear indication that this may be occurring (both sets of estimations yielded long-run coefficients of around -0.40 per cent). However, the short-run error correction coefficients were markedly different, with the second subsample estimation yielding a short-run private savings offset that was close to that obtained over the long run.

The two subsample estimations in Chapter 7 also appeared to confirm increased linkages between Australia and the global economy. The coefficient on net foreign liabilities (*FLIB*), which was taken as a proxy for financial market openness, was statistically insignificant, and dropped from the first subsample. However, this coefficient was statistically significant in the second subsample, and suggests that greater access to international capital has lowered private saving. The coefficient on the terms of trade (*TOT*) was also higher in the second subsample, potentially indicating that Australia has derived higher income from commodities over this period, and also that the removal of market distortions (such as tariffs) has delivered greater pass-through of international prices.

Considering the four structural breaks that were identified in Chapter 6, only the dummy variable on the 1990s recession was shown to have had a statistically significant (negative) impact on the level of private saving in Australia. Structural breaks coinciding with the 1960s resources boom (*B1960*), the expansion of social welfare programmes, oil prices shocks and inflation in the 1970s (*B1973*), and the

floating of the Australian dollar and financial market reforms (*B1984*) were not statistically significant in any of the long- and short-run estimations.

Chapter 7 then turned to the hypothesis that was presented in the introductory chapter:

> *Does fiscal policy influence private saving behaviour in a manner that is consistent with Ricardian equivalence, thus mitigating the effects of fiscal policy, or does fiscal policy exert a substantial influence on the Australian economy – invoking effects on the balance of payments consistent with the twin deficits hypothesis?*

Chapter 7 sought to test this hypothesis by focusing on the coefficient on government saving, β_i. It was noted that where $\beta_i = 0$, changes in the government's fiscal stance have no impact on private saving, implying that the twin deficits hypothesis may operate. This hypothesis was rejected throughout Chapter 7 wherever the coefficient on government saving was shown to be statistically significant. As this coefficient was consistently found to be statistically significant, the hypothesis that fiscal policy influences the economy in a manner consistent with the twin deficits hypothesis was rejected.

The hypothesis of a strict private savings offset (Ricardian equivalence) was represented as $\beta_i = -1$, controlling for the other private saving determinants. Chapter 7 noted that a negative coefficient on public saving, but statistically less than 0: $(-1 < \beta_i < 0)$, would indicate a partial saving offset, and that movements in the fiscal stance have some measurable impacts on the wider economy. The hypothesis that fiscal policy influences the economy in a manner consistent with the Ricardian equivalence theorem was rejected, as the null hypothesised value of -1 did not lie within the confidence intervals.

8.1.1 Contribution to the literature

Results in this thesis have indicated that while full Ricardian equivalence has not been observed, the estimations conducted in Chapter 7 suggest that over the longer

term, households and organisations are more forward-looking, and exhibit some partial Ricardian behaviour. Nevertheless, the results also indicate that fiscal policy does have some ability to affect real economic activity.

The original contributions to the literature from this thesis include:

- testing the relationship between private saving and the general government's fiscal position in Australia, and to what extent this relationship is consistent with the Ricardian equivalence theorem;
- providing a more up-to-date analysis on the efficacy of fiscal policy in Australia;
- accounting for structural change, and determining the time series properties of the data through endogenous structural break tests;
- considering the statistical measurement of private saving in Australia, and introducing proxies for household wealth into the analysis;
- estimating the model through the ARDL approach to cointegration, which provided the flexibility to accommodate stationary time series data, the incorporation of structural breaks, and a long data sample; and
- has explored the impact of more open financial markets on the efficacy of fiscal policy in Australia.

Chapter 2 highlighted that very little research has been produced for Australia with regard to the efficacy of fiscal policy, Ricardian equivalence and the twin deficits hypothesis, and that previous empirical work is now extremely dated. This thesis has provided a more up-to-date analysis on the effectiveness of fiscal policy in Australia, and whether private saving behaviour is consistent with Ricardian equivalence. These results are relevant for analysing recent fiscal policy debates in Australia, including attempts at discretionary fiscal policy in response to the global economic downturn over 2008 and 2009.

Measures of saving in Australia, particularly how these relate to the economic concept of saving, were discussed in Chapter 5. The measurement of financial openness and wealth effects was also considered in this chapter. Previous empirical studies (particularly for Australia) have not paid a great deal of attention to the measurement of these variables, and the thesis has made an original contribution to the literature by providing a more detailed consideration of this. This should benefit future empirical research by demonstrating the importance of using correct statistical data for saving in Australia, and knowing the potential limitations of this. Similarly, the proxies used for wealth effects would also be of benefit to other empirical work.

Chapter 6 demonstrated the importance of considering structural breaks when conducting time series analysis on Australian macroeconomic data, with the results indicating that all of the time series considered in this thesis contain at least one structural break. This chapter also considered the timing of the structural breaks in some detail – particularly for consistency with major economic events and policy changes. As the results have found structural breaks in all of the time series considered here, this suggests that other macroeconomic time series in Australia are also likely to contain structural breaks, and future empirical research on time series data should take this into consideration.

The application of the ARDL procedure in Chapter 7 allowed for the calculation of long- and short-run dynamics – particularly over the long sample considered in this thesis (1959:3-2006:2). Previous empirical studies that have considered Australia have not undertaken modelling with such a large sample. Second, the ARDL procedure has also provided the flexibility to incorporate the structural breaks that were identified in Chapter 6, which is also a new contribution to the empirical literature for Australia.

Finally, results in this chapter make a new contribution to the literature by considering how greater integration into international financial markets may have impacted on the efficacy of fiscal policy in Australia. This was undertaken by: using net foreign liabilities to GDP as a proxy for financial openness; including a breakpoint dummy variable in the full sample estimations that coincided with the floating of the Australian dollar in December 1983; and estimating a split sample that

around this point (1959:3-1983:4 and 1984:1-2006:2). While there are various approaches for measuring financial openness, the results here have indicated that greater access to financial markets has had an impact on the efficacy of fiscal policy, and that future empirical research would also need to take this into consideration.

8. 2 Policy implications

The results from this thesis are relevant to two contemporary fiscal policy issues in Australia:

- debates over discretionary fiscal policy and fiscal activism; and
- medium to long-run fiscal sustainability.

8.2.1 Discretionary fiscal policy

Dynamic market economies are often subject to some degree of instability, as well as gradual (and sudden) structural change. However, excessive macroeconomic instability can impose significant economic and social costs. For example, in an overheated economy, where aggregate demand exceeds aggregate supply, inflation will result. Conversely, in a sluggish economy, aggregate supply exceeds aggregate demand, which can lead to business failures and unemployment.

Macroeconomic stabilisation policies attempt to control the volatility of the business cycle without diminishing the ability of the economy to raise living standards over time. In most modern, advanced economies, monetary policy has assumed the primary role for macroeconomic stabilisation, usually via medium-term inflation targeting.

With regard to fiscal policy, the current consensus has been to let the economy's automatic stabilisers operate unabated when faced with cyclical economic shocks (see for example, Krugman: 2005). This means that during a cyclical upturn in the real economy, revenues are allowed to increase (and cyclically related expenditures, such as unemployment benefits, to decline) in the short term without undertaking structural measures to offset such cyclical effects and vice-versa during a downturn.

Monetary policy (inflation targeting) is then tasked with dealing with short-term deviations in output and inflation.

One reason for the move to adopting monetary policy for managing short-term economic fluctuations was due to previous experience with the use of fiscal policy for demand management purposes. Over previous decades, fiscal policy in Australia and other countries was often used for activist demand management – particularly during the 1950s and 1960s – and to a lesser extent through the 1980s and 1990s. While activist fiscal policy was popular, difficulties with lags (recognition, policy formulation and implementation) can lead to pro-cyclical outcomes and excessive debt accumulation. Additionally, previous experience in many countries has also shown that it is extremely difficult to use discretionary fiscal policy to fine-tune aggregate demand for stabilisation purposes (see for example, Elmendorf & Furman: 2008). From this perspective, the role of fiscal policy in Australia has shifted to a focus upon medium-term sustainability, and as far as possible, limiting changes in the fiscal stance from one year to the next to ensure that such changes do not create excessive short-term instability.

However, fiscal policy still has the ability to exert a marked impact on macroeconomic stability through discretionary fiscal policy (or fiscal 'activism') – which includes deliberate changes to expenditure or revenue in order to stimulate or dampen economic activity. Using fiscal policy in this manner is particularly relevant in a number of circumstances which include: deep and protracted economic downturns; situations where monetary policy reaches the zero-bound constraint on nominal interest rates; and liquidity traps (Krugman: 2005).

Two recent episodes of discretionary fiscal policy in Australia include personal income tax cuts introduced by the Howard Government, and attempts at fiscal activism by the Rudd Government.[55] While both policies were introduced under different economic circumstances, they have generated considerable debate.

[55] While recent discretionary fiscal stimulus by the Rudd Government is outside the data sample considered in this thesis, the results are still likely to be relevant to the policy debate.

8.2.1.1 The Howard Government's income tax cuts

With increasing revenues and consistent fiscal surpluses (which had averaged around one per cent of GDP over 2000-2007), the Howard Government embarked on a series of income tax cuts, of which the first tranche was announced in the 2003-04 Budget. Critics argued that this was an irresponsible use of fiscal policy, as the tax cuts would only add to aggregate demand – leading to higher inflation and interest rates in an economy that was considered to be operating at close to potential.

The similar but opposite signs of the estimated long-run coefficients on public saving and disposable incomes derived from the full sample estimation in Chapter 7 (Table 7.10) suggest an interesting implication for the macroeconomic impact of the Howard Government's tax cuts. First, re-write equation (8.1) as:

$$S_t^{priv} = \alpha_0 + \beta_0 S_t^{pub} + \phi_0 Y^d + \sum_{i=1}^{k} \phi_i Z_{ti} + e_t \qquad 8.2$$

or

$$S_t^{priv} = \alpha_0 + \beta_0 \left(T_t - G_t\right) + \phi_0 \left(Y_t - T_t\right) + \sum_{i=1}^{k} \phi_i Z_{ti} + e_t \qquad 8.3$$

The long-run effect of a tax cut can thus be derived as:

$$\frac{dS_t^{priv}}{dT_t} = \beta_0 - \phi_0 \qquad 8.4$$

Considering the coefficient estimates in Table 7.10, equation (8.4) infers that approximately 80 per cent of these tax cuts were saved – largely mitigating any adverse impacts on inflation.

8.2.1.2 The Rudd Government's fiscal stimulus

More recently, sharp falls in output associated with the global financial and economic crisis in 2008 and 2009 has seen the Rudd Government implementing a number of discretionary spending measures in an attempt to support economic activity. These measures have included direct payments and transfers to individuals

and households, tax credits for business and infrastructure spending (Commonwealth of Australia: 2009a).

Evaluating the potential impacts of this stimulus is not straightforward – particularly as a large proportion of this has been directed at households on low incomes (as opposed to the Howard Government tax cuts, which were broadly-based across all income tax scales). These lower income households may be credit constrained and likely to have a higher marginal propensity to consume out of each dollar of income (particularly in the short term). Considering these factors, the bulk of the fiscal stimulus may well have been spent by these households. However, the same may not be true for other households. With the stimulus measures causing a deterioration in public saving, other households not directly benefiting from any stimulus transfer payments may have inferred that this deterioration in the Commonwealth's fiscal position would require higher taxes in the future (or reduced expenditure on government services); and hence saved an additional portion of their income. Additionally, the Government's move could have been viewed as signalling a marked deterioration in the economy[56] – which may also have led to an increase in precautionary saving among some households. To the extent these effects may have occurred, the increased saving would act to mitigate any stimulus effects from these policies.

While results in Chapter 7 suggest that households are not fully Ricardian, fiscal policy can nonetheless exert some impact on real economic activity. However, it is unreasonable to expect that any discretionary fiscal policy actions will have a one-for-one impact on the real economy. To the extent that households anticipate higher (lower) taxes in the future, they will partially offset any policy action through higher (lower) saving. Where policymakers see a need for discretionary policy, it is important to consider the composition of expenditure, as policies directed at particular sectors or households will likely generate different impacts.[57]

[56] Particularly where the government is perceived to have superior information.

[57] Other leakage through expenditure on imports (for example) also needs to be considered.

While there is a role for activist fiscal policy under extreme economic circumstances, the results from this thesis indicate that fiscal policy will only exert a partial impact on activity. It would take substantial movements in the fiscal stance (greater than one per cent of GDP) to have a marked impact on the real economy. Such large movements in the fiscal position only exacerbate the risks of poor policy, which includes a risk of excessive debt accumulation, entrenched expenditures and pro-cyclical impacts (arising from poorly timed policy).

8.2.1.3 Returning the budget to balance

The global financial crisis and economic downturn of 2008 and 2009 has seen the Federal Government's budget position move from an underlying cash surplus of 1.7 per cent of GDP in 2007-08 to a deficit of -2.3 per cent of GDP in 2008-09 (due to the operation of the automatic stabilisers and the implementation of discretionary fiscal stimulus). Over the forward estimates, a deficit of -4.9 per cent of GDP is forecast for 2009-10, with a return to budget surplus projected around 2015. Net government debt is forecast to peak at around 14 per cent of GDP in 2013-14, and to steadily decline thereafter (Commonwealth of Australia: 2009a, 2009b).

In the short term, the challenge for the Rudd Government has been to support aggregate demand and employment so as to minimise the social and economic costs of the economic downturn. Focusing upon the medium to longer term, the challenge for fiscal policy is to return the budget to a more sustainable footing, and to ensure that recent increases in debt do not jeopardise the economy's long-term performance. Policies that address the short-term challenge of stimulating aggregate demand, allow resources to be allocated to their most productive uses, and invest in future productive capacity will help to achieve these goals.

As noted in Chapter 4, the Rudd Government has maintained a commitment to the medium-term fiscal frameworks established under the 1996 Charter of Budget Honesty. The Rudd Government's medium-term fiscal strategy involves: achieving budget surpluses, on average, over the medium term; keeping taxation as a share of GDP on average below the level for 2007-08; and improving the Government's net financial worth over the medium term. Further to this, the deterioration in the fiscal position prompted the Rudd Government to also introduce a number of

supplementary objectives to its fiscal strategy. This involves a commitment to allowing the level of tax receipts to recover naturally as the economy strengthens, and holding real growth in spending to 2 per cent per annum, once economic growth is above-trend, until the budget returns to surplus (Commonwealth of Australia: 2009a, 2009b).

While these medium-term frameworks provide an important anchor for achieving and maintaining fiscal sustainability, they also deliver a degree of credibility and certainty on the likely course of fiscal policy going forward. The International Monetary Fund (2009) has also noted that macroeconomic strategies (which include fiscal frameworks) are essential for maintaining confidence in fiscal solvency and for financial stability. The Governor of the Reserve Bank of Australia (Stevens: 2009) also draws attention to this, and has noted that the policy stimulus delivered over 2008 and 2009 needs to be accompanied by a credible story about how governments will keep their finances on a sustainable footing over time.

The Federal Government's fiscal stimulus has included a large amount of spending on infrastructure and other investments, totalling around $55 billion (around 4½ per cent of GDP) over the four years from 2008-09 through 2011-12 (Commonwealth Budget: 2009a). These measures have been designed to add to the economy's overall productive capacity, and to the extent to which these measures enhance productivity, they will raise the level of GDP over the medium to longer term (and will assist in returning the budget to balance and paying-down sovereign debt).[58] [59]

Further to the government's investment measures, a commitment to implementing further economic reforms will also boost the economy's productive capacity (and lift productivity) over time. This can include microeconomic reforms that remove externalities, improve pricing signals in the economy, and promote competition. At the macroeconomic level, this will include maintaining Australia's medium-term

[58] Assuming there are no further deteriorations in the Government's structural budget position.

[59] Public spending on productive infrastructure will only raise national income when its rate of return exceeds the servicing cost of the borrowing required to fund it.

frameworks for monetary and fiscal policy (and preserving their credibility), ensuring that financial markets are subject to sound prudential oversight, and continuing Australia's relatively good access to international capital and foreign direct investment.

8.2.2 Fiscal sustainability

While the results in this thesis suggest that fiscal policy only has a limited ability to influence short-term economic activity, fiscal policy may be better directed at securing the medium to long-term sustainability of government finances. Medium- to long-term fiscal sustainability is essentially referring to the intertemporal budget constraint faced by governments, which was discussed in Chapter 4 (equation 4.10):

$$g_0 + g_1(1+r_0)^{-1} + (1+r_{-1})b'_{-1} = \tau_0 + \tau_1(1+r_0)^{-1} \qquad 8.5$$

Importantly, the government's intertemporal budget constraint states that the net present value of tax revenue is equal to the net present value of government expenditure plus the initial value of government debt. Establishing and maintaining fiscal discipline will ensure that fiscal policy satisfies the intertemporal budget constraint over the medium to longer term. Such discipline requires that governments maintain fiscal positions that are consistent with macroeconomic stability and sustained economic growth, and can include policies such as: ensuring that the automatic stabilisers are allowed to operate; avoiding large swings in the fiscal stance; minimising distortionary tax and expenditure policies; and avoiding excessive borrowing and debt accumulation. The policies mentioned in the previous section, such as continuing to pursue microeconomic reform, will also help to achieve fiscal sustainability.

8.2.3 Other policy implications

In addition to the fiscal policy implications discussed above, results from the estimations in Chapter 7 are also potentially relevant to a number of other policy issues facing Australia. These include policies with regard to the resources sector and Australia's terms of trade, and taxation policies that affect saving and investment.

8.2.3.1 Australia's terms of trade

With regard to financial openness and the terms of trade, the higher coefficient on the terms of trade (*TOT*) in the second subsample indicates that Australia has been deriving higher income from commodities since the early 1990s. The removal of market distortions (such as tariffs) is also likely to have delivered greater pass-through of international prices.

From 2004 through to late 2008, rapid industrialisation in China (and to a lesser extent in India) saw a marked increase in demand for Australia's bulk commodity exports (coal and iron ore) as well as energy (oil and natural gas) and base metals. This surge in demand saw a 50 per cent increase in Australia's terms of trade through to June 2008.[60] This expansion in the terms of trade led to policymakers questioning whether this large shift in relative prices was burdening Australia with a 'resources curse' or 'Dutch disease' that would lead to some degree of deindustrialisation across the economy and slower growth in the non-resource sectors (see for example, Henry: 2006). Where the economy is capacity constrained, Garton (2008) notes that the stimulus to demand from rises in the terms of trade also adds to inflationary pressures, requiring some offsetting mechanism to moderate demand growth. Under the macroeconomic policy framework in operation in Australia this largely occurs through higher interest rates and a higher exchange rate.

As noted by Macfarlane (2004) sound institutional frameworks are a crucial ingredient for sustained economic performance, and are far more important than distance, geography or the presence of resources. For Australia, which already has relatively sound institutional frameworks, this includes ensuring that: appropriate restraints are placed on governments and other organisation and institutions from exercising arbitrary power; property rights are enforced; and ensuring that people have some degree of equal opportunity to access education and investment opportunities.

Similar policy responses are raised by the Commonwealth Treasury (2004), which has noted that developed countries with strong resource sectors should focus on

[60] The largest increase in Australia's terms of trade since the Korean War boom in the early 1950s.

improving the prospects for stable, transparent and competitive markets, and addressing market failures. More specifically, this can also include: liberalising investment and trade to encourage competition and greater efficiency (which includes unfettered access to foreign direct investment); making decisions about price signals and whether subsidies are appropriate or prices should pass through to consumers; and requiring full disclosure of transactions related to the resources sector (Commonwealth Treasury: 2004).

8.2.3.2 Taxation policies and saving

Fiscal policy, through the tax system, has a range of impacts on saving and investment incentives. These occur because of the interaction of the tax treatment of different assets, different forms of financing, and different types of organisations. The different tax treatments across these areas can be expected to affect saving and investment decisions across the economy. Related to this is a recurring policy debate in Australia regarding rates of saving (particularly relative to other advanced economies), and whether there are distortions to saving inherent in the tax and transfer system.

Results in Chapter 7 noted that the significant coefficient for the ratio of social assistance payments to household gross disposable income (*AS*) indicates that the existence of a welfare safety net has lowered the rate of private saving in Australia. While it was noted that this may be occurring due to reduced incentives for precautionary saving, Australia's system of means-tested aged pensions, health benefit cards and other retirement income support result in high effective marginal tax rates on saving for retirement (especially for those on low- and middle-incomes).

In addition to these points, Freebairn (2000) has noted that the Australian tax system also likely distorts intertemporal consumption and saving decisions towards too high a level of current consumption. While the tax system is an income tax system, some saving receives a consumption-base treatment, which includes savings invested in owner-occupied housing and business investment in human capital. Other saving receives close to a consumption-base treatment, including superannuation; and there are concessions for the returns on other forms of saving, including the benefits of deferral and lower tax rates on capital gains. However, a number of savings options

receive an income tax treatment, including saving via financial instruments and business equity. To the extent these income-taxed forms of saving represent marginal saving, the present tax system distorts decisions against private sector saving (Freebairn: 2000).

The discussion above has highlighted a number of features of Australia's tax and transfer system that distort saving and investment decisions. Further reforms in these areas should be directed at addressing these distortions. While these reforms will improve the transparency of the tax and transfer system, they will also enhance the efficacy of fiscal policy. The Australian Government is currently undertaking a review of Australia's tax system, which is expected to present its findings in late 2009.

8. 3 Directions for further research

The endogenous unit root tests considered in this thesis allowed for the possibility of up to two structural breaks in the data. It is conceivable that two or more structural breaks may in fact be present in long macroeconomic time series – particularly given that the data considered in this thesis was from 1959-60 onwards. However, present techniques for testing unit roots in time series data only consider at most two structural breaks – namely the procedure developed by Lee and Strazicich (2001, 2003) that was presented in Chapter 6. While a procedure that tests for multiple structural breaks in time series has been developed by Bai and Perron (2003), this technique does not consider the unit root hypothesis. Future advancements in econometric techniques would allow for the possibility of multiple structural breaks in the unit root tests.

Similar issues regarding multiple structural breaks also hold for cointegration techniques. Gregory and Hansen (1996) noted that conventional cointegration tests can have low power in the presence of structural breaks, and subsequently developed a procedure that provides a suggested point for an unknown structural break and corresponding test statistics that take the structural break into account. However, the Gregory and Hansen method considers only one structural break and assumes that all data series are integrated of order one – making it unsuitable for the empirical analysis undertaken here. Given the current limitations in estimation techniques, the

thesis sought to account for structural breaks in the ARDL estimations through the use of dummy variables. Advances in cointegration techniques that can accommodate multiple endogenous structural breaks, and a combination of stationary and non-stationary data, would allow for a more robust application of the analytical framework considered here.

Despite allowing for long- and short-run dynamics through the ARDL approach, the analytical framework has only been a partial analysis of the relationship between changes in the government's fiscal stance and private saving. Methodologies such as structural vector auto regressions (SVAR), or large dynamic stochastic general equilibrium models (DSGE) could be employed to consider the hypotheses considered in this thesis, and would allow for greater linkages and dynamics to be considered. The International Monetary Fund's Global Integrated Monetary and Fiscal Model (GIMF) would also be well suited for this type of analysis.

Finally, the diagnostic tests presented for all of the ARDL results in Chapter 7 indicated that the models were correctly specified, did not suffer from serial correlation, and had residuals that were normally distributed. However, fiscal policy and economic activity are endogenous – depending on each other and usually occurring simultaneously. The International Monetary Fund's 2008 World Economic Outlook noted that changes in the government's fiscal stance can occur through a combination of taxes, transfers and spending – which presents challenges when estimating the economic impacts of fiscal policy. While taxation, spending and transfers individually can have different effects on the economy, their relative impacts will also be determined by the prevailing economic conditions and circumstances. To some extent, these factors would account for the large variances in the estimates of fiscal multipliers that were surveyed in Chapter 2. Structural fiscal measures that attempt to strip-out those elements of taxes, transfers and expenditure that occur with the economic cycle could potentially alleviate any endogeneity issues that may occur when empirically estimating fiscal policy impacts. However, the approach in this thesis for separating long- and short-run impacts through the ARDL estimations (and accounting for the presence of structural breaks), may have helped to alleviate any endogeneity problems.

REFERENCES

Abell, J. D. 1990, Twin deficits during the 1980s: An empirical investigation, *Journal of Macroeconomics*, 12(1), 81-96.

Abeysinghe, T. & Boon, T. K. 1999, Small sample estimation of a cointegrating vector: an empirical evaluation of six estimation techniques, *Applied Economics Letters*, 6, 645-648.

Acaravci, A. & Ozturk, I. 2008, Twin deficits phenomenon: Empirical evidence from the ARDL bound test approach for Turkey, *Bulletin of Statistics and Economics*, 2, 57-64.

Afonso, A. 2005, *Ricardian Fiscal Regimes in the European Union*, Working Paper No. 558, European Central Bank.

Agenor, P. R. Bismut, C. Cashin, P. & McDermott, J. C. 1999, Consumption smoothing and the current account: evidence for France 1970-1996, *Journal of International Money and Finance*, 18, 1-12.

Ahmed, S. 1986, Temporary and permanent government spending in an open economy: Some evidence for the United Kingdom, *Journal of Monetary Economics*, 17, 197-224.

Aisen, A. & Hauner, D. 2008, *Budget Deficits and Interest Rates: A Fresh Perspective*, IMF Working Paper No. 08-42, International Monetary Fund, Washington, D.C.

Alesina, A. & Perotti, P. 1995, The political economy of budget deficits, *IMF Staff Papers*, 42(1), 1-31.

Alesina, A. 2000, The political economy of the budget surplus in the United States, *Journal of Economic Perspectives*, 14(3), 3-19.

Al-Eyd, A. J. & Barrell, R. 2005, Estimating tax and benefit multipliers in Europe, *Economic Modelling*, 22, 259-76.

Altissimo, F. Georgiou, E. Sastre, T. Valderrama, M. T. Sterne, G. Stocker, M. Weith, M. Whelan, K. & Willman, A. 2005, *Wealth and Asset Price Effects on Economic Activity*, Occasional Paper Series, No. 29, European Central Bank.

Aschauer, D. A. 1985, Fiscal policy and aggregate demand, *American Economic Review*, 75(1), 117-127.

Atkins, F. J. 2002, *Multiple Structural Breaks in the Nominal Interest Rate and Inflation in Canada and the United States*, Department of Economics Discussion Paper, 2002-07, University of Calgary.

Auerbach, A, J. 2005, *The Effectiveness of Fiscal Policy as Stabilisation Policy*, mimeo, University of California, Berkeley.

Auerbach, A. J. 2009, Implementing the new fiscal policy activism, *American Economic Review*, 99(2), 543-549.

Auerbach, A. J. 2009, *Implementing the New Fiscal Policy Activism*, Working Paper No. 14725, National Bureau of Economic Research, Cambridge, Massachusetts.

Auerbach, A. J. & Gale, B. G. 2009, *Activist Fiscal Policy to Stabilize Economic Activity*, A symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, August 20-22.

Australian Bureau of Statistics 2000, *Australian National Accounts: Concepts Sources and Methods*, Australian Bureau of Statistics, Canberra.

Australian Bureau of Statistics 2001, *Saving, Borrowing, Investment and Wealth*, Australian System of National Accounts, ABS Cat No. 5204.0, Australian Bureau of Statistics, Canberra.

Australian Bureau of Statistics 2003, *New Analytical Measures of Income Saving and Wealth*, Australian System of National Accounts, ABS Cat No. 5204.0, Australian Bureau of Statistics, Canberra.

Australian Bureau of Statistics, 2006, *Household Wealth and Wealth Distribution, Australia*, 2003-04, ABS Cat No. 6554.0, Australian Bureau of Statistics, Canberra.

Australian Securities Exchange 2007, *2006 Australian Share Ownership Study*, Australian Securities Exchange, Sydney.

Azar, S. A. 2005, Econometric diagnostics to distinguish between the IS curve and the Ricardian equivalence, *Applied Economics*, 37, 93-98.

Bachman, D. D. 1992, Why is the US current account deficit so large? Evidence from vector autoregressions, *Southern Economic Journal*, 59, 232-240.

Bagnai, A. 2006, Structural breaks and the twin deficits hypothesis, *International Economics and Economic Policy*, 3(2), 137-155.

Baharumshah, A. Z. Lau, E. & Khalid, A. M. 2006, Testing twin deficits hypothesis using VARs and variance decomposition, *Journal of the Asia Pacific Economy*, 11(3), 331-354.

Bahmani-Oskooee, M. & Payesteh, S. 1993, Budget deficits and the value of the dollar: an application of cointegration and error-correction modelling, *Journal of Macroeconomics*, 15(4), 661-677.

Bahmani-Oskooee, M. 1995, The long-run determinants of the US trade balance revisited, *Journal of Post Keynesian Economics*, 17(3), 457-465.

Bahmani-Oskooee, M. and Nasir, A. B. M. 2004, ARDL approach to test the productivity bias hypothesis, *Review of Development Economics*, 8(3), 483-488.

Bai, J. & Perron, P. 2003, Computation and analysis of multiple structural change models, *Journal of Applied Econometrics*, 18, 1-22.

Bai, J. & Perron, P. 2003, Critical values for multiple structural change tests, *Econometrics Journal*, 6(1), 72-8.

Bailey, M. J. 1971, *National Income and the Price Level*, McGraw-Hill, New York.

Ball, L. & Mankiw, N. G. 1995, What do budget deficits do?, in, *Budget Deficits and Debt: Issues and Options*, A symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, 5-55.

Banerjee, A. Lumsdaine, R. L. & Stock, J. H. 1992, Recursive and sequential tests of unit-root and the trend break hypotheses: theory and international evidence, *Journal of Business Economics and Statistics*, 10, 271-287.

Barro, R. J. 1974, Are government bonds net wealth?, *Journal of Political Economy*, 82, 1095-1117.

Barro, R. J. 1979, On the determination of the public debt, *Journal of Political Economy*, 87, 941-969.

Barro, R. J. 1981, Output effects of government purchases, *Journal of Political Economy*, 89, 1086-1121.

Barro, R. J. 1987, Government spending, interest rates, prices, and budget deficits in the United Kingdom, 1701-1918, *Journal of Monetary Economics*, 20, 221-247.

Barro, R. J. 1989, The Ricardian approach to budget deficits, *Journal of Economic Perspectives*, 3(2), 37-54.

Barro, R. J. 2009, Voodoo multipliers, *The Economists' Voice*, 6(2), 1-4.

Barro, R. J. & Redlick, C. J. 2009, *Macroeconomic Effects from Government Purchases and Taxes*, NBER Working Paper Series, No. 15369, National Bureau of Economic Research, Cambridge, Massachusetts.

Bartolini, L. & Lahiri, A. 2006, Twin deficits, twenty years later, *Current Issues in Economics and Finance*, Federal Reserve Bank of New York, 12(7).

Battellino, R. 2009, Global Monetary Developments, *Address to the 2009, Securities and Derivatives Industry Association Conference*, 28 May, Sydney.

Baunsgaard, T. & Symansky, S. A. 2009, *Automatic Fiscal Stabilizers*, IMF Staff Position Note 09/23, International Monetary Fund, Washington, D.C.

Bayoumi, T. 2000, The morning after: explaining the slowdown in Japanese growth, in *Post-Bubble Blues – How Japan Responded to Asset Price Collapse*, eds, Bayoumi, T. & Collyns, C. International Monetary Fund, Washington, D.C.

Bayoumi, T. & Sgherri, S. 2006, *Mr Ricardo's Great Adventure: Estimating Fiscal Multipliers in a Truly Intertemporal Model*, International Monetary Fund Working Paper No. 168, International Monetary Fund, Washington D.C.

Beetsma, R. Giuliodori, M. & Klaassen, F. 2008, The effects of public spending shocks on trade balance and budget deficits in the European Union, *Journal of the European Economic Association*, 6(2-3), 414-423.

Ben-David, D. & Papell, D. H. 1995, The great wars, the great crash and the unit root hypothesis, *Journal of Monetary Economics*, 36, 453-475.

Ben-David, D. Lumsdaine, R. L. & Papell, D. H. 2003, Post-war slowdowns and long-run growth: evidence from two structural breaks, *Empirical Economics*, 28(2), 303-319.

Berben, R. P. & Brosens, T. 2007, The impact of government debt on private consumption in OECD countries, *Economics Letters*, 94, 220-225.

Bergin, P. R. & Sheffrin, S. M. 2000, Interest rates, exchange rates and present value models of the current account, *The Economic Journal*, 110 (April), 535-558.

Bernanke, B. S. 2005, The global saving glut and the U.S. current account deficit, *Sandridge Lecture*, Virginia Association of Economics, Richmond, Virginia.

Bernheim, D. 1987, *Ricardian Equivalence: an evaluation of theory and evidence*, in S. Fischer, Macroeconomics Annual, pp. 263-304, National Bureau of Economic Research.

Bernheim, D. 1989, A Neoclassical perspective on budget deficits, *Journal of Economic Perspectives*, 3(2), 55-72.

Beetsma, R. Giuliodori, M. & Klaassen, F. 2008, The effects of public spending shocks on trade balances and budget deficits in the European Union, *Journal of the European Economic Association*, 6, 414-423.

Belkar, R. Cockerell. L. and Kent, C. 2007, *Current Account Deficits: The Australian Debate*, Research Discussion Paper No. 2007-02. Reserve Bank of Australia, Sydney.

Blanchard, O, J. 1985, Debt, deficits and finite horizons, *Journal of Political Economy*, 93, 223-247.

Blanchard, O. & Perotti, R. 2002, An empirical characterization of the dynamic effects of changes in government spending and taxes on output, *The Quarterly Journal of Economics*, 117(4), 1329-1368.

Blanchard, O. J. 2007, Current account deficits in rich countries, *IMF Staff Papers*, 54(2), 191-219.

Blundell-Wignall, A. and Stevens, G. 1992, *Fiscal policy in Australia: recent developments and current issues*, Current Issues in Fiscal Policy and Their Implications for the Conduct of Monetary Policy, Bank for International Settlements, 1-31.

Bruneau, C. & de Bandt, O. 1999, Consumption, savings, and fiscal policy, *American Economic Review*, Papers and Proceedings, 78, 401-407.

Buchanan, J, M. 1976, Barro on the Ricardian equivalence theorem, *Journal of Political Economy*, 84, 337-342.

Buffie, E. F. 1992, The short and long-run effects of fiscal policy, *The World Bank Economic Review*, 6(2), 331-351.

Bussière, M. Fratzscher, M. & Müller, G.J. 2005, *Productivity Shocks, Budget Deficits and the Current Account*, ECB Working Paper No. 509, European Central Bank, Frankfurt.

Byrne, J. P. and Perman, R. 2006, *Unit Roots and Structural Breaks: A Survey of the Literature*, Department of Economics Discussion Paper, 2006-10, University of Glasgow.

Caballero, R. J. & Krishnamurthy, A. 2004, *Fiscal Policy and Financial Depth*, NBER Working Paper Series, No. 10532, National Bureau of Economic Research, Cambridge, Massachusetts.

Callen, T. and Thimann, C. 1997, *Empirical Determinants of Household Saving: Evidence From OECD countries*, International Monetary Fund Working Paper, WP/97/181, International Monetary Fund, Washington D.C.

Campbell, J. and Mankiw, G. 1989, Consumption, income and interest rates, *Macroeconomics Annual*, National Bureau of Economic Research, 185-216.

Campbell, J. and Mankiw, G. 1991, The response of consumption to income: a cross-country investigation, *European Economic Review*, 35, 723-767.

Campbell, Y. 1987, Does saving anticipate declining labor income? An alternative test of the permanent income hypothesis, *Econometrica*, 55(6), 1249-1273.

Campbell, Y. & Shiller, R. J. 1987, Consumption and tests of present value models, *Journal of Political Economy*, 95(3), 1062-1089.

Carrion-I-Silvestre, J. L. & Sanso, A. 2006, Joint hypothesis specification for unit root tests with a structural break, *Econometrics Journal*, 9, 196-224.

Carroll, C. and Summers L. 1991, *Consumption growth parallels income growth: some new evidence*, National Savings and Economic Performance, Chicago University Press, 305-343.

Cashin, P. & McDermott, J. C. 1999, *Terms of Trade Shocks and the Current Account*, Research Paper No. 678, Department of Economics, The University of Melbourne.

Cashin, P. & McDermott, J. C. 1998, Are Australia's current account deficits excessive?, *The Economic Record*, 74(227), 346-361.

Cashin, P. & McDermott, J. C. 2002, Terms of trade shocks and the current account: evidence from five industrial countries, *Open Economies Review*, 13(3), 219-235.

Chaudhri, D. P. & Wilson, E. J. 2000, Savings, investment, productivity and economic growth of Australia, 1861-1990: some explorations, *The Economic Record*, 76(232), 55-73.

Christiano, L. J. 1992, Searching for a break in GNP, *Journal of Business and Economic Statistics*, 10(3), 237-250.

Christiano, L. J. Eichenbaum, M. & Rebelo, S. 2009, *When is the government spending multiplier larger?*, Northwestern University.

Clemente, J. Montañés, A. & Reyes, M. 1998, Testing for a unit root in variables with a double change in the mean, *Economics Letters*, 59, 175-182.

Comley, B. Anthony, S. & Ferguson, B. 2002, The effectiveness of fiscal policy in Australia – selected issues, *Economic Roundup*, Winter 2002, 45-72, Canberra.

Commonwealth of Australia 1985, Budget Speech, 1985-86, Australian Government Publishing Service, Canberra.

Commonwealth of Australia 1987, Budget Speech, 1987-88, Australian Government Publishing Service, Canberra.

Commonwealth of Australia 1988, Budget Speech, 1988-89, Australian Government Publishing Service, Canberra.

Commonwealth of Australia 1990, Budget Speech, 1990-91, Australian Government Publishing Service, Canberra.

Commonwealth of Australia 1991, Budget Speech, 1991-92, Australian Government Publishing Service, Canberra.

Commonwealth of Australia 1999, Budget Strategy and Outlook, Budget Paper No.1, 1999-2000, Australian Government Publishing Service, Canberra.

Commonwealth of Australia 2002, Budget Strategy and Outlook, Budget Paper No.1, 2002-2003, Australian Government Publishing Service, Canberra.

Commonwealth of Australia 2003, Budget Strategy and Outlook, Budget Paper No.1, 2003-2004, Australian Government Publishing Service, Canberra.

Commonwealth of Australia 2006, Budget Strategy and Outlook, Budget Paper No.1, 2006-2007, Australian Government Publishing Service, Canberra.

Commonwealth of Australia 2007, Budget Strategy and Outlook, Budget Paper No.1, 2007-2008, Australian Government Publishing Service, Canberra.

Commonwealth of Australia 2008, Budget Strategy and Outlook, Budget Paper No.1, 2008-2009, Australian Government Publishing Service, Canberra.

Commonwealth of Australia 2009a, Budget Strategy and Outlook, Budget Paper No.1, 2009-2010, Australian Government Publishing Service, Canberra.

Commonwealth of Australia 2009b, Final Budget Outcome, 2008-09, Australian Government Publishing Service, Canberra.

Commonwealth Treasury 1999, The measurement of saving in Australia, *Economic Roundup*, Spring 1999, 21-50, Canberra.

Commonwealth Treasury 2004, *Effective Resource Management – Policy Considerations*, Background paper, Canberra.

Congressional Budget Office 2008, *Options for Responding to Short-Term Economic Weakness*, January, Washington. D.C.

Cooper, D. N. 2001, Is the US current account deficit sustainable? Will it be sustained?, *Brookings Papers on Economic Activity*, 1, 217-226.

Corbo, V. and Schmidt-Hebel, K. 1991, Public policies and saving in developing countries, *Journal of Development Economics*, 36, 89-115.

Corden, W. M. 1991, Does the current account matter? The old view and the new, *Economic Papers*, 10, 119.

Corsetti, G. & Muller, G. J. 2006, Twin deficits: squaring theory, evidence and common sense, *Economic Policy*, October, 597-633.

Cotis, J. Coppel, J. & de Mello, L. 2006, Is the United States prone to "overconsumption"?, in, *The Macroeconomics of Fiscal Policy*, eds, Kopcke, R, W. Tootell, G. & Triest, R, K. MIT Press, Cambridge, Massachusetts.

Creel, J. & Sawyer, M. 2009, *Current Thinking on Fiscal Policy, Palgrave Macmillan*, London.

Darrat, A. F. 1988, Have large budget deficits caused rising trade deficits?, *Southern Economic Journal*, 54, 879-887.

Dawson, J. W. & Strazicich, M. 2006, *Time Series Tests of Income Convergence With Two Structural Breaks: An Update and Extension*, Working Papers, Department of Economics, Appalachian State University.

De Arcangelis, G. & Lamartina, S. 2003, *Identifying Fiscal Shocks and Policy Regimes in OECD Countries*, European Central Bank Working Paper No. 281.

Deng, A. & Perron, P. 2006, *A Comparison of Alternative Asymptotic Frameworks to Analyse a Structural Change in a Linear Time Trend*, Working Paper, Department of Economics, Boston University.

Dewald, W. G. & Ulan, M. 1990, The twin-deficit illusion, *Cato Journal*, 9(3), 689-707.

Diamond, P. A. 1965, National debt in a Neoclassical growth model, *American Economic Review*, 5(1), 1126-1150.

Dickey, D. A. & Fuller, W, A. 1979, Distribution of the estimators for autoregressive time series with a unit root, *Journal of the American Statistical Association*, 84(3), 427-431.

Dixon, H. 1999, Controversy: exchange rates and fundamentals, *The Economic Journal*, 109, 652-654.

Dornbusch, R. 1976, Expectations and exchange rate dynamics, *Journal of Political Economy*, 84, 1161-1175.

Dornbusch, R. Fischer, S. & Kearney, C. 1996, *Macroeconomics: Australian edition*, McGraw Hill, Sydney.

Drakos, K. 2001, Testing the Ricardian equivalence theorem: time series evidence from Greece, *Journal of Economic Development*, 26(1), 149-160.

Dukpa, K. & Perron, P. 2006, *Unit Root Tests for a Break in the Trend Function at an Unknown Time Under Both the Null and Alternative Hypotheses*, Working Paper, Department of Economics, Boston University.

Edelberg, W. Eichenbaum, M. & Fisher, J, D, M. 1999, Understanding the effects of a shock to government purchases, *Review of Economic Dynamics*, 1, 166-206.

Edey, M. & Britten-Jones, M. 1990, Saving and investment, *The Australian Macro-Economy in the 1980s*, Reserve Bank of Australia, 79-145.

Edey, M. & Gower, L. 2000, *National Saving: Trends and Policy*, paper presented to the Reserve Bank of Australia conference: The Australian Economy in the 1990s, 24-25 July, Sydney.

Edwards, S. 1996, Why are Latin America's saving rates so low? An International Comparative Analysis, *Journal of Development Economics*, 51, 5-44.

Elmendorf, D. W. and N. Gregory Mankiw. 1999. Government Debt, in, *Handbook of Macroeconomics*, Volume 1C, eds, Taylor, J. & Woodford, M., 1615-1669, Elsevier Science B.V., Amsterdam.

Elmendorf, D. W. & Reifschneider, D. 2002, Short-run effects of fiscal policy with forward-looking financial markets, *National Tax Journal*, 55(3), 357-386.

Elmendorf, D. W. & Furman, S. 2008, *If, When, How: A Primer on Fiscal Stimulus*, The Brookings Institution, Washington, D.C.

Elliott, G. Rothenborg, T. J. & Stock, J.H. 1996, Efficient tests for an autoregressive unit root, *Econometrica*, 64, 813-36.

Enders, W. & Lee, B, S. 1990, Current account and budget deficits: twins or distant cousins?, *The Review of Economics and Statistics*, 72(3), 373-381.

Engle, R. F. & Granger, C, W, J. 1987, Co-integration and error correction: representation, estimation and testing, *Econometrica*, 55(2), 251-276.

Engle, R. F. & Yoo, B. S. 1987, Forecasting and testing in cointegrated systems, *Journal of Econometrics*, 35, 143-159.

Erceg, C. J. Guerrieri, L. & Guest, C. 2005, *Expansionary Fiscal Shocks and the Trade Deficit*, International Finance Discussion Papers, Board of Governors of the Federal Reserve System.

European Central Bank 2006, Fiscal policy and financial markets, *ECB Monthly Bulletin*, February, Chapter 3.

Evans, P. 1986, Is the current account high because of large budget deficits?, *Journal of Monetary Economics*, 18, 227-249.

Evans, P. 1987, Interest rates and expected future budget deficits in the United States, *Journal of Political Economy*, 95, 34-58.

Evans, P. 1988, Are consumers Ricardian?, *Journal of Political Economy*, 96(5), 983-1004.

Evans, P. 1991, Is Ricardian Equivalence a good approximation?, *Economic Inquiry*, 29, 626-644.

Evans, P. 1993, Consumers are not Ricardian: evidence from nineteen countries, *Economic Inquiry*, 31, 534-548.

Evans, P. & Hasan, I. 1994, Are consumers Ricardian? evidence for Canada, *Quarterly Review of Economics and Finance*, 34(1), 25-40.

Evans, P. and Karras, G. 1996, Private and government consumption with liquidity constraints, *Journal of International Money and Finance*, 15, 255-266.

Feldstein, M. & Horioka, C. 1980, Domestic saving and international capital flows, *The Economic Journal*, 90, 314-329.

Feldstein, M. 1982, Government deficits and aggregate demand, *Journal of Monetary Economics*, 9, 1-20.

Feldstein, M. 1985, American economic policy and the world economy, *Foreign Affairs*, Summer, 995-1008.

Feldstein, M. 1987, Correcting the trade deficit, *Foreign Affairs*, Spring, 795-806.

Feldstein, M. 1990, *The Budget and Trade Deficit Aren't Really Twins*, National Bureau of Economic Research Working Paper Series, No 3966.

Feldstein, M. 2008, *The Tax Rebate Was a Flop. Obama's Stimulus Plan Won't Work Either*, Wall Street Journal, August 6, 2008.

Feldstein, M. 2009, Rethinking the role of fiscal policy, *American Economic Review*, 99(2), 556-559.

Fidrmuc, J. 2003, The Feldstein-Horioka puzzle and twin deficits in selected countries, *Economics of Planning*, 36, 135-152.

Fisher, I. 1930, *The Theory of Interest*, Macmillan, New York.

Flavin, M. 1985, Excess sensitivity of consumption to current income: liquidity constraints or myopia?, *Canadian Journal of Economics*, 18(1).

Fleming, M. J. 1962, Domestic financial policies under fixed and under floating exchange rates, *IMF Staff Papers*, 9(3), 369-380.

Flood, R. P. & Rose, A. K. 1999, Understanding exchange rate volatility without the contrivance of macroeconomics, *The Economic Journal*, 109, 660-672,

Freebairn, J. 1990, *Some Results from the ORANI-F Model*, Centre for Economic Policy Research, Discussion Paper No. 224, Australian National University, Canberra.

Freebairn, J. 2000, *Discussion of National Saving: Trends and Policy*, paper presented to the Reserve Bank of Australia conference: The Australian Economy in the 1990s, 24-25 July, Sydney.

Frenkel, R. P. & Mussa, M. L. 1985, Asset markets, exchange rates and the balance of payments, in, *Handbook of International Economics*, Vol 2, eds, Jones, R. W & Kenen, P, B. Elsevier Science Publishers, Amsterdam.

Frenkel, R. P. & Razin, A. 1996, *Fiscal Policies and Growth in the World Economy*, 3rd edn, MIT Press, Cambridge, Massachusetts.

Fuller, W. A. 1976, *Introduction to Statistical Time Series*, John Wiley, New York.

Fuller, W. A. 1985, Non-stationary autoregressive time series, in *Handbook of Statistics 5: Time Series in the Time Domain*, eds, E, J. Hannan, P, R, Krishnaiah. & M, M, Rao, Elsevier Publishers, Amsterdam.

Fraser, B. W. 1991, Three decades of real interest rates, *Reserve Bank of Australia Bulletin*, October, Reserve Bank of Australia.

Gale, W. G. & Orszag, P, R. 2003, Economic effects of sustained budget deficits, *National Tax Journal*, 56(3), 463-485.

Gale, W. G. & Orszag, P, R. 2004, *Budget Deficits, National Saving and Interest Rates*, Brookings Institution, Washington, D.C.

Gali, J. Valles, J. & Lopez-Salido, J, D. 2007, Understanding the effects of government spending on consumption, *Journal of the European Economic Association*, 5(1), 227-270.

Garcia, R. & Perron, P. 1996, An analysis of the real interest rate under regime shifts, *The Review of Economics and Statistics*, 78, 111-125.

Garton, P. 2008, The resources boom and the two-speed economy, *Economic Roundup*, 3, 17-29, Commonwealth Treasury, Canberra.

Genberg, H. 1988, *The Fiscal Deficit and the Current Account: Twins or Distant Relatives?*, Research Discussion Paper No. 8813, Reserve Bank of Australia.

Giorgioni, G. & Holden, K. 2003, Does the Ricardian equivalence proposition hold in less developed countries?, *International Review of Applied Economics*, 17(2), 209-221.

Glick, R. & Rogoff, K. 1995, Global versus country-specific productivity shocks and the current account, *Journal of Monetary Economics*, 35, 159-192.

Glynn, J. Perera, N. & Verma, R. 2007, Unit root tests and structural breaks: A survey with applications, *Journal of Quantitative Methods for Economics and Business Administration*, 3(1), 63-79.

Ghosh, A. R. & Ostry, J. D. 1995, The current account in developing countries: a perspective from the consumption-smoothing approach, *The World Bank Economic Review*, 9(2), 305-333.

Graham, F. C. & Himarios, D. 1991, Fiscal policy and private consumption: instrumental variables tests of the 'consolidated approach', *Journal of Money, Credit and Banking*, 23(1), 53-67.

Granger, C. W. J. & Newbold, P. 1974, Spurious regressions in econometrics, *Journal of Econometrics*, 2, 111-120.

Greenwood, J. 1983, Expectations, the exchange rate and the current account, *Journal of Monetary Economics*, 12, 543-569.

Gregory, A. W. & Hansen, B. 1996, Residual based tests for cointegration in models with regime shifts, *Journal of Econometrics*, 70, 199-226.

Gruen, D. & Sayegh, A. 2005, The evolution of fiscal policy in Australia, *Oxford Review of Economic Policy*, 21(4), 618-635.

Guest, R. S. & McDonald, I. M. 1998 The socially optimal level of saving in Australia, 1960-61 to 1994-95, *Australian Economic Papers*, 37(3), 213-235.

Guest, R. S. & McDonald, I, M. 1999, *Demographic change in Asia: The Impact on Optimal National Saving, Investment and the Current Account*, Research Paper No. 726, Department of Economics, The University of Melbourne.

Hall, R. E. 1978, Stochastic implications of the life cycle-permanent income hypothesis: Theory and evidence, *Journal of Political Economy*, 86(6), 971-987.

Hall, R. E. 2009, *By How Much Does GDP Rise If the Government Buys More Output?*, paper presented to the Brookings Panel on Economic Activity, September 10, Brookings Institution, Washington, D.C.

Hall, R. E. and Mishkin, F. 1982, The sensitivity of consumption to transitory income: estimates from panel data on households, *Econometrica*, 50, 461-481.

Hansen, B. E. 2001, The new econometrics of structural change: Dating breaks in US labor productivity, *Journal of Economic Perspectives*, 15, 117-128.

Haque, N. Pesaran, M. H. & Sharma, S. 1999, *Neglected Heterogeneity and Dynamics in Cross-country Savings Regressions*, IMF Working Paper, No. 09/128, International Monetary Fund, Washington, D.C.

Harris, D. Klaus Neusser, K. & Wälti, M. 2005, *Fiscal Policy in Open Economies*, Working Paper, Department of Economics, University of Bern.

Harvey, D. I. & Mills, T. C. 2004, Tests for stationarity in series with endogenously determined structural change, *Oxford Bulletin of Economics and Statistics*, 66, 863-894.

Hatemi-J, A. & Shukur, G. 2002, Multivariate-based causality tests of the twin deficits in the United States, *Journal of Applied Statistics*, 29(6), 817-24.

Hatemi-J, A. 2008, Tests for cointegration with two unknown regime shifts with an application to financial market integration, *Empirical Economics*, 35(3), 497-505

Hauner, D. 2006, *Fiscal Policy and Financial Development*, IMF Working Paper, No. 06-26, International Monetary Fund, Washington, D.C.

Hauner, D. & Kumar, M. S. 2006, *Fiscal Policy and Interest Rates: How Sustainable is the New Economy?*, IMF Working Paper No. 06-112, International Monetary Fund, Washington, D.C.

Hemming, R. Kell, M. & Mahfouz, S. 2002, *The Effectiveness of Fiscal Policy in Stimulating Economic Activity – a Review of the Literature*, International Monetary Fund Working Paper No. 02-208, International Monetary Fund, Washington, D.C.

Henry, K. 2006, *The Fiscal and Economic Outlook*, address to the Australian Business Economists, 16 May.

Henry, O. & Olekalns, N. 1999, *Are Private Sector Consumption Decisions Affected by Public Sector Consumption?*, Research Paper No. 687, Department of Economics, The University of Melbourne.

Hervey, J. L. & Merkel, L. S. 2000, A record current account deficit: Causes and implications, *Economic Perspectives*, 4th quarter, 2-13, Federal Reserve Bank of Chicago.

Hiebert, P. 2006, *Household Saving and Asset Valuations in Selected Industrial Countries*, RBA Research Discussion Paper, Reserve Bank of Australia, Sydney.

Himarios, D. 1989, Do devaluations improve the trade balance? The evidence revisited, *Economic Inquiry*, 27, 143-168.

Higgins, M. & Klitgaard, T. 1998, Viewing the current account defict as a capital inflow, *Current Issues in Economics and Finance*, 4(13), Federal Reserve Bank of New York.

Hoelscher, G. 1986, New Evidence on deficits and interest rates, *Journal of Money, Credit and Banking*, 18(1), 1-17.

Hossain, F. 1999, Transitory and permanent disturbances and the current account: An empirical analysis in the intertemporal framework, *Applied Economics*, 31, 965-974.

Huang, C. & Lin, S. 1993, Deficits, government expenditures, and tax smoothing in the United States: 1929-1988, *Journal of Monetary Economics*, 31, 317-339.

Hughes, B. 1990, *Twin deficits in the IMP model*, Centre for Economic Policy Research, Discussion Paper No. 224, Australian National University, Canberra.

Ilzetki, E. Mendoza, E. G. & Vegh, C. A. 2009, *How big are fiscal multipliers?*, Policy Insight No. 39, Centre for Economic Policy Research.

International Monetary Fund 2001, *World Economic Outlook: Fiscal Policy and Macroeconomic Stability*, May, International Monetary Fund, Washington, D.C.

International Monetary Fund 2002, *Japan – Selected Issues*, International Monetary Fund, Washington D.C.

International Monetary Fund 2008, *World Economic Outlook: Fiscal Policy as a Countercyclical Tool*, October, International Monetary Fund, Washington D.C.

International Monetary Fund 2009, *World Economic Outlook Update: Contractionary Forces Receding But Weak Recovery Ahead*, June, International Monetary Fund, Washington D.C.

Islam, F. M. 1998, Brazil's twin deficits: an empirical examination, *Atlantic Economic Journal*, 26(2), 121-128.

Johansen, S. 1991, Estimation and hypothesis testing of cointegration vector in Gaussian vector autoregressive models, *Econometrica*, 59(6), 1551-80.

Johansen, S. 1995, *Likelihood-Based Inference in Cointegrated Vector Autoregressive Models*, Oxford University Press.

Johansen, S. & Juselius, K. 1990, Maximum likelihood estimation and inference on cointegration – with applications to the demand for money, *Oxford Bulletin of Economics and Statistics*, 52(2), 169-210.

Johnson, D. 1986, Consumption, permanent income, and financial wealth in Canada: Empirical evidence on the intertemporal approach to the current account, *Canadian Journal of Economics*, 19(2), 189-206.

Kapetanois, G. 2005, Unit root testing against the alternative hypothesis of up to m structural breaks. *Journal of Time Series Analysis*, 26, 123-133.

Karunaratne, N. D. 1992, The twin deficits hypothesis in the Australian context, *Economica Internazionale*, 45(3/4), 330-350.

Kasa, K. 1994. Finite horizons and the twin deficits, *Economic Review*, 3, 1-28, Federal Reserve Bank of San Francisco.

Kawai, K. & Maccini, L, J. 1995, Twin deficits versus unpleasant fiscal arithmetic in a small open economy, *Journal of Money, Credit and Banking*, 27(3), 639-658.

Kearney, C. & Monadjemi, M. 1987, *Australia's Twin Deficit Problem*, Centre for Applied Economic Research, Working Paper No. 95, University of New South Wales.

Kearney, C. & Fallick, L. 1987, Macroeconomic policy and the balance of payments in Australia, *Economic Analysis and Policy*, 17(2), 131-148.

Kearney, C. & Monadjemi, M. 1990, Fiscal policy and current account performance: international evidence on twin deficits, *Journal of Macroeconomics*, 12(2), 197-219.

Keating, P. J. 1994, *Working Nation: The White Paper on Employment and Growth*, Australian Government Publishing Service, Canberra.

Kenen, P. B. 1985, Macroeconomic theory and policy: how the closed economy was opened, in, *Handbook of International Economics*, Vol 2, eds, Jones, R, W. & Kenen, P. B. Elsevier Science Publishers, Amsterdam.

Kennedy, S. Luu, N. Morling, S. & Yeaman, L. 2004, *Fiscal Policy in Australia: Discretionary Policy and Automatic Stabilisers*, paper prepared for the Treasury/Australian National University Macroeconomic Conference, Canberra.

Kim, C. H. Kim, D. 2006, Does Korea have twin deficits?, *Applied Economics Letters*, 13, 675-680.

Kim, K. H. 1995, On the long-run determinants of the US trade balance: a comment, *Journal of Post Keynesian Economics*, 17(3), 447-455.

Kim, K. D. & Perron, P. 2008, *Assessing the Relative Power of Structural Break Tests Using a Framework Based on the Approximate Bahadur Slope*, Working Paper, Boston University.

Kim, K. D. & Perron, P. 2009, Unit root tests allowing for a break in the trend function at an unknown time under both the null and alternative hypotheses, *Journal of Econometrics*, 148(1), 1-13.

Kim, S. & Roubini, N. 2008, Twin deficit or twin divergence? Fiscal policy, current account, and real exchange rate in the US, *Journal of International Economics*, 74(2), 362-383.

Kirchner, S. 2007, Fiscal policy and interest rates in Australia, *Policy*, 23(3), 11-15.

Kirsanova, T. Leith, C. & Wren-Lewis, S. 2009, Monetary and fiscal policy interaction: the current consensus assignment in the light of recent developments, *The Economic Journal*, 119, 482-496.

Knight, M. & Scacciavillani, F. 1998, *Current Accounts: What is Their Relevance for Economic Policymaking?*, International Monetary Fund Working Paper, 98/71, International Monetary Fund, Washington, D.C.

Kochin, L. A. 1974, Are future taxes anticipated by consumers?, *Journal of Money, Credit and Banking*, 6, 385-394.

Kopcke, R. W. Tootell, G, M, B. & Triest, R. K. 2006, *The Macroeconomics of Fiscal Policy*, MIT Press, Cambridge, Massachusetts.

Kormendi, R. 1983. Government debt, government spending, and private sector behavior, *American Economic Review*, Vol. 73(5), 994-1010.

Kouassi, E. Mougoue, M. & Kymn, K, O. 2004, Causality tests of the relationship between the twin deficits, *Empirical Economics*, 29, 503-525.

Kremers, J. J. Ericson, N, R. and Dolado, J, J. 1992, The power of cointegration tests, *Oxford Bulletin of Economics and Statistics*, 54, 545-579.

Krugman, P. 2005, Is fiscal policy poised for a comeback?, *Oxford Review of Economic Policy*, 21(4), 515-523.

Lane, P. R. & Milesi-Ferretti, G. M. 2001, The external wealth of nations: measures of foreign assets and liabilities for industrial and developing countries, *Journal of International Economics*, 55, 263-294.

Lai, K, S. 1997, Is the real interest rate unstable? Some new evidence, *Applied Economics*, 29, 359-364.

Lai, K. S, 1997, Long-term persistence in the real interest rate: some evidence of a fractional unit root, *International Journal of Finance and Economics*, 2(3), 225-235.

Lai, K. S, 2004, On structural shifts and stationarity of the ex ante real interest rate, *International Review of Economics and Finance*, 13(2), 217-228.

Lai, K, S. 2008, The puzzling unit root in the real interest rate and its inconsistency with intertemporal consumption behaviour, *Journal of International Money and Finance*, 27, 140-155.

Leachman, L. L. 1996, New evidence on the Ricardian equivalence theorem: a multicointegration approach, *Applied Economics*, 28, 695-704.

Lee, J. Huang, C. J. & Shin, Y. 1997, On stationary tests in the presence of structural breaks, *Economics Letters*, 55, 165-172.

Lee, J. 1999, Australia: household saving, in, *Australia: Selected Issues and Statistics*, 36-43, International Monetary Fund, Washington D.C.

Lee, J. 1999, Stationarity tests with multiple endogenized breaks, In Rothman, P. eds, *Nonlinear Time Series Analysis of Economic and Financial Data*, Kluwer Academic Press, Massachusetts.

Lee, J. & Strazicich, M. 2001, Testing the null hypothesis of stationarity in the presence of structural breaks, *Applied Economic Letters*, 8, 377-382.

Lee, J. & Strazicich, M. 2003, Minimum Lagrange multiplier unit root tests with two structural breaks, *Review of Economics and Statistics*, 81, 1082-1089.

Lee, J. & Strazicich, M. 2004, *Minimum LM Unit Root Test With One Structural Break*, Working Papers, No. 04-17, Department of Economics, Appalachian State University.

Lee, J. List, A. J. & Strazicich, M. 2005, *Modelling Nonrenewable Resource Prices: Deterministic or Stochastic Trends?*, NBER Working Paper Series, No. 11487, National Bureau of Economic Research, Cambridge, Massachusetts.

Leeper, E. M. Walker, T. B. & Yang, S. S. C. 2009, *Government investment and fiscal stimulus in the short and long run*, NBER Working Paper Series, No. 15153, National Bureau of Economic Research, Cambridge, Massachusetts.

Leibfritz, W. Roseveare, D. & Van Den Noord, P. 1994, *Fiscal policy, government debt and economic performance*, OECD Economics Department Working Paper, 94(51), Organisation for Economic Co-Operations and Development, Paris.

Leiderman, L. & Bleijer, M, I. 1988, Modelling and testing Ricardian equivalence: a survey, *IMF Staff Papers*, 35, 1-31.

Leslie, D. 1993, *Advanced Macroeconomics: Beyond IS/LM*, McGraw-Hill, Berkshire.

Leybourne, S. J. & Newbold, P. 2003, Spurious rejections by cointegration tests induced by structural breaks, *Applied Economics*, 35(9), 1117-1121.

Liu, H. & Rodriguez, G. 2006, Unit root tests and structural change when the initial observation is drawn from its unconditional distribution, *Econometrics Journal*, 9, 225-251.

Loayza, N. K. Schmidt-Hebbel, K. & Serven, L. 2000, What drives private saving across the world?, *Review of Economics and Statistics*, 82.

Lopez, C. 2005, *Improved Unit Root Tests With Changes in the Intercept*, Working Paper, Department of Economics, University of Cincinnati.

Lopez, C. Murray, C, J. & Papell, D. 2005, State of the art unit root tests and purchasing power parity, *Journal of Money, Credit, and Banking*, 37, 361-369.

Lowe, P. 1994, *Introduction to International Integration of the Australian Economy*, Reserve Bank of Australia, Sydney.

Lumsdaine, R. L. & Papell, D. H. 1997, Multiple trend breaks and the unit root hypothesis, *Review of Economics and Statistics*, 79(2), 212-218.

MacDonald, R. 1999, Exchange rate behaviour: are fundamentals important?, *The Economic Journal*, 109, 673-691.

McDermott C. J. 1999, Australia's current account: a consumption-smoothing approach, in, *Australia – Selected Issues and Statistical Appendix*, IMF Staff Country Report, 99-1, 3–13.

McKinnon, R. I. 2001, The international dollar standard and the sustainability of the US current account defiict, *Brookings Papers on Economic Activity*, 1, 227-239.

McCarthy, J. & Pham, H. N. 1995, The impact of individual retirement accounts on savings, *Current Issues in Economics and Finance*, Federal Reserve Bank of New York, 1(6).

Macfarlane, I. J. 1995, Financial deregulation and financial markets, *Reserve Bank of Australia Bulletin*, May, Reserve Bank of Australia.

Macfarlane, I. J. 2004, *Geography, Resources or Institutions?*, speech to the 'Bottom Line' function, 25 August, Melbourne.

Madalla, G. S. & Kim, I. M. 1999, *Unit Roots, Cointegration and Structural Change*, Cambridge University Press, Cambridge.

Makin, T. 1988, Targeting Australia's current account: A new mercantilism?, *Economic Analysis and Policy*, 18(2), 199–212.

Makin, T. 1990, *Inflation and the External Accounts: Australia in the 1980s*, Discussion Paper No. 35, Department of Economics, University of Queensland.

Makin, T. 1998, When contractionary fiscal policy is expansionary, *Agenda*, 5(4), 419-26.

Makin, T. 2007, Re-examining the effectiveness of stabilisation policy, *Australian Economic Papers*, 46(4), 348-359.

Makrydakis, S. 1999, Consumption-smoothing and the excessiveness of Greece's current account deficits, *Empirical Economics*, 24, 183-209.

Mankiw, N. G. 2000, The savers-spenders theory of fiscal policy, *Papers and Proceedings of the One Hundred and Twelfth Annual Meeting of the American Economic Association*, 90(2), eds, Baldwin, D, & Oaxaca, R, L.

Masson, P. & Mussa, M. 1995, Long-term tendencies in budget deficits and debt, in, *Budget Deficits and Debt: Issues and Options*, A symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, 5-55.

Masson, P. R. T. Bayoumi, T. & Samiei, H. 1998, International evidence on the determinants of private saving, *The World Bank Economic Review*, 12, 483-501.

Matsuoka, M. 1996, *Measuring the Effects of Fiscal Policy in Japan*, unpublished, Daiwa Institute.

De Mello, L. Kongsrud, P, M. & Price, R. 2004, *Saving Behaviour and the Effectiveness of Fiscal Policy*, Economics Department Working Papers, No. 397, Organisation for Economic Co-Operation and Development, Paris.

Meer, A. J. & Heijdra, B, J. 1990, An econometric analysis of the Australian current account balance, *Australian Economic Papers*, 29(5), 199-225.

Milbourne, R. & Otto, G. 1992, Consumption smoothing and the current account, *Australian Economic Papers*, 31(59), 369-384.

Miller, S. M. & Russek, F. S. 1989, Are the twin deficits really related?, *Contemporary Policy Issues*, 7, 91-115.

Mohammadi, H. & Skaggs, N. T. 1999, The twin deficts: fiscal imbalances and trade deficits, in, *Budget Deficits and Debt: A Global Perspective*, eds, Shojai, S. Praeger Publishers, Westpoint, Connecticut.

Monadjemi, M. S. & Kearney, C. 1991, The interest rate neutrality of fiscal deficits: testing for Ricardian equivalence and capital inflow, *Journal of International Money and Finance*, 10, 541-551.

Mountford, A. & Uhlig, H. 2008, *What are the Effects of Fiscal Policy Shocks?*, Working Paper No. 14551, National Bureau of Economic Research, Cambridge, Massachusetts.

Mukhtar, T. Zakaria, M. & Ahmed, M. 2007, An empirical investigation for the twin deficits hypothesis in Pakistan, *Journal of Economic Cooperation*, 28(4), 63-80.

Narayan, P. K. and Smyth, R. 2004, Structural breaks and unit roots in Australian macroeconomic time series, Department of Economics Discussion Paper, No. 18/04, Department of Economics, Monash University.

Narayan, P. K. and Narayan, S. 2006, Savings behaviour in Fiji: an empirical assessment using the ARDL approach to cointegration, *International Journal of Social Economics*, 33(7), 468-80.

Nason, J. M. & Rogers, J. H. 1999, Investment and the current account in the short run and the long run, *International Finance Discussion Papers*, No. 647, Board of Governors of the Federal Reserve System.

Nelson, C. & Plosser, P. 1982, Trends and random walks in macroeconomic time series: some evidence and implications, *Journal of Monetary Economics*, 10, 139-162.

Nguyen, D. T. & Pagan, A. 1990, *Fiscal Policy and the Current Account: Historical, Theoretical and Policy Perspectives and 'Twin Deficit' and the Australian Models Comments on a Conference*, Discussion Paper No. 222, Centre for Economic Policy Research, Australian National University.

Normandin, M. 1999, Budget deficit persistence and the twin deficits hypothesis, *Journal of International Economics*, 49, 171-193.

Nunes, L. C. Kuan & Newbold, P. 1997, Spurious regression, *Econometric Theory*, 11, 736-749.

Nunes, L. C. Newbold, P. & C-M, Kuan. 1997, Testing for unit roots with breaks: Evidence on the great crash and the unit root hypothesis reconsidered, *Oxford Bulletin of Economics and Statistics*, 59, 435-448.

Obstfeld, M. & Rogoff, K. 1995, The intertemporal approach to the current account, in, *Handbook of International Economics*, Vol 3, eds, Grossman, G. & Rogoff, K. Elsevier Science Publishers, Amsterdam.

Obstfeld, M. & Rogoff, K. 1996, *Foundations of International Macroeconomics*, MIT Press, Cambridge, Massachusetts.

Ohara, H. I. 1999, A unit root test with multiple trend breaks: A theory and application to US and Japanese macroeconomic time series, *The Japanese Economic Review*, 50, 266-290.

Olekalns, N. 1999, *Sustainability and Stability Australian Fiscal Policy in the 20th Century*, Research Paper No. 721, Department of Economics, The University of Melbourne.

Olivei, G, P. 2000, The role of savings and investment in balancing the current account: Some empirical evidence from the United States, *New England Economic Review*, July/August, Federal Reserve Bank of Boston, 3-14.

Organisation for Economic Co-operation and Development (OECD) 1992, *OECD Economic Surveys: Australia*, OECD, Paris.

Organisation for Economic Co-operation and Development (OECD) 1994, *OECD Economic Surveys: Australia*, OECD, Paris.

Organisation for Economic Co-operation and Development (OECD) 1994, *OECD Economic Surveys: United States*, OECD, Paris.

Organisation for Economic Co-operation and Development (OECD) 1995, *OECD Economic Surveys: United States*, OECD, Paris.

Organisation for Economic Co-operation and Development (OECD), 1999, *OECD Economic Surveys: United States*, OECD, Paris.

Organisation for Economic Co-operation and Development (OECD) 2000, *OECD Economic Surveys: Australia*, OECD, Paris.

Organisation for Economic Co-operation and Development (OECD) 2009, *OECD Interim Economic Outlook Chapter 3: The Effectiveness and Scope of Fiscal Stimulus*, OECD, Paris.

Otto, G. 1992, Testing a present-value model of the current account: Evidence from US and Canadian time series, *Journal of International Money and Finance*, 11, 414-430.

Otto, G. & Voss, G. 1995, Consumption, external assets and the real exchange rate, *Journal of Macroeconomics*, 17(3), 471-494.

Otto, G. 2003. Can an intertemporal model explain Australia's current account deficit?, *The Australian Economic Review*, 36(3), 350-359.

Pahlavani, M. & Valadkhani, A. 2005, *Structural Changes in the Iranian Economy: An Empirical Analysis With Endogenously Determined Breaks*, Economics Working Paper Series, No. 05-05, Department of Economics, University of Wollongong.

Pahlavani, M. Valadkhani, A. & Worthington, A. C. 2005, The impact of financial deregulation on monetary aggregates and interest rates in Australia, *Applied Financial Economics Letters*, 1, 157-163.

Pakko, M, R. 1999, The U.S trade deficit and the "new economy", *Federal Reserve Bank of St. Louis Review*, September/October, 11-19.

Papaioannou, S. & Kei-Mu, Y. 2001, The effects of a booming economy on the US trade deficit, *Current Issues in Economics and Finance*, 7(2), Federal Reserve Bank of New York.

Papell, D. H. 1997, Searching for stationarity: Purchasing power parity under the current float, *Journal of International Economics*, 43, 313-332.

Papell, D. H. & Prodan, R. 2003, The uncertain unit root in US real GDP: Evidence with restricted and unrestricted structural change, *Journal of Money, Credit, and Banking*, 36, 423-427.

Papell, D. H. & Prodan, R. 2006, Additional evidence of long-run purchasing power parity with restricted structural change, *Journal of Money, Credit, and Banking*, 38, 1329-49.

Parsell, B. F. Powell, A. A. & Wilcoxen, P. J. 1991, The effects of fiscal restraint on the Australian economy as projected by the Murphy and MSG2 models: A comparison, *The Economic Record*, 67(197), 97-114.

Patinkin, D. 1965, *Money, Interest, and Prices*, Harper and Row, New York.

Peeters, M. 1999, The public-private savings mirror and causality relations among private savings, investment, and (twin) deficits: A full modeling approach, *Journal of Policy Modeling*, 21(5), 579-605.

Perotti, R. 2002, *Estimating the effects of fiscal policy in OECD countries*, European Central Bank Working Paper No. 168.

Perotti, R. 2005, *Estimating the effects of fiscal policy in OECD countries*, Discussion Paper No. 4842, Centre for Economic Policy Research, London.

Perotti, R. 2007, *In search of the transmission mechanism of fiscal policy*, Working Paper No. 13143, National Bureau of Economic Research, Cambridge, Massachusetts.

Perron, P. 1989, The great crash, the oil price shock, and the unit root hypothesis, *Econometrica*, 57(6), 1361-1401.

Perron, P. 2006, Dealing with structural breaks, in *Palgrave Handbook of Economics*, Vol. 1: Econometric Theory, eds, Patterson, K. and Mills, T, C., Palgrave Macmillan.

Perron, P. & Vogelsang, T. 1992, Nonstationarity and level shifts with an application to purchasing power parity, *Journal of Business and Economic Statistics*, 10, 301-320.

Perron, P. 1994, Unit root and structural change in macroeconomic time series, in *Cointegration for the Applied Economist*, eds, B. Rao, Macmillan, London.

Perron, P. 1997, Further evidence on breaking trend functions in macroeconomic variables, *Journal of Econometrics*, 80(2), 355-385.

Perron, P. 2006, Dealing with structural breaks, *Palgrave Handbook of Econometrics, Volume 1: Econometric Theory*, eds, T, C, Mills. & Patterson, K. Palgrave Macmillian, London.

Perry, G. L. & Schultze, C. L. 1993, Was this recession different? Are they all different?, *Brookings Papers on Economic Activity*, 1, 145-211, Brookings Institution, Washington D.C.

Pesaran, M. H. Shin, Y. & Smith, R. J. 1996, *Testing for the Existence of a Long-run Relationship*, Cambridge Working Papers in Economics, Department of Applied Economics, Cambridge University.

Pesaran, M. H. 1997, The role of economic theory in modelling the long run, *Economic Journal*, 107(440), 178-191.

Pesaran, M. H. & Shin, Y. 1998, An autoregressive distributed-lag modelling approach to cointegration analysis, *Econometrics and Economic Theory in the Twentieth Century: The Ragnar Frisch Centennial Symposium*, eds, Strom, S.

Pesaran, M. H. & Smith, R. J. 1998, Structural analysis of cointegrating VARs, *Journal of Economic Surveys*, 12(5), 471-505.

Pesaran, M. H. Shin, Y. & Smith, R. J. 2001, Bounds testing approaches to the analysis of level relationships, *Journal of Applied Econometrics*, 16(3), 289-326.

Pitchford, J. 1989, A sceptical view of Australia's current account and debt problem, *The Australian Economic Review*, 86, 514.

Plosser, C. I. 1982, Government financing decisions and asset returns, *Journal of Monetary Economics*, 9, 325-352.

Ramey, V. A. & Shapiro, M. D. 1997, *Costly Capital Reallocation and the Effects of Government Spending*, Working Paper No. 6283, National Bureau of Economic Research, Cambridge, Massachusetts.

Ramey, V. A. 2006, *Identifying Government Spending Shocks: It's all in the Timing*, unpublished, University of California, San Diego.

Reitschuler, G. 2008, Assessing Ricardian Equivalence for the new member states: does debt-neutrality matter?, *Economic Systems*, 32(2), 119-128.

Reserve Bank of Australia 1999, *Bulletin*, December, Reserve Bank of Australia, Sydney.

Reynolds, A. 2001, The fiscal-monetary mix, *Cato Journal*, 21(2), 263.

Ricardo, D. 1966, *The Works and Correspondence of David Ricardo*, 1, edited by Piero Sraffa, Cambridge University Press, London.

Ricardo, D. 1966, *The Works and Correspondence of David Ricardo*, 4, edited by Piero Sraffa, Cambridge University Press, London.

Ricciuti, R. 2003, Assessing Ricardian Equivalence, *Journal of Economic Surveys*, 17(1), 57-78.

Rogers, C. & Neal, P. 1994, *Macroeconomics And The Australian Economy – Recent Performance And Challenges Of The 1990s*, Prentice Hall, Sydney.

Romer, C. D. & Romer, D. H. 1994, What ends recessions?, in *NBER Macroeconomics Annual 1994*, eds, Blanchard, O. & Fischer, S. National Bureau of Economic Research, Cambridge, Massachusetts.

Romer, D. 2000, Keynesian macroeconomics without the LM curve, *Journal of Economic Perspectives*, 14(2), 149-169.

Rose, A. K. 1988, Is the real interest rate stable?, *Journal of Finance*, 43, 1095-1112.

Rosenwig, J. A. & Tallman, E. W. 1993, Fiscal policy and trade adjustment: are the deficits really twins?, *Economic Inquiry*, 31, 580-594.

Roubini, N. 1988, *Current Account and Budget Deficits In An Intertemporal Model of Consumption and Taxation Smoothing. A Solution to the "Feldstein-Horioka Puzzle"?*, Working Paper No. 2773, National Bureau of Economic Research, Cambridge, Massachusetts.

Roubini, N. 2006, The unsustainability of the US twin deficits, *Cato Journal*, 26(2), 343-356.

Sachs, J. 1982, The current account in the macroeconomic adjustment process, *Scandinavian Journal of Economics*, 84(2), 147-159.

Scarth, W, M. 1988, *Macroeconomics: An Introduction to Advanced Methods*, Harcourt Brace, Canada.

Schiff, A. F. and Phillips, P. C. B. 2000, *Forecasting New Zealand's Real GDP*, Working Paper Series, No. 209, Department of Economics, University of Auckland.

Seater, J. J. & Mariano, R. S. 1985, New tests of the life cycle and tax discounting hypothesis, *Journal of Monetary Economics*, 15(2), 195-215.

Seater, J. J. 1993, Ricardian equivalence, *Journal of Economic Literature*, 31, 142-190.

De Serres, A. Pelgrin, F. 2002, *The decline in private savings rates in the 1990s in OECD countries: How much can be explained by non-wealth determinants?*, Working Paper No. 344, Organisation for Economic Cooperation and Development, Paris.

Shapiro, M. & Slemrod, J. 2002, *Did the 2001 Tax Rebate Stimulate Spending?*, NBER Working Paper No. 9308, National Bureau of Economic Research, Cambridge, Massachusetts.

Shapiro, M. & Slemrod, J. 2003, Consumer response to tax rebates, *American Economic Review*, 93(1), 381-396.

Sheffrin, S. M. & Woo, W. T. 1990a, Present value tests of an intertemporal model of the current account, *Journal of International Economics*, 29, 237-253.

Sheffrin, S. M. & Woo, W. T. 1990b, Testing an optimizing model of the current account via the consumption function, *Journal of International Money and Finance*, 9, 220-233.

Shrestha, M. B. & Chowdhury, K. 2005, *A Sequential Procedure for Testing Unit Roots in the Presence of Structural Break in Time Series Data*, Economics Working Paper Series, No. 05-06, University of Wollongong.

Smyth, R. & Kumar Narayan, P. 2005, Structural breaks and unit roots in Australian macroeconomic time series, *Pacific Economic Review*, 10, 421-437.

Solow, R. M. 2005, Rethinking fiscal policy, *Oxford Review of Economics and Statistics*, 21(4), 509-514.

Sorpraseuth, T. 1999, The US "Twin Deficits" a reappraisal, *Recherches Economiques de Louvrain*, 65(2), 139-178.

Spilimbergo, A. Symansky, S. Blanchard, O. & Cottarelli, C. 2008, *Fiscal policy for the crisis*, IMF Staff Position Note 08/01, International Monetary Fund, Washington, D.C.

Spilimbergo, A. Symansky, S. & Schindler, M. 2009, *Fiscal multipliers*, IMF Staff Position Note 09/11, International Monetary Fund, Washington, D.C.

Stevens, G. R. 2009, The Road to Recovery, Address to the Australian Institute of Company Directors, 21 April, Adelaide.

Strazicich, M. Lee, J. & Day, E. 2004, Are incomes converging among OECD countries? Time series evidence with two structural breaks, *Journal of Macroeconomics*, 26, 131-145.

Taylor, J, B. 2000, Reassessing discretionary fiscal policy, *Journal of Economic Perspectives*, 14(3), 21-36.

Taylor, J, B. 2009, The lack of an empirical rationale for a revival of discretionary fiscal policy, *American Economic Review*, 99(2), 550-555.

Tobin, J. 1998, *Monetary policy: Recent theory and practice*, Cowles Foundation Discussion Paper Series, No. 1187.

Tornell, A. & Lane, P. R. 1998, Are windfalls a curse? A non-representative agent model of the current account, *Journal of International Economics*, 44, 83-112.

Tytell, I. & Wei, S-J. 2004, *Does Financial Globalization Induce Better Macroeconomic Policies?*, IMF Working Paper, No. 04-84, International Monetary Fund, Washington, D.C.

United Nations, 1993, *System of National Accounts 1993*, New York.

Van Aarle, B. Garretson, H. & Gobbin, N. 2003, Monetary and fiscal policy transmission in the Euro-area: evidence from a structural VAR analysis, *Journal of Economics and Business*, 55(5-6), 609-638.

Vamvoukas, G. A. 1997, A note on budget deficits and interest rates: Evidence from a small open economy, *Southern Economic Journal*, 63, 803-811.

Vamvoukas, G. A. 1999, The twin deficits phenomenon: Evidence from Greece, *Applied Economics*, 31, 1093-1100.

Ventura, J. 2001, A portfolio view of the US current account deficit, *Brookings Papers on Economic Activity*, 1, 241-253.

Walker, C. W. 2002, Ricardian equivalence and fiscal policy effectiveness in Japan, *Asian Economic Journal*, 16(3), 285-302.

Weber, C. E. 1999, Fiscal policy in general equilibrium: Empirical estimates from an error correction model, *Applied Economics*, 31, 907-913.

Westerlund, J. 2006, Testing for panel cointegration with multiple structural breaks, *Oxford Bulletin of Economics and Statistics*, 68, 101-132.

Westerlund, J. 2006, *Simple Unit Root Tests With Multiple Breaks*, Working Paper, Department of Economics, Lund University.

Williamson, J. 1988, Conflicting views of the twin deficits, *Cato Journal*, 8(2), 529-532.

Yi, C. D. 2003, An empirical analysis of Ricardian Equivalence on real exchange rate and current account: Korea, *International Economic Journal*, 17(4), 61-83.

Yi, K. M. 1993, Can government purchases explain the recent US net export deficits?, *Journal of International Economics*, 35, 201-225.

Yule, G. U. 1926, Why do we sometimes get nonsense correlations between time series? A study in sampling and the nature of time series, *Journal of the Royal Statistical Society*, 89, 1-64.

Zeldes, S. 1989, Consumption and liquidity constraints: an empirical investigation, *Journal of Political Economy*, 97, 305-346.

Zietz, J. & Pemberton, D. K. 1990, The U.S. budget and trade deficits: A simultaneous equation model, *Southern Economic Journal*, 57(1), 23-34.

Zivot, E. & Andrews, D. 1992, Further evidence on the great crash, the oil price shock, and the unit root hypothesis, *Journal of Business and Economic Statistics*, 10(3), 251-270.

APPENDIX A DATA DEFINITIONS AND SOURCES

S_t^{priv} = Net household plus net corporate saving. Net household saving, seasonally adjusted, (ABS Cat. No. 5206.36). Net corporate saving calculated as the residual of net national saving, seasonally adjusted (ABS Cat. No. 5206.32B), minus net household saving and net general government saving, seasonally adjusted (ABS Cat. No. 5206.38).

S_t^{pub} = Net general government saving, seasonally adjusted (ABS Cat. No. 5206.38).

Y_t = Household gross disposable income, seasonally adjusted (ABS Cat. No. 5206.36).

AS_t = Social assistance benefits in cash to residents, seasonally adjusted (ABS Cat. No. 5206.38).

U_t = Unemployment rate (ABS Cat. No. 6202.0).

INF_t = Quarterly inflation rate, seasonally adjusted, calculated from consumer price index (ABS Cat. No. 6401.0).

R_t = Real interest rate, calculated from quarterly 10-year Treasury bond yields (RBA, Bulletin, Table F.02) – and subtracting the corresponding quarterly inflation rate (ABS Cat. No. 6401.0).

TOT_t = Terms of trade index, seasonally adjusted (ABS Cat. No. 5206.02).

$FLIB_t$ = Net foreign liabilities, seasonally adjusted (ABS Cat. No. 5302.0).

EQ_t = Quarterly share price index, S&P ASX200 (OECD Economic Outlook Database).

H_t = Quarterly house price index, Commonwealth Treasury. Spliced house price series constructed from the following data sources: Australian Bureau of Statistics Cat. No. 6416.0; Australian Property Monitors; and BIS Shrapnel.