Testing Intertemporal Models of the Current Account for Australia

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(Honours in Business Economics)

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6 June 2008
Declaration

I hereby declare that this thesis is my original work and citations of other authors have been properly referenced in the text. This thesis contains no material which has been submitted to any other institutions as part of the requirements for a degree or other award.

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6 June 2008
Acknowledgements

I would like to express my gratefulness to have the guidance and support from my supervisor Glenn Otto throughout the Honours year. His extensive economics knowledge has deeply inspired my passion towards macroeconomics and this thesis would not be possible without his generous assistance. I also wish to thank Garry Barrett and Lance Fisher who kindly offered me advice and suggestions on my econometrics methods. I am thankful to those present at my final thesis presentation and their helpful comments are highly appreciated.

I am grateful to be awarded with the scholarships from the Centre of Applied Economic Research, the Australian School of Business and the University of New South Wales which provided me great encouragement in my Honours year.

I would also like to thank my Honours fellows for their cheerful support. Thank you to my girlfriend Wing Ng for her precious care and tremendous assistance. My special thanks to my family and friends especially my mother and father for their invaluable love and encouragement.
Abstract

This thesis investigates the ability of three versions of the intertemporal model of the current account to account for fluctuations in Australia’s current account. The intertemporal framework attributes an economy’s current account to the outcome of rational consumption and investment decisions by various agents in the economy. The basic intertemporal model emphasizes consumption smoothing as a determinant of the current account, with a key role played by the expectation of the future changes in national cash flow. In a generalized version of the intertemporal model due to Bergin and Sheffrin (2000), the current account does not solely driven by the movements in net cash flow but also by the real exchange rate and world real interest rate. Bergin and Sheffrin’s model is extended by Bouakez and Kano (2008) who also incorporate a role for the terms of trade into the intertemporal model.

All of the intertemporal models considered give rise to a present-value relationship for the current account. An implication of the models is that the current account should anticipate and consequently forecast the forcing variables. Using the Granger-causality tests and long horizon tests, it is found that Australia’s current account is able to forecast changes in net cash flows over horizons of one to two years. However there is little support for any relationship between the current account and other variables implied by either of the generalized models. A formal (orthogonality) test of the basic model indicates that it is not rejected by the Australian data. Interestingly, no improvement is found for the fit of the intertemporal model in the financial deregulated environment from 1980 and this differs from previous findings (Cashin and McDermott, 1998).
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Chapter 1: Introduction

Australia has traditionally been a capital importing country with a long history of large current account deficits. The sizeable and persistent current account deficits were frequently raised as a cause of concern in the 1980s, due to their possible adverse effect on the domestic economy. Countries with large and persistent current account deficits are sometimes considered to be on a path of insolvency which may eventually increase the chances of a significant reversal in capital flows and prospects of default. Current account deficits are also the originator of foreign indebtedness and thus the major influence on the size of external debts. The rising indebtedness and large current account deficits may leave countries vulnerable to external shocks if foreign lenders change their willingness to lend for external debts (Pitchford, 1990). However, Australia has no experience of default on public debt and there have not been any significant reversal in capital flows.

Figure 1 shows the annual current account as a share of nominal gross domestic product (GDP) from 1960 to 2007. From the mid 1960s to early 1970s, Australia experienced an investment boom in resources-related industries. It stimulated the Australian economy by having a real income growth with average of 5 per cent per annum. The increased investment in the early stages of the boom contributed to the raised current account deficit which implied the involvement of imported capital in the investment boom. The speculation of devaluation under the managed exchange rate regime in the late 1970s and early 1980s and the pressure for a complete liberalization of the capital account eventually led to the development of a floating exchange rate regime in December 1983. The depreciation of the Australian dollar that followed immediately after the floating of exchange rate improved the international competitiveness of domestic firms.
The increase in the current account deficit from an average of 4% of GDP in the early 1980s to figures in the range of 4% to 7% in the late 1980s attracted the attention of many government authorities, economic commentators and academics. The removal of capital controls and the development of the floating exchange rate regime allow foreigners to freely invest in Australia and produced an inflow of foreign capital. Australia’s current account deficit was viewed as a serious problem in the latter part of the 1980s which required a remedial policy action. In the late 1990s when the technology boom emerged, Australia was viewed as a traditional economy which contributed to a large depreciation of Australian dollar. This improved the trade balance and the associated current account deficit in Australia. The overall size and level of fluctuations in the current account deficit also declined since the latter part of 1990s compared to the late 1980s.
Apart from the trend-decline in the size of the current account deficit since the 1980s, the emergence of the Pitchford’s (1990) argument and the intertemporal approach of the current account have significantly changed the way in which policy-makers and economists think about the current account. From the early 1970s to December 1983, prior to the floating exchange rate regime, Australia’s current account deficit was a concern for policy makers. To the extent that the deficit was not matched by the capital flows it was required to be financed by reducing foreign exchange reserve. After the float of the Australian dollar, the view that current account balance should be regarded as a policy target persisted and there were increased concerns about the persistent and sizeable deficits in the mid 1980s. The current account deficit and the associated external debt were viewed as major policy issues and intervention was considered to be necessary to rein in the large current account deficits.

By the end of 1980s, the view that current account is basically the outcome of rational decisions by private agents was propounded by several Australian academics (Pitchford, 1990). Policy intervention to reduce the deficit was considered under this view to be unnecessary and may even reduce social welfare. The relevance of having the current account as an explicit goal for the monetary policy was also debated within the Reserve Bank of Australia. The development of models which focus on the intertemporal character of current account over the previous decade also contributed to the change of perception on current account (Frenkel and Razin, 1987; Obstfeld and Rogoff, 1996). In the Australian context, the intertemporal approach to the current account is most closely associated with Pitchford’s (1990) argument. It is now widely accepted that current account balance should not be a policy objective, at least to the extent that it reflects the optimal decisions of borrowers and lenders.
The basic intertemporal approach to the current account is an extension of the permanent income hypothesis (PIH) (Friedman, 1957; Hall, 1978). Under the PIH, consumption expenditure depends upon expected permanent income instead of the current disposable income. The concept of consumption smoothing behaviour indicates that savings and investment decisions of rational agents are related to their expectations of future changes in certain economic fundamentals including output, government spending (taxes) and real interest rate.

When the current income for the economy deviates from its permanent level, agents will borrow and lend in the international capital market to accommodate the temporary fluctuations. If an economy is expected to have a temporary increase in future income, agents will raise current consumption, producing an increase in the current account deficit. In contrast, if future income of an economy is anticipated to decline, the consumption smoothing behaviour of the rational agents would bring about a reduction in the size of current account deficit. Basic versions of the intertemporal model can be represented by a present-value relationship between current account and changes in net output (or net cash flow). This basic model focuses on the role on expected future income while more recent developments in the intertemporal model of the current account have included the effects of expected relative prices – real interest rates and real exchange rates.

An econometric methodology was developed by Campbell and Shiller (1987) to test present-value models. This methodology was used by Campbell (1987) to test the permanent income hypothesis using the present-value relationship between labour income and private saving. Household saving is expected to increase if people rationally expect labour income to decline. The way in which small open economies can save for a rainy day is by having a current account surplus or a smaller current account deficit. On the other hand, countries which are
optimistic towards future income prospects will tend to run a current account deficit or a smaller current account surplus.

A number of empirical studies have been conducted to test the intertemporal approach to the current account, following Campbell’s (1987) method. There are various degrees of formal statistical support for the intertemporal approach. In an early study for Australia, Milbourne and Otto (1992) rejected the restrictions of the basic intertemporal model using quarterly data. The intertemporal approach was also tested by Cashin and McDermott (1998, 2002) and the basic intertemporal model was strongly rejected. The consumption smoothing model of the current account was found to be a poor approach to explaining Australia’s current account behaviour. More recently Otto (2003), however, suggested that the intertemporal model was able to explain the annual changes in Australia’s current account deficit for the sample dated from 1980 to 2003.

The basic model in most of the existing studies is statistically rejected for many small open economies (Obstfeld and Rogoff, 1995). In response, economists sort to include other variables into the simple intertemporal model and the generalized intertemporal model was developed. The generalized intertemporal approach allows for small open economies to be affected by a number of external shocks. These include changes in the world real interest rate and the real exchange rate. When facing changes in world real interest rate, economic agents are influenced in how they allocate their consumption expenditure towards the present or the future. Thus countries will choose to increase or decrease their current account balance in respond to changes in the interest rate or exchange rate (Bergin and Sheffrin, 2000). There is some evidence that Bergin and Sheffrin’s generalized intertemporal model provides a better description of Australia’s current account than does the basic model.
A recent extension of the intertemporal model allows for changes in the terms of trade. The inclusion of this variable seeks to account for the Harberger-Laursen-Metzler (HLM) effect, where a temporary rise in terms of trade tends to improve the current account. Bouakez and Kano (2008) develop an intertemporal model of current account which accounts for the HLM effect in addition to the traditional consumption smoothing behaviour and the effects of future changes in exchange rate and time varying interest rate, as highlighted in Bergin and Sheffrin. The extended intertemporal model illustrates not only the intertemporal substitution effect but also the income and wealth effects with a change in the world interest rate and the immediate effect on net foreign interest payments.

The empirical work by Bouakez and Kano finds the generalized intertemporal model which allows for variations in interest and exchange rate does not improve the fit of the standard model on Australia’s data which contrasts to the results of Bergin and Sheffrin. Furthermore their extended model, augmented with terms of trade variations, was strongly rejected by the Australia’s data and variations in terms of trade did not seem to significantly affect the current account.

There is mixed evidence about the ability of the intertemporal models to explain Australia’s current account. The aim of this thesis is to examine and compare the ability of the models (basic, generalized and extended) to explain fluctuations in Australia’s current account. In particular it examines whether the inclusion of the world interest rate, the exchange rate and the terms of trade yield an improvement in the fit of data.
The predictions of the intertemporal models are also tested using three methods: Granger-Causality tests (Granger, 1969); long horizon regressions (Campbell and Shiller, 1988) and a test of the orthogonality restrictions. The empirical models are estimated using annual data over a full sample period 1960-2007 and two sub-sample periods 1960-1980 and 1980-2007. Previous studies on Australian data suggest that there is stronger support for the models during the post-deregulation period (Cashin and McDermott, 1998, 2002; Otto, 2003).

The results indicate that for the full sample period, allowing for a time-varying real interest rate, the real exchange rate and the terms of trade does not generate any improvement in the model to fit the data. The basic intertemporal model seems to provide the best explanation of the Australian data. Using the data for the two sub-samples; the generalized intertemporal model is rejected for both periods, while there is some support for the extended intertemporal model during the later sub-sample period.

The rest of the thesis is structured as follows. Chapter 2 outlines the various intertemporal models of the current account. Chapter 3 describes the data including; data sources, construction of variables, choice of parameter values and results of unit root tests. Chapter 4 discusses the methods used to examine the predictions of the models and reports the results from testing the models on the Australian data. Chapter 5 concludes.
Chapter 2: Intertemporal Models of the Current Account

2.1 Basic Intertemporal Model for the Current Account

The basic intertemporal model considers an infinitely lived representative household in a small open economy. The intertemporal model is similar to the permanent income hypothesis (Friedman, 1957, Hall, 1978) where the representative agent chooses an optimal consumption path to maximise the present-value of lifetime utility subject to a budget constraint. The consumer’s expected lifetime utility function at period $t$ is given as:

$$\max E_t \sum_{t=0}^{\infty} \beta^t U(C_t) \quad 0 < \beta < 1 \quad (1)$$

where $C_t$ is the consumption at period $t$, $U(\cdot)$ is the consumer’s period utility function and $\beta$ is the subjective discount factor with a value between 0 and 1. $E_t$ is the expectation operator conditional upon the information set of period $t$.

The basic intertemporal model specifies the requirement of a small open economy. The real interest rate for this economy is assumed to be constant over time and determined by the international financial market. Regarding the above assumption, the consumption decision of the agent can be made without reference to any production decision and only depends on a country’s wealth (Sheffrin and Woo, 1990). It is also assumed that only a single good exists in the small open economy (Sheffrin and Woo, 1990, Otto, 1992, Ghosh, 1995).

The agent’s consumption behaviour is subject to a budget constraint. By defining $B_t$ as the stock of net external assets at the beginning of period $t$. $Y_t$ is output, $I_t$ is investment
expenditure and $G_t$ is government spending. The consumer’s budget constraint is given as follows:

$$Y_t - C_t - I_t - G_t + rB_{t-1} = B_t - B_{t-1} \quad (2)$$

The last term on the left hand side of the budget constraint, $rB_{t-1}$, equals to the interest earned by the stock of net external assets held in the previous period. Additionally, the right hand side of the budget constraint, $B_t - B_{t-1}$, equals to the change in the stock of net external assets held from previous period to current period. $B_t - B_{t-1}$ is also equivalent to the current account in current period. Thus, equation (2) can be represented in this form

$$Z_t - C_t + rB_{t-1} = CA_t \quad (3)$$

To obtain an optimal consumption path, the representative household has to maximize equation (1) subject to constraint equation (2). The following Euler equation is obtained from the first-order conditions of the optimization problem:

$$u'(C_t) = \beta E_t (1 + r) u'(C_{t+1}), \quad (4)$$

where $\beta = \frac{1}{1 + r}$

The following transversality condition is also imposed:

$$\lim_{t \to \infty} \left( \frac{1}{1 + r} \right)^i B_{t+i} = 0 \quad (5)$$

By summing the consumer’s budget constraint (2) over the infinite future and using the transversality condition (4), the consumer’s intertemporal budget constraint is obtained where the present value of consumption equals to the present value of net income and net external assets in the initial period:
\[
\sum_{i=0}^{\infty} \left( \frac{1}{1 + r} \right)^{i+1} C_{t+i} = \sum_{i=0}^{\infty} \left( \frac{1}{1 + r} \right)^{i+1} Z_{t+i} + B_t,
\]

(6)

Assuming a quadratic form for the utility function and using the equations (4) and (6), the following present-value model for the current account \(ca\) can be obtained (Obstfeld and Rogoff, 1996):

\[
CA_t = -E_t \sum_{i=1}^{\infty} \beta^i \Delta Z_{t+i}
\]

(7)

Equation (7) shows that a country’s current account is equivalent to (minus) the present discounted value of the infinite sum of expected future changes in national (net) cash flow, \(Z_t\). This equation implies that a country will run a current account deficit if agents expect changes in national cash flow to rise in the future and increase their current consumption. In order to finance the temporary short-fall in current income, a country will smooth consumption by borrowing in world capital markets and therefore running a current account deficit. This mechanism is consistent with Campbell’s (1987) analogy where the permanent income model can be illustrated by households’ decisions to save when the future labour income is expected to decline. In the basic intertemporal model, net cash flow substitutes for labour income and current account substitutes for saving. The current account has a major function for consumption smoothing behaviour when the net cash flow is temporarily deviated from its permanent level.

The basic intertemporal model also implies that current values of current account contain information which is useful to forecast agents’ expectations of future changes in net cash
flows. Thus, the current value of current account is deemed to be a predicator of future changes in national cash flows.

A number of previous empirical studies have found that the basic intertemporal model is quite restrictive and fails for many small open economies. This result is surprising as it is anticipated that the basic model to be most appropriate for small open economies where they can borrow from the rest of the world without imposing any changes in variables such as the equilibrium world interest rate.

However in light of these findings, a number of studies have sort to relax the assumption that the world real interest rate is constant over time and only one good is produced in the economy (which ignores the role of real exchange rate in affecting the current account). Bergin and Sheffrin (2000) develop a generalized model in which current account depends not only on net cash flow but also on the world real interest rate and country’s real exchange rate.

2.2 Generalized Intertemporal Model for the Current Account

Bergin and Sheffrin (2000) extended the basic intertemporal model by assuming a small country producing both traded and non-traded goods. The country can also borrow and lend in the world capital market at a time-varying real interest rate. In the model, changes in both real interest rate and real exchange rate stimulate consumption substitution between periods and therefore it generates an intertemporal effect on a country’s current account. A representative household chooses a consumption path that maximizes their discounted life time utility:
\[
\max E_0 \sum_{t=0}^{\infty} \beta^t U(C_{T,t}, C_{N,t})
\]

where \(U(C_{T,t}, C_{N,t}) = \frac{1}{1-\sigma} (C_{T,t}^\sigma C_{N,t}^{1-\sigma})^{1-\sigma}\)

\[
\sigma > 0, \quad \sigma \neq 1, \quad 0 < \sigma < 1
\]

The functional form of the household’s utility is specified as above, where \(\sigma\) is equivalent to the concavity of the utility function and \(\alpha\) represents the share of traded goods in total consumption. The utility function is assumed to exhibit the constant relative risk aversion.

Total consumption in the economy is now separated into consumption of traded goods, \(C_{T,t}\) and consumption of non-traded goods \(C_{N,t}\). The household utility maximization decision is again subject to a budget constraint:

\[
Y_t - (C_{T,t} + P_t C_{N,t}) - I_t - G_t + r_t B_{t-1} = B_t - B_{t-1}
\]

The relative price of non-traded to traded goods at time \(t\) is denoted \(P_t\). It can be calculated as \(P_{N,t} / P_{T,t}\). Based on the assumption that the economy has both traded and non-traded goods, the total consumption expenditure in terms of traded goods is equal to \(C_{T,t} + P_t C_{N,t}\). Other variables in equation (9) are equivalent to those in equation (2) respectively. A major difference between the budget constraint in basic and generalized model is that \(r_t\) in equation (9) represents the world real interest rate in terms of traded goods, which may be time varying rather than a constant.

The right hand side of the budget constraint represents the current account in the present period and thus equation (9) can be written as following:

\[
Z_t - C_t - r B_{t-1} = CA_t
\]
The national cash flow $Z_t$ is defined as $Y_t - I_t - G_t$. By summing up the budget constraint over an infinite horizon and imposing the transversality condition:

$$\lim_{t \to \infty} E_0 (R_t B_{t+1}) = 0$$  \hspace{1cm} (11)

where $R_t = 1 / \prod_{j=1}^{i} (1 + r_j)$

the following intertemporal budget constraint is obtained (where $B_0$ is the net foreign assets in the initial period):

$$\sum_{t=0}^{\infty} E_0 (R_t C_{t+1}) = \sum_{t=0}^{\infty} E_0 (R_t Z_{t+1}) + B_0$$  \hspace{1cm} (12)

Based on the functional form of utility illustrated in equation (8), Bergin and Sheffrin (2000, Appendix A) derived the first-order conditions for the problem of household utility maximization and the optimal consumption profile can be defined as follow:

$$1 = E_t \left[ \beta^\gamma (1+r_{t+1})^\gamma \left( \frac{C_t}{C_{t+1}} \right)^{(\gamma-1)(1-\sigma)} \right]$$  \hspace{1cm} (13)

where $\gamma$ is the intertemporal elasticity of substitution and equals to $1 / \sigma$, which is the reciprocal of the concavity of the utility function. Bergin and Sheffrin (2000) followed the methodology adopted by Dornbusch (1983) and Obstfeld and Rogoff (1996) to derive the optimal consumption profile in equation (13). This method involves specifying the Cobb-Douglas consumption index with regards to the utility function and defining a related price index. The intertemporal Euler equation is then constructed as equation (13) which is expressed in terms of total consumption expenditure and the relative price of non-traded goods.
By assuming joint log normality with constant variances and covariances, equation (13) can be expressed in logs as follow:

\[ E_t \Delta c_{t+1} = \gamma E_t r^*_{t+1} \]

where \( r^* = r_t + \left( \frac{1 - \gamma}{\gamma} \right) (1 - \alpha) \Delta p_t + \text{constant} \)

\[ \Delta c_{t+1} = \log C_t + 1 - \log C_t \quad \text{and} \quad \Delta p_{t+1} = \log P_{t+1} - \log P_t \]

The optimal consumption profile is thus influenced by the world varying interest rate, \( r_t \), and the change in the relative price of non-traded goods, \( \Delta p_t \). Consumption based interest rate, \( r^* \) is then computed by integrating the above two variables. Movements in the consumption based interest rate will affect households’ consumption decisions in the economy.

The main difference between basic intertemporal model and generalized intertemporal model is the inclusion of consumption based interest rate (which is composed of time varying interest rate and change in the relative price of non-traded goods). Considering the permanent income hypothesis (Friedman, 1957, Hall, 1978), the basic intertemporal model proposes that the agents’ consumption is subject to permanent income only where they borrow and lend over time in the world financial market to smooth their consumption. The expected change in consumption is thus zero. Contrary to the above proposition, the generalized intertemporal model allows households to change their consumption profile when facing changes in terms of borrowing and lending. The expected change in consumption is no longer zero in the generalized model and the consumption smoothing behaviour will also be altered.

The intertemporal substitution of consumption can be analysed through the movements in real interest rate and the changes in the relative price of non-traded goods. A rise of the conventional interest rate, \( r \), causes the current consumption to become more costly in terms
of future consumption forgone and thus creates an incentive for household to switch towards future consumption with elasticity $\gamma$. An expected fall in the relative price of non-traded goods can bring a similar intertemporal effect as above. The price of traded goods is therefore expected to rise and it will cost more in future to repay the loan in traded goods in terms of the consumption basket. Consumption based interest rate, $r^*$, will be higher than the conventional interest rate, $r$, and thus the current consumption will be decreased by elasticity $\gamma (1 - \alpha)$.

The intratemporal substitution between traded and non-traded goods is also induced due to the changes to their relative prices. Households will substitute towards traded goods by intratemporal elasticity if the price of non-traded goods is temporarily high relative to traded goods. The current consumption expenditure will then be raised by elasticity $(1 - \alpha)$.

A present-value relationship for the current account is developed by using the optimal consumption profile in equation (14) together with the intertemporal budget constraint in equation (12). The present-value relationship for the current account in the generalized model depends upon not only the national cash flow but also the consumption based interest rate. Bergin and Sheffrin (2000) log linearised the intertemporal budget constraint in equation (12) and assumed the net foreign assets are zero. The resulting present value relationship of the current account is presented as follows in log terms:

$$ca_t^* = -E_t \sum_{i=1}^{\infty} \beta^i (\Delta z_{t+i} + \gamma r_t^*)$$

(15)

where $ca_t^* \equiv n_t - c_t$
Comparing the present value relationship between basic and generalized models, the addition of the consumption based interest rate in the generalized intertemporal model in equation (15) is the major difference between the models. If net cash flow is expected to decrease in future periods, the current account will increase due to the households’ consumption smoothing behaviours. Apart from any changes in the expected national cash flow, an increase in the consumption based interest rate will induce the agents in the economy to defer current consumption. Thus, the current account will improve.

Bergin and Sheffrin (2000) indicated that an intertemporal model which allows for varying interest rates and distinction between tradable and non-tradable goods substantially improves the fit of the model over the basic intertemporal model. The modification of the basic model helps the prediction of the model to fit the volatility of current account better and thus improved the ability of the model to explain the current account fluctuations.

2.3 Extension of the Intertemporal Model for the Current Account

Bouakez and Kano (2008) developed an intertemporal model which has similar assumptions as the generalized model above where representative households can consume both tradeable and non-tradeable goods in a small open economy. Three kinds of goods (exportable goods, importable goods and non-tradeable goods) are now assumed to exist in the economy. In order to measure the present-value relationship between variations in terms of trade and the current account, a stochastic infinite horizon model have to be constructed with the following household’s lifetime utility:

$$U_t = E_t \sum_{i=0}^{\infty} \beta^i \frac{C_{t+i}^{1-1/\sigma}}{1 - 1/\sigma}, \quad 0 < \beta < 1, \quad \sigma > 0,$$

(16)
Similar notations as previous models have used; where $\beta$ is the subjective discount factor and $\sigma$ is the elasticity of the intertemporal substitution. $E_t$ is the expectation operator conditional on the information set available at time $t$. The consumption index, $C_t$, is a Cobb-Douglas aggregator of tradeable goods and non-tradable goods as follow:

$$C_t = \omega_1 (C_t^T)^\varepsilon (C_t^N)^{1-\varepsilon}, \quad 0 < \varepsilon < 1,$$

(17)

The total consumption expenditure is now separated in to $C_t^T$ and $C_t^N$ which are consumption of tradeable goods and consumption of non-tradeable goods respectively. $\varepsilon$ represents the weight of tradeable goods in the consumption bundle and $\omega_1 = \varepsilon^\varepsilon(1-\varepsilon)^{\varepsilon-1}$ is a positive parameter. The price of tradable goods is then normalized to 1 (Bouakez and Kano, 2008) and the consumption based price index, $P_t^c$, is constructed as follow where the price of non-tradable goods is denoted $Q_t$:

$$P_t^c = Q_t^{1-\varepsilon}$$

(18)

Obstfeld (1996) and Obstfeld and Rogoff (1996) defined the consumption of tradable goods is a mix of exportable and imported goods in an economy. Assuming the tradable good is also a Cobb-Douglas aggregator of domestic exportable goods and domestic imported goods, the tradable good consumption can be interpreted as follow,

$$C_t^T = \omega_2 X_t^\gamma M_t^{1-\gamma}, \quad 0 < \gamma < 1,$$

(19)

where the consumption of exportable goods and consumption of imported goods at period $t$ are denoted $X_t$ and $M_t$ respectively. Parameter $\omega_2$ is positive and equals to $\gamma^{-\gamma}(1-\gamma)^{\gamma-1}$. 


Since the price of tradable goods is normalized to 1, the following condition regarding the prices of domestic exportable goods, $P_t^x$, and the price of imported goods, $P_t^m$, must hold:

$$1 = (P_t^x)^\gamma (P_t^m)^{1-\gamma}$$ (20)

The terms of trade which is the price of export divided by the price of imports can then be constructed as follow:

$$P_t = \frac{P_t^x}{P_t^m} - (P_t^x)^{1/\gamma}$$ (21)

Suppose an economy with initial endowment of exportable and non-tradable net outputs at the beginning of period $t$. The representative households then distribute the allocated income to the consumption of exportable, non-tradable and imported goods. Part of the income is also spent on purchasing the international bonds. Thus, the households have to face the following budget constraint in each period:

$$B_{t+1} = (1 + r_t)B_t + P_t^x NY_t^x + Q_t NY_t^n - P_t^c C_t$$ (22)

where exportable net output is denoted by $NY_t^x$ and non-tradable net output is denoted by $NY_t^n$. In order to maximize household’s lifetime utility function in equation (16) subject to the budget constraint in equation (22) where a Ponzi scheme is not allowed, the first order condition of this problem yields the following Euler equation:

$$1 = \beta E_t(1 + r_{t+1}) \left( \frac{P_t^c}{P_t^{c+1}} \right) \left( \frac{C_t}{C_{t+1}} \right)^{1/\gamma}$$ (23)

By imposing the following transversality condition on international bond holdings where $R_{t,i}$ is the market discount factor:
\[
\lim_{i \to \infty} E_t \left( R_{t,i} B_{t+1+1} \right) = 0 ,
\]

where \( R_{t,i} = \begin{cases} 1/\prod_{j=t+1}^{t+i} (1 + \eta), & \text{if } i \geq 1, \\ 1, & \text{if } i = 0 \end{cases} \)

The intertemporal budget constraint is then yielded by considering both the transversality condition in equation (24) and the budget constraint in equation (22):

\[
\sum_{i=0}^{\infty} E_t R_{t,i} c_{t+i}^T = (1 + r_t)B_t + \sum_{i=0}^{\infty} E_t R_{t,i} p_x^Y N Y_{t+i}^x
\]

The intertemporal budget constraint is linearly approximated by having a first-order Taylor expansion around the unconditional means (Bouakez and Kano, 2008). The consumption-output ratio, \( C_t/Y_t \), is denoted by \( \tau_t \). The ratio of exportable net output to total output, \( P_x^Y N Y_{t+i}^x/P_t^c Y_t \), is denoted by \( \eta_t \). The ratio of foreign debt to total output, \( B_t/P_t^c Y_t \), is denoted by \( b_t \). The linearly approximated intertemporal budget constraint is then constructed as below:

\[
\varepsilon_t \left( 1 - \alpha \right) \exp (r) \bar{b}_t + (1 - \alpha) \exp (r) b \bar{r}_t - \varepsilon t \sum_{i=1}^{\infty} \alpha^i E_t \left[ \Delta c_{t+i}^T - \Delta \tilde{r}_{t+i} \right]
\]

\[+ \eta \left( 1 - \alpha \right) \sum_{i=1}^{\infty} \kappa^i E_t \left[ \Delta n Y_{t+i}^x - \Delta p_{t+i}^x - \tilde{r}_{t+i} \right]
\]

where \( \Delta c_t^T = \ln C_t^T - \ln C_{t-1}^T, \Delta n Y_t^x = \ln N Y_{t}^x - \ln N Y_{t-1}^x \) and \( \Delta p_t^x = \ln P_t^x - \ln P_{t-1}^x \). The variables, \( \tau_t, \eta_t, b_t, \Delta c_t^T, \Delta n Y_t^x, \Delta y_t, r_t, \Delta p_t^x \), are all assumed to be stationary and have the following unconditional means \( \tau \eta, b, g^c, g^{nY}, g^{r}, r, g^p \) respectively. Both \( \alpha \) and \( \beta \) are assumed to be less than 1 where \( \alpha = \exp (g^c - r) \) and \( \beta = \exp (g^p + g^{nY} - r) \).
By assuming joint conditional homoscedasticity and log-normality for the world real interest rate, $r_t$, the consumption price index, $P_t^c$, and the consumption bundle, $C_t$, the linearised representation of the Euler equation in equation (23) can be expressed in log forms as follow (Campbell and Mankiw, 1989, Campbell, 1993 and Campbell et al., 1997):

$$ E_t \Delta \tilde{C}_{t+1} = \sigma E_t \tilde{r}_{t+1} - \sigma (1 - \varepsilon) E_t \Delta \tilde{q}_{t+1}, $$ (27)

From the above equation and the demand function of tradable goods where $C_t^T = \epsilon P_t^c C_t$, the Euler equation for the tradable consumption bundles is estimated by:

$$ E_t \Delta \tilde{C}_{t+1}^T = \sigma E_t \tilde{r}_{t+1} - (1 - \sigma)(1 - \varepsilon) E_t \Delta \tilde{q}_{t+1}, $$ (28)

The present value relationship of the current account output ratio is built by aggregating the intertemporal budget constraint in equation (26) and the Euler equation for tradable goods consumption basket in equation (28):

$$ \tilde{c}a_t = b\tilde{r}_t + [\eta + \varepsilon \tau (\sigma - 1)] \sum_{i=1}^{\infty} \kappa^i E_t \tilde{r}_{t+i} - \eta \sum_{i=1}^{\infty} \kappa^i E_t \Delta \tilde{n}_t y_{t+i}^x + \varepsilon \tau (1 - \sigma)(1 - \varepsilon) \sum_{i=1}^{\infty} \kappa^i E_t \Delta \tilde{q}_{t+i} - \eta (1 - \gamma) \sum_{i=1}^{\infty} \kappa^i E_t \Delta \tilde{p}_{t+i}, $$ (29)

where current account output ratio $c_a_t = CA_t/P_t^c Y_t$. The above condition involves the effects of the changes in the world real interest rate, the consumption behaviour, the real exchange rate, and the terms of trade on the current account. These effects can be analysed by segregating equation (29) into five components.

The instant effect on the current account of a change in the world real interest rate can be represented by the first term in the right hand side of equation (29), $b\tilde{r}_t$. An increase in the
world real interest rate $r_t$ will raise the interest payments for the net foreign asset immediately if the economy is a net borrower with $B_t < 0$. The current account will therefore worsen.

This present value model also measures the effect of expected changes in the future world real interest rate on the current account at present period. The effect can be illustrated by the second term, $[\eta + \epsilon r (\sigma - 1)] \sum_{i=1}^{\infty} \kappa^i E_t \hat{r}_{t+i}$. The impact can be separated into substitution effect, income effect and wealth effect which are measured by $\epsilon \tau \sigma$, $-\epsilon \tau$ and $\eta$ respectively. An increase in the expected world real interest rate in future periods raises the consumption based real interest rate. The current consumption is then more expensive relative to future consumption and representative households will tend to defer their consumption to future periods. Since consumers save more in the current period, the current account is thus improved by this intertemporal effect. The increase of consumption based real interest rate, on the other hand, reduces the cost for future consumption. The lifetime feasible consumption set is then extended and households are prompted to save less and increase their current consumption expenditure. This income effect thus deteriorates the current account. The negative wealth effect can be illustrated by a rise in the world real interest rate which reduces the discount factor and the present value of lifetime income. The wealth effect induces households to consume less and save more in present period and therefore current account improves.

The third term, $-\eta \sum_{i=1}^{\infty} \kappa^i E_t \Delta \hat{n}_{t+i}$, represents the consumption smoothing behaviours of the households. When agents in the economy expect the future national cash flow/national income to change, they will smooth consumptions by tuning the current account.
The impact of the expected changes in the future real exchange rate on the current account can be captured by the forth term, $\epsilon \tau (1 - \sigma)(1 - \epsilon) \sum_{i=1}^{\infty} \kappa^i E_t \Delta q_{t+i}$. This impact is separated into intertemporal substitution effect and income effect which are measured by $-\epsilon \tau \sigma (1-\epsilon)$ and $\epsilon \tau (1-\epsilon)$ respectively. Both effects are similar to those illustrated in the impact of the expected future changes in world real interest rate on the current account.

The effect of the expected changes in the terms of trade on the current account is measured by the last term in equation (29), $-\eta (1 - \gamma) \sum_{i=1}^{\infty} \kappa^i E_t \Delta P_{t+i}$. Since an improvement of terms of trade increases the relative price of exports in term of imports, the present value of representative households’ lifetime income will also be raised and induces consumers to increase current consumption expenditure. The marginal propensity to consume is always less than one and thus the increase of current consumption must be less than the increase of current income. The current account is therefore improved by this HLM effect. On the other hand, a permanent shock to the terms on trade has no impact of the current account since the permanent income hypothesis indicated that households are unable to adjust to the permanent shocks.

The extension of the generalized intertemporal model identified by Bouakez and Kano (2008) decomposes the impact of consumption based interest rate (Bergin and Sheffrin, 2000) into the effects of time varying world interest rate and the expected future fluctuation in real exchange rates. This approach can separate and evaluate the effect of both variables rather than investigating a single composited variable. The generalized model (Bergin and Sheffrin, 2000) illustrated the intertemporal substitution effect of the expected changes in future world real interest rate on the current account while the extended model demonstrated the intertemporal substitution effect as well as the income and wealth effects of the change in the
world varying interest rate. The immediate effect on the net foreign interest payment regarding the change in world real interest rate is also reflected by the extensions of the generalized model.
Chapter 3: Data

3.1 Data Sources

The time series data applied on the basic intertemporal model are obtained from *Australian Bureau of Statistics (ABS)*. On the other hand, the data for additional variables for the generalized intertemporal model are from *International Financial Statistics (IFS)*. Appendix A contains the details of the time series used and Appendix B graphs the major time times adopted in the models.

The data used to estimate the parameters of the models are annual observation for the period: 1960 to 2007. Australia’s quarterly data were found to be problematic to fit into the intertemporal models by Milbourne and Otto (1992) and Cashin and McDermott (1998, 2002). In light of the above findings, Australia’s annual data is tested in this thesis to see if it yields an improvement on the fit of the models.

3.2 Construction of Variables

*Current Account and Net Cash Flow*

The nominal current account is constructed as $CA = Y - C - I - G$ where $Y$ is gross national product, $C$ is household final consumption expenditure, $I$ is investment expenditure which consists of gross fixed capital formation and change in inventories, $G$ is government spending. Nominal Net cash flow is constructed as $Z = Q - I - G$ where $Q$ equals to gross domestic product (GDP). Both nominal variables are converted to constant prices by using the GDP price deflator. The GDP price deflator is obtained by dividing nominal GDP by chain volume measure of GDP each year. Since the models in this thesis are based on rational agents in the
economy, both real current account and real national cash flow are divided by population to obtain per-capita series $ca_t$ and $z_t$ respectively. The time series for the change in net cash flow, $\Delta z_t$, is the first difference of series $z_t$.

The current account as a share of national cash flow, $ca/z_t$, and the growth rate in net cash flow, $%\Delta z_t$, are constructed to reduce the possible effects of heteroscedasticity. The variable $ca/z_t$ is simply the series of real current account divided by the series of real national cash flow and the variable $%\Delta z_t$ is the first difference of the log of $z_t$.

**Consumption based Real Interest Rate and Real Exchange Rate**

The consumption based interest rate is comprised of the world real interest rate and the change in the relative price of non-trades goods.

Nominal interest rates for the United States are used as a proxy for the world interest rate. A series for real interest rates are constructed using the Treasury-bill rate. In order to obtain the world real interest rate, $r_t$, the nominal interest rate has to be adjusted by inflationary expectations which are proxied by past inflation levels. Inflation is measured by using by the CPI data provided by the *IFS*. The nominal world interest rate is then adjusted by inflationary expectations to compute the real world interest rate.

By following the methodology adopted by Rogoff (1992) and Bergin and Sheffrin (2000), a measure of the real exchange rate from the *IFS* can be used as a proxy of the change in relative price of non-traded and traded goods. The Australia’s nominal exchange rates from the *IFS* are converted to real terms by multiplying the nominal rates with the ratio of the United States consumer price index to Australia’s consumer price index. In order to apply the Australia’s real exchange rate into the generalized intertemporal model, the real
exchange rate is logged and differenced to obtain $\Delta q_t$, the change in Australia’s real exchange rate.

The consumption based interest rate, $r^*_t$, can be calculated by combining both world real interest rate and the change in Australia’s real exchange rate as indicated by the generalized intertemporal model. In order to generate the consumption based interest rate, $r^*_t$, the parameters $\alpha$ and $\beta$ are assumed to have certain values. The values of the parameters will be further discussed below.

**Terms of Trade**

The terms of trade are computed as the ratio of export price index to import price index and these indices are collected from IFS. The terms of trade series are logged and expressed in first differences, $\Delta p_t$, the change in Australia’s terms of trade.

**Parameter values**

In order to compute the consumption based interest rate, the generalized intertemporal model also includes the following parameters, $\beta$, $\alpha$ and $\gamma$. The test of the model is also based on the values of these parameters.

The discount factor, $\beta$, is derived from the world real interest rate. By obtaining the sample mean for the real interest rate in the data set, $\bar{r}$, the discount factor is calculated as $1/(1 + \bar{r})$. The discount factor is computed to be equal to approximately 0.986 in this empirical study.

In order to obtain the share of traded goods in private final consumption, $\alpha$, Bergin and Sheffrin (2000) has applied the methods adopted by Stockman and Tesar (1995) and Kravis
et al. (1982) to compute the value of this parameter. The estimates of $\alpha$ by both papers are one-half and two-thirds respectively. Bergin and Sheffrin (2000) used mainly one-half as the value of the share parameter, $\alpha$, in their empirical study. They have also conducted the calculation by using the value found by Kravis et al. (1982), where $\alpha$ is found to be close to two-thirds. The results are similar with both values of the share parameter and thus $\alpha = 0.5$ is chosen for this empirical study.

Due to various views regarding the intertemporal elasticity of substitution in different literatures, there is certain difficulty to provide a specific value for the parameter, $\gamma$. Hall (1988) estimated the intertemporal elasticity is likely to be in the range of 0 to 0.1 because consumption expenditure tends to have little response to real interest rate. Bergin and Sheffrin (2000) obtained the resulting estimate of $\gamma = 0.087$ for Australia’s data which is comparatively lower to other estimates such as $\gamma$ is greater than 0.5 which was estimated by Mehra and Prescott (1985). In respect to all these findings, a value of 0.1 for $\gamma$ is used in this thesis which is within the range of Hall’s (1998) estimate and closes to the estimate of Bergin and Sheffrin (2000).

3.3 Unit Root Tests

One of the underlying assumptions of the intertemporal model is that the current account and its fundamental drivers are stationary. However, in practice variables may not be stationary due to the existence of a unit root and the use of non-stationary data can lead to spurious regressions.
In order to test the presence of a unit root in the variables, augmented Dickey-Fuller (ADF) tests are conducted for all the variables included in the empirical study. The regression for the ADF test is as follows:

\[
\Delta y_t = \theta + \psi y_t + \rho y_{t-1} + \sum_{i=1}^{n} \delta_i \Delta y_{t-i} + e_t
\]

(30)

where \( y \) represents the variable being tested. All the variables are tested by using one lagged difference term and the regression is estimated over the full sample of data. Since current accounts can display local trends, a linear time term is then added to the ADF test for the current account. The null hypothesis of the ADF test is that the coefficient of the lagged dependent variable is zero, \( H_0: \rho = 0 \). If the coefficient is not statistically different from zero based on a t-test, this would indicate that \( y_t \) contains a unit root and is non-stationary.

The results in Table 1 indicates the presence of unit root in \( \Delta z_t \) and \( \% \Delta z_t \) are strongly rejected at the one percent level of significance and hence changes in (or the growth rate of) net cash flow is stationary. According to the basic intertemporal model, the current account is expressed as the present discounted value of the infinite sum of a country’s expected changes in national cash flow. Since \( \Delta z_t \) appears to be stationary, \( ca_t \) should also be considered as a stationary series. From Table 1 it is confirmed that the null hypothesis of a unit root in the current account can be rejected at five per cent level for the \( ca_t \) series when the ADF test includes an intercept and trend term. However, the test statistics fail to provide any evidence against the unit root in current account in the ADF test with intercept term only. This may be due to the low power of the Dickey Fuller test if the process is stationary but with a root close to the non-stationary boundary.
The test statistics also reject the unit root hypothesis for $\Delta q_t$ and $r_t$ at one per cent and ten per cent level respectively. But it is not possible to reject the presence of a unit root in the $r^*_t$ series which is computed as a combination of $\Delta q_t$ and $r_t$. There is some weak evidence against a unit root in $r^*_t$ at around the fifteen per cent significance level. Finally, $\Delta p_t$ and $r_l$ are found to be stationary at one per cent and ten per cent level respectively.

### Table 1

*Unit Root Tests*

<table>
<thead>
<tr>
<th>Variables</th>
<th>ADF test with intercept</th>
<th>ADF test with intercept and trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current account (ca_t)</td>
<td>-1.6239</td>
<td>-3.5687 **</td>
</tr>
<tr>
<td>Current account as a share of GDP (ca/z_t)</td>
<td>-2.4883</td>
<td>-</td>
</tr>
<tr>
<td>Change in net cash flow ($\Delta z_t$)</td>
<td>-4.8552 ***</td>
<td>-</td>
</tr>
<tr>
<td>Percentage change in net cash flow (%$\Delta z_t$)</td>
<td>-4.2094 ***</td>
<td>-</td>
</tr>
<tr>
<td>World real interest rate ($r_t$)</td>
<td>-2.6089 *</td>
<td>-</td>
</tr>
<tr>
<td>Change in exchange rate ($\Delta q_t$)</td>
<td>-5.0654 ***</td>
<td>-</td>
</tr>
<tr>
<td>Consumption based interest rate ($r^*_t$)</td>
<td>-2.5209</td>
<td>-</td>
</tr>
<tr>
<td>Change in terms of trade ($\Delta p_t$)</td>
<td>-5.4408 ***</td>
<td>-</td>
</tr>
</tbody>
</table>

*Notes:*
- ADF tests are conducted at the level of 1 lag.
- Critical values for the ADF test statistics are from Fuller (1976).
- To compute for the $r^*_t$ series, $\alpha = 0.5$, $\gamma = 0.1$ and $\beta = 0.986$
- ‘***’, ‘**’ and ‘*’ imply significance at the 1, 5 and 10 per cent levels respectively
Chapter 4: Tests of the Intertemporal Models

4.1 Granger-causality Tests

Granger-causality tests have been extensively adopted in recent decades to investigate possible causal relationships between economic variables (Granger, 1969). The present-value models discussed above imply that today’s current account should reflect households’ expectations of future movements in national cash flow, world varying interest rate, real exchange rate and the terms of trade. Unless there is an exact linear relationship between current account and the current and lagged values of the above variables, today’s current account will contain information about the expected future changes in the other variables identified in the intertemporal models. Therefore, current account should possess the ability to forecast these macroeconomic variables. The following regression model is estimated to test the above implication of the present-value relationship:

\[ X_t = \pi + \theta X_{t-1} + \alpha c\text{a}_{t-1} + \epsilon_t \]  

(31)

where \( X_t \) includes variables identified in the present-value models which are changes in net cash flow (\( \Delta z_t \)), time varying world real interest rate \( (r_t) \), changes in Australia’s real exchange rate \( (\Delta q_t) \), the consumption-based interest rate \( (r^*_t) \), and the changes in Australia’s terms of trade \( (\Delta p_t) \).

As an alternative to the above model where the current account enters in levels, a second specification is considered where the above variables are regressed against the current...
account as a share of national cash flow ($ca_t/z_t$) and thus the following regression model is estimated:

$$Y_t = \gamma + \theta Y_{t-1} + \beta \left( \frac{ca_{t-1}}{z_{t-1}} \right) + v_t$$

(32)

where $Y_t$ includes the growth rate in national cash flow, ($%Az_t$) which is obtained by first difference of the log terms of national cash flow, time varying world real interest rate ($r_t$), changes in Australia’s real exchange rate ($Aq_t$), the consumption-based interest rate ($r^*_t$) and the changes in Australia’s terms of trade ($Ap_t$).

The focus of (31) and (32) is on whether the current account Granger-causes the other macroeconomic variables. The sign and significance of $\alpha$ and $\beta$ are examined to check the economic and statistical significance for the current account to forecast the variables indicated in the intertemporal models.

Although equation (31) and (32) contain only one lag of each variable, the Granger-Causality test can be generalized to allow for $p$ lags and an F-test can be conducted to examine the joint significance of the lagged values of the current account to forecast the future changes in the other macroeconomic variables.

4.2 Long Horizon Regressions

Long horizon regressions have been widely used in financial economics. One important application is in looking at whether the dividend ratio can predict long horizon changes in stock prices (Campbell and Shiller, 1988; Fama and French, 1988). This methodology can be applied on the intertemporal models to evaluate whether the current account has the long
horizon predictability for other macroeconomic variables by estimating the following regression model:

\[ X_{t+i} - X_t = \alpha + \beta c_{a_t} + \epsilon_{t+i} \]  \hspace{1cm} (33)

where \( X_t \) represents each of the variables identified in the intertemporal models and \( i \) is equal to 1, 2 and 3 respectively. The coefficient of today’s current account, \( \beta \), is then checked by \( t \)-test to examine whether it has the appropriate sign as indicated by the present value models and whether it is statistical significant. If these conditions are met, then today’s current account is considered to be able to forecast the long horizon changes in other variables. The long run and short run predictability of the current account can be tested by conducting the Granger-Causality test and estimating the long horizon regression.

### 4.3 Orthogonality Tests

The Granger-Causality test and the long horizon test can effectively analyse the ability of the current account to predict other financial variables but they do not test all the restrictions that the present-value models impose on the data. The present value relationships derived in Chapter 2 have the effects of imposing restrictions on the relationships between the time series. The orthogonality test can formally examine the restrictions implied by the models and evaluate whether the data are consistent with the present value models (Campbell and Shiller, 1987; Otto, 1992).

The test can be derived by using the basic intertemporal model in the following steps:

\[ c_{a_t} = -(\psi E_t \Delta z_{t+1} + \psi^2 E_t \Delta z_{t+2} + \psi^3 E_t \Delta z_{t+3} \ldots) \]  \hspace{1cm} (34)
where $\psi = 1/(1 + r)$ and $r$ is the world real interest rate and thus equation (34) for period $t + 1$ can be constructed as follow:

$$c_a_{t+1} = -(\psi E_{t+1} \Delta z_{t+2} + \psi^2 E_{t+1} \Delta z_{t+3} + \psi^3 E_{t+1} \Delta z_{t+4} \ldots) \quad (35)$$

By taking expectations conditional on information at time $t$ on both sides of the above equation, the following can be obtained:

$$E_t c_a_{t+1} = -(\psi E_t \Delta z_{t+2} + \psi^2 E_t \Delta z_{t+3} + \psi^3 E_t \Delta z_{t+4} \ldots) \quad (36)$$

The law of iterated expectations has been applied to construct the above equation where $E_t(E_{t+k}X_{t+k}) = E_tE_{t+k}$. Multiplying both sides of equation (36) by $\psi$ and subtracting that from equation (34) yields

$$c_a_t = \frac{1}{1 + r} E_t(c_a_{t+1} - \Delta z_{t+1}) \quad (37)$$

Assuming rational expectations, the conditional expectation in equation (37) can be substituted by the realized expectation plus a random forecast error. The following equation can then be obtained with the innovation term, $\mu_{t+1}$:

$$c_a_{t+1} - \Delta z_{t+1} - (1 + r) c_a_t = \mu_{t+1} \quad (38)$$

If agents in the economy have rational expectation, the forecast error in equation (38) will be orthogonal to any information dated period $t$ or earlier. Thus, the expected value of the error team at period $t+1$ conditional on agent’s information set available at period $t$ will be equal to zero, $E(\mu_{t+1}|I_t) = 0$. 

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The data are consistent with the intertemporal model if the linear combination of the current account and change in net cash flow on the left hand side of equation (38) is uncorrelated with any other variables in the models dated period $t$ or earlier. The following variable can be formed by assuming a certain value of the real interest rate:

$$X_t = ca_t - \Delta z_t - (1 + r)ca_{t-1}$$  \hspace{1cm} (39)

In order to test the orthogonality restrictions derived from the intertemporal models, the following regressions are estimated for each model:

- **basic model:**
  $$X_t = \pi_t + \theta_1 ca_{t-1} + \theta_2 \Delta z_{t-1} + \mu_t$$  \hspace{1cm} (40)

- **generalized model:**
  $$X_t = \pi_t + \theta_1 ca_{t-1} + \theta_2 \Delta z_{t-1} + \theta_3 r^*_{t-1} + \mu_t$$  \hspace{1cm} (41)

- **extended model:**
  $$X_t = \pi_t + \theta_1 ca_{t-1} + \theta_2 \Delta z_{t-1} + \theta_3 r^*_{t-1} + \theta_4 \Delta p_{t-1} + \mu_t$$  \hspace{1cm} (42)

F tests are then conducted to test the hypothesis that the coefficients for the lagged variables, $\theta_i$, are jointly insignificant. If the null hypothesis for the basic model, $\theta_1 = \theta_2 = 0$, cannot be statistically rejected, the data are considered to be consistent with the basic present value model. The difference between the forecast and the actual current account is thus unpredictable, given the relevant information set.
4.4 Results

The tests of the present value models are conducted over three sample periods: the full sample (1960 to 2007) and the sub-samples (1960-1980) and (1980-2007). The tests on the sub-samples are conducted as robustness checks for the results in the full sample and the choice of sub-sample periods is based on Cashin and McDermott (1998, 2002) who found stronger support for the basic intertemporal model since the deregulation of the Australia’s financial system in the early 1980s.

Full sample Result

The basic present value model implies that the current account is the present discounted sum of expected future changes in a country’s national cash flow. This implies that $ca_t$ should Granger-cause $\Delta z_t$ because current account contains information to predict future movements in net cash flow (not because of a structural relationship between $ca_t$ and $\Delta z_t$.) The upper half of Table 1 below reports the Granger-Causality tests of the intertemporal models (lag-length equal one) for the full sample period. For the basic model, the coefficient on $ca_{t-1}$ in the equation of $\Delta z_t$ and the coefficient of $ca/z_{t-1}$ in the equation of $\%\Delta z_t$ are both negative, which is consistent with the basic intertemporal model. This implies an increase in the current account deficit predicts a rise in the growth rate of future national cash flow. Both coefficients are also highly statistically significant at the five per cent and the one per cent levels respectively. Thus, there is strong evidence that the $ca_t$ does Granger-cause $\Delta z_t$. The results in lower half of Table 2 confirm these results for the models based on two lags.

The long horizon test is also implemented to examine whether the current account possess any long run ability to forecast changes in future net output. Table 3 summarizes the results for the long horizon tests of intertemporal models for the full sample period. There is strong
evidence that $ca_t$ can predict both $\Delta z_t - \Delta z_{t-1}$ and $\Delta z_t - \Delta z_{t-2}$. The coefficients on $ca_t$ are both negative and statically significant at one per cent level which implies that today’s current account anticipates changes in national cash flow over a horizon of two years. However, there is little evidence that the current account forecasts changes in national cash flow over longer horizons than two years.

Although the ability of current account to forecast changes in net cash flow is consistent with the basic intertemporal model, it does not provide a comprehensive test of all of the restrictions imposed on the data by the basic model. The orthogonality test discussed in the previous chapter is implemented to test the restrictions. The annual real interest rate is assumed to be 5 per cent and as indicated from the results in Table 4, the variable $X_t = ca_t - \Delta z_t - (1+r)ca_{t-1}$ is found to be uncorrelated with lagged values of $ca$ and $\Delta z$. The associated p-value for the orthogonality test of basic present value model is 0.9145 for the full sample. The results from the orthogonality test indicate that the annual Australian data is consistent with the restrictions imposed by the basic intertemporal model.

Bergin and Sheffrin (2000) suggested that the inclusion of the consumption-based interest rate improves the fit of the intertemporal model to the Australia’s quarterly data. This additional variable seems particularly relevant to a small open economy like Australia as it can potentially capture external shocks to the economy. However according to Table 2, there is no support for the hypothesis of Granger-causality from $ca_t$ to $r_t$, $ca_t$ to $\Delta q_t$, and $ca_t$ to $r^*_t$. The current account has no short run predictability for the future world real interest rate, changes in real exchange interest rate or the consumption-based real interest rate. Similarly, the Australian current account is found to have no ability to predict these variables over longer horizons. None of the coefficients on $ca_t$ in Table 3 are statistically different from zero.
for the generalized present value model. These findings are inconsistent with the prediction of
the generalized intertemporal model where world real interest rate, real exchange rate and
consumption based interest rate are relevant to the optimal investment and saving decisions
by the agents in an economy.

Since there is also a close relationship between movements in terms of trade and the
fluctuation of business cycle in small open economies, the terms of trade shocks maybe an
important factor in explaining the current account changes in these countries (Mendoza,
1995). Bouakez and Kano (2008) extended the intertemporal model by allowing variations of
terms of trade and investigate whether this will improve the fit of the present value model.
From the results in Table 2 the current account is found to have no ability to predict any
future changes in the terms of trade. The coefficients on the lagged values of $ca_t$ and $ca/z_t$ are
statistically insignificant in both the one lag and two lag Granger-causality tests. The current
account also fails to forecast changes in the terms of trade in the long horizon test (see Table
3). Thus, there no evidence in the full sample data to support Bouakez and Kano’s extended
model for Australia.

The above empirical findings provide support for the basic model and the inclusion of the
interest rate, exchange rate and terms of trade fail to improve the ability of the present value
model to explain the current account. As further confirmation of this finding, the
orthogonality test is generalized by including as additional independent variable ($r^*_{t-1}$ and $\Delta p_t$).
If either of these variables dated at time $t-1$ is correlated with the linear combination of the
current account and net cash flow, the restrictions that the basic present value model imposes
on the data would be rejected. Results in Table 4 indicate that the lagged values of $ca_t$, $\Delta z_t$ and
$r^*_{t}$ are jointly insignificant and the null hypothesis of $\theta_1 = \theta_2 = \theta_3 = 0$ is not rejected (p-value
of 0.8712). Further extending the orthogonality test to include $\Delta p_{t-1}$, the lagged values of all the independent variables are still uncorrelated with the dependent variable, $X_t$, with the reported p-value of 0.5831. These results imply that the linear combination of current account and national cash flow is orthogonal and uncorrelated with these additional variables. It provides further evidence to support that the basic present value model is consistent with the data and capable of explaining current account movements in Australia.

The findings in the full sample period are summarized as follows. There is strong evidence that the basic intertemporal model can reasonably explain the current account fluctuations in Australia during 1960 – 2007. The current account has short run ability to forecast the future changes in the national cash flow. On the other hand, the generalized and the extended present value models are both statistically rejected by the full sample data and the current account is found to have no significant ability to explain any of the variables implied by both models. Thus, the world real interest rate, changes in exchange rate and the terms of trade variations are not important in explaining the current account movements in Australia during the full sample period.

The above result provides certain support for the view that current account deficit is simply the outcome of the forward looking decisions by Australians to smooth their consumption paths. This general result is fairly contrasts with the findings of Milbourne and Otto (1992) who investigated the Australian current account from 1961-1989. Although the findings that the current account does Granger-causes the changes in national cash flow are consistent with their results in the full sample, the results of the orthogonality test in this thesis differ from the findings of Milbourne and Otto that the validity of the basic present value model to explain the Australia’s current account behaviour is strongly rejected. The positive support
for the basic intertemporal model in this empirical study also differs to the results by Cashin and McDermott (1998), and Belkcar, Cockerell and Kent (2007) who find that Australian data are not consistent with the basic intertemporal model.

The empirical findings also suggest that allowing movements in exchange rate and interest rate does not help to explain current account fluctuations in Australia. This contrasts with the finding in Bergin and Sheffrin (2000) where the generalized model is found to perform better on quarterly Australian data than the basic model. However, the result in this thesis is consistent with Bouakez and Kano (2008), who find that the generalized intertemporal model does not improve the fit of the basic intertemporal model on Australian quarterly data.

Cashin and McDermott (2002) adopted a structural VAR approach and suggested that the terms of trade variations have the ability to explain a large proportion of current account movements in Australia. Again this differs from the empirical results presented in this thesis where current account is shown not to predict terms of trade variations.
Sub-samples Results

Prior to the early 1980s, the existence of capital controls may have resulted in restricted consumption smoothing behaviour in Australia. Since the beginning of the 1980s, the Australian financial system became increasingly deregulated and the implementation of a floating exchange rate regime in December 1983 saw the removal of any remaining restrictions on the overseas capital transactions. It is reasonable that the intertemporal models of current account may have better performance in the post-deregulation period (Cashin and McDermott, 1998).

Table 5 and Table 8 present the results from estimating the Granger-causality tests for both sub-samples of data. In the earlier sub-sample 1960-1980, the estimate for the lagged value of $ca_t$ provides strong support that $ca_t$ does Granger-cause $\Delta z_t$. Coefficients on $ca_{t-1}$ and $ca/z_{t-1}$ are statistically significant and have negative signs. The coefficients of the lagged values of $ca_t$ and $ca/z_t$ in the two lag Granger-causality test are statistically insignificant as indicated from Table 5. Comparing the results in the period 1981-2007 with those from the earlier sub-sample, the coefficients in both Granger-causality tests are apparently more significant indicating an increase of the ability of current account to predict future changes in national cash flow, under the deregulated financial system. Today’s current account is also capable to foreshadow the average changes in national cash flow in both sub-samples as illustrated the long horizon tests in Table 6 and Table 9.

The orthogonality tests can be conducted to determine whether the sub-sample data are consistent with the basic present value model. It is noted from Table 7 and Table 10 that $ca_t - \Delta z_t - (1+r)ca_{t-1}$ is orthogonal to the lagged values of $ca$ and $\Delta z$ in the earlier sub-sample with the p-value of 0.7220 while the lagged values of $ca$ and $\Delta z$ in latter sub-sample 1981-2007 are
jointly correlated with the dependent variable, $X_t$, with the reported p-value of 0.0475. This provides some support that the basic intertemporal model is consistent with the earlier sub-sample data but surprisingly is rejected during the later sub-sample.

It is interesting to examine whether the generalized model has a more significant support in the later sub-sample period 1981-2007. However similar results to the full sample emerge. There is no evidence that the current account has any ability to forecast the future changes in the variables of the generalized model either in sub-sample 1960-1980 or sub-sample 1981-2007.

The extension of the generalized intertemporal model with variable terms of trade is statistically rejected in Bouakez and Kano (2008) paper and the empirical finding for the full sample period in this thesis. However, this finding generally contrasts from the empirical results in the later sub-sample where the current account is found to have some ability to forecast changes in terms of trade. From Table 8, the coefficient of the lagged $ca_t$ in the one lag Granger-causality test are estimated to be statistical significant at one per cent level with the appropriate negative sign as implied by the extension of the generalized model. In the two lag model $ca_{t-1}$ and $ca_{t-2}$ are also jointly significant (p-value of 0.0134). Therefore, there is strong support in the latter sub-sample data that current account has short run capability to forecast the changes in terms of trade. Despite the positive result in the latter sub-sample period, the current account is found to have no ability to predict variations in the terms of trade in the earlier sub-sample period (see Table 5).

The orthogonality tests are generalized by the inclusion of the additional explanatory variables $r^{*}_{t-1}$ and $\Delta p_{t-1}$. Adding the consumption based interest rate into the orthogonality
test in sub-sample 1960-1980, indicates the dependent variable is still uncorrelated with the explanatory variables. However including the terms of trade in the orthogonality test in the earlier sub-sample period causes the dependent variable \( ca_t - \Delta z_t - (1+r)ca_{t-1} \) to be significantly correlated with the lagged value of current account and changes in terms of trade at five percent level. The reported value of the joint significance of the explanatory variables is 0.000004 for the earlier sub-sample. As illustrated above, since the lagged value of \( ca \) and \( \Delta z \) are jointly correlated with the dependent variable in the latter sub-sample, the inclusion of additional variables in the right hand side of the orthogonality test does not effectively alter the result. The reported values of the orthogonality test by adding \( r^{*}_{t-1} \) and \( \Delta p_{t-1} \) are 0.0898 and 0.1523 respectively. Thus, the orthogonality tests suggest that the basic present value model is not significantly rejected by the data in earlier sub-sample while there is some evidence against the basic model in the latter sub-sample.

The results from both sub-sample periods are summarized as follows. There is strong support that the current account has short run ability to forecast the changes in national cash flow in both sub-sample periods. There is also evidence that the current account has some predictability to the terms of trade variations in the latter sub-sample period. Nevertheless, the current account has again found to possess no relationship with any of the other variables implied by generalized and the extension of the generalized model. The basic intertemporal model is estimated to be consistent with sub-sample data in 1960-1980 while it is statistically rejected in latter sub-sample 1981-2007. The deregulation of the financial system and the liberalization of the capital controls since the early 1980s are thus unable to provide a stronger support for the basic intertemporal model. This may due to the large fluctuations in the current account and the terms of trade in recent years. Comparing with the full-sample results in the orthogonality tests, weaker support for the basic present value model is found in
both sub-sample periods. These results interestingly contrasts with the views of Olekalns (1997), Cashin and McDermott (1998, 2002) and Otto (2003) which they suggest the deregulation of the Australia's financial system plays an important role to improve the fit of the basic intertemporal model and the consumption smoothing behaviour of the consumers where current account deficit has raised because the forward-looking decisions are made correctly by the Australians.
Table 2
Granger-Causality Tests of the Intertemporal Models for Australia (Full sample: 1960-2007)

<table>
<thead>
<tr>
<th>Regressor</th>
<th>Basic</th>
<th>Generalized</th>
<th>Extended</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Δz_t</td>
<td>%Δz_t</td>
<td>r_t</td>
</tr>
<tr>
<td>ca_t-1</td>
<td>-0.1838*</td>
<td>-</td>
<td>-0.0002</td>
</tr>
<tr>
<td></td>
<td>(-2.3045)</td>
<td></td>
<td>(-0.8333)</td>
</tr>
<tr>
<td>ca/z_t-1</td>
<td>-0.2620**</td>
<td>-8.6875</td>
<td>0.0092</td>
</tr>
<tr>
<td></td>
<td>(-2.9324)</td>
<td>(-1.1017)</td>
<td>(0.0203)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Regressor</th>
<th>Basic</th>
<th>Generalized</th>
<th>Extended</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Δz_t</td>
<td>%Δz_t</td>
<td>r_t</td>
</tr>
<tr>
<td>ca_t-1</td>
<td>-0.4639***</td>
<td>-</td>
<td>0.00002</td>
</tr>
<tr>
<td></td>
<td>(-2.7920)</td>
<td></td>
<td>(0.0423)</td>
</tr>
<tr>
<td>ca_t-2</td>
<td>0.3238*</td>
<td>-</td>
<td>-0.0003</td>
</tr>
<tr>
<td></td>
<td>(1.8251)</td>
<td></td>
<td>(-0.8992)</td>
</tr>
<tr>
<td>ca/z_t-1</td>
<td>-0.6862***</td>
<td>-4.2668</td>
<td>0.3130</td>
</tr>
<tr>
<td></td>
<td>(-4.3258)</td>
<td>(-0.5094)</td>
<td>(0.6279)</td>
</tr>
<tr>
<td>ca/z_t-2</td>
<td>0.4395***</td>
<td>-9.0101</td>
<td>-0.4894</td>
</tr>
<tr>
<td></td>
<td>(2.6526)</td>
<td>(-1.3269)</td>
<td>(-0.8335)</td>
</tr>
</tbody>
</table>

Notes:
- α = 0.5, γ = 0.1, β = 0.986 to computer the series r*_t
- ca_t-1 and ca_t-2 are jointly significant to forecast Δz_t with p-value: 0.0075
- ca_t-1 and ca_t-2 are jointly significant to forecast Δz_t with p-value: 0.00003
- Lags of ca_t and ca/z_t are jointly insignificant to forecast the other variables (r_t, Δq_t, r*_t and Δp_t)
- Numbers in round brackets are White (1980) t-statistics
- ‘***’, ‘**’ and ‘*’ imply significance at the 1, 5 and 10 per cent levels respectively
### Table 3

*Long Horizon Tests of the Intertemporal Models for Australia (Full sample: 1960-2007)*

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Basic $c_{t}$</th>
<th>Generalized $c_{at}$</th>
<th>Extended $c_{at}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta z_{t+1} - \Delta z_{t}$</td>
<td>-0.2304**</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(-2.0834)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta z_{t+2} - \Delta z_{t}$</td>
<td>-0.1829***</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(-2.4348)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta z_{t+3} - \Delta z_{t}$</td>
<td>-0.0811</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(-1.2994)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r_{t+1} - r_{t}$</td>
<td>-</td>
<td>-0.00002</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.0584)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r_{t+2} - r_{t}$</td>
<td>-</td>
<td>-0.0001</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(-0.1020)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r_{t+3} - r_{t}$</td>
<td>-</td>
<td>0.0003</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.4539)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta q_{t+1} - \Delta q_{t}$</td>
<td>-</td>
<td>0.000004</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.1540)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta q_{t+2} - \Delta q_{t}$</td>
<td>-</td>
<td>0.000002</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.0473)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta q_{t+3} - \Delta q_{t}$</td>
<td>-</td>
<td>0.00002</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.5387)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r_{t+1}^{<em>} - r_{t}^{</em>}$</td>
<td>-</td>
<td>0.000002</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.0078)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r_{t+2}^{<em>} - r_{t}^{</em>}$</td>
<td>-</td>
<td>-0.00005</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(-0.0957)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r_{t+3}^{<em>} - r_{t}^{</em>}$</td>
<td>-</td>
<td>0.0004</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.5424)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta p_{t+1} - \Delta p_{t}$</td>
<td>-</td>
<td>-</td>
<td>-0.00002</td>
</tr>
<tr>
<td></td>
<td>(-0.7035)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta p_{t+2} - \Delta p_{t}$</td>
<td>-</td>
<td>-</td>
<td>-0.00003</td>
</tr>
<tr>
<td></td>
<td>(0.5298)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta p_{t+3} - \Delta p_{t}$</td>
<td>-</td>
<td>-</td>
<td>-0.00002</td>
</tr>
<tr>
<td></td>
<td>(0.4267)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- $\alpha = 0.5, \gamma = 0.1, \beta = 0.986$ to computer the series $r_{t}^{*}$
- Numbers in round brackets are White (1980) t-statistics
- ‘***’, ‘**’ and ‘*’ imply significance at the 1, 5 and 10 per cent levels respectively
Table 4

Orthogonality Tests of the Intertemporal Models for Australia (Full sample: 1960-2007)

<table>
<thead>
<tr>
<th>Orthogonality Test</th>
<th>Dependent Variable</th>
<th>Basic</th>
<th>Generalized</th>
<th>Extended</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$X_t$</td>
<td>$X_t$</td>
<td>$X_t$</td>
<td></td>
</tr>
<tr>
<td>$ca_{t-1}$</td>
<td>-0.0217</td>
<td>-0.0348</td>
<td>-0.0220</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.4026)</td>
<td>(-0.6117)</td>
<td>(-0.4498)</td>
<td></td>
</tr>
<tr>
<td>$\Delta z_{t-1}$</td>
<td>-0.0176</td>
<td>-0.0101</td>
<td>0.0331</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.2057)</td>
<td>(-0.1101)</td>
<td>(-0.3302)</td>
<td></td>
</tr>
<tr>
<td>$r^*_{t-1}$</td>
<td>-</td>
<td>-14.5931</td>
<td>-16.4170</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-0.7191)</td>
<td>(-0.7995)</td>
<td></td>
</tr>
<tr>
<td>$\Delta p_{t-1}$</td>
<td>-</td>
<td>-</td>
<td>682.2495</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1.6258)</td>
<td></td>
</tr>
</tbody>
</table>

Basic Model: Joint significance of lags: p-value = 0.9145
Generalized Model: Joint significance of lags: p-value = 0.8712
Extended Model: Joint significance of lags: p-value = 0.5831

Notes:
- $\alpha = 0.5, \gamma = 0.1, \beta = 0.986$ to compute the series $r^*_t$
- Series $X_t$ in the Orthogonality Test is constructed as $(ca_t - \Delta z_t - (1+r)ca_{t-1})$
- Results in Orthogonality Test is based $r = 0.05$
- Numbers in round brackets are White (1980) t-statistics
- ‘***’, ‘**’ and ‘*’ indicate rejection of null at the 1, 5 and 10 per cent significance levels respectively
Table 5

<table>
<thead>
<tr>
<th>Regressor</th>
<th>Basic</th>
<th>%Δz</th>
<th>Δq</th>
<th>r*</th>
<th>Δp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Δz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td>%Δz</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>r</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Δq</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>r*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Δp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ca_{t-1}</td>
<td>-0.3172</td>
<td>-</td>
<td>0.0007</td>
<td>0.000003</td>
<td>-0.0005</td>
</tr>
<tr>
<td></td>
<td>(-2.4865)</td>
<td>(-0.7482)</td>
<td>(0.0878)</td>
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<td>(-0.3905)</td>
</tr>
<tr>
<td>ca/z_{t-1}</td>
<td>-</td>
<td>-0.4797</td>
<td>-11.7805</td>
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<td>-9.7058</td>
</tr>
<tr>
<td></td>
<td>(-4.0992)</td>
<td>(-0.9436)</td>
<td>(-0.2017)</td>
<td>(-1.0347)</td>
<td>(-0.5022)</td>
</tr>
</tbody>
</table>

Granger-Causality Test (2 lag)

<table>
<thead>
<tr>
<th>Regressor</th>
<th>Basic</th>
<th>%Δz</th>
<th>Δq</th>
<th>r*</th>
<th>Δp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Δz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>%Δz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>r</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Δq</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>r*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Δp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ca_{t-1}</td>
<td>-0.0811</td>
<td>-</td>
<td>0.0010</td>
<td>0.000001</td>
<td>-0.0007</td>
</tr>
<tr>
<td></td>
<td>(-0.4014)</td>
<td>(-0.9062)</td>
<td>(-0.0257)</td>
<td>(-0.8816)</td>
<td>(0.8515)</td>
</tr>
<tr>
<td>ca_{t-2}</td>
<td>-0.3204</td>
<td>-</td>
<td>0.0006</td>
<td>0.000001</td>
<td>0.0005</td>
</tr>
<tr>
<td></td>
<td>(-1.2115)</td>
<td>(1.1418)</td>
<td>(0.2871)</td>
<td>(0.8977)</td>
<td>(-1.0062)</td>
</tr>
<tr>
<td>ca/z_{t-1}</td>
<td>-</td>
<td>-0.3140</td>
<td>-11.8540</td>
<td>-0.0663</td>
<td>-9.133</td>
</tr>
<tr>
<td></td>
<td>(-1.1647)</td>
<td>(-0.9388)</td>
<td>(-0.1632)</td>
<td>(-0.9127)</td>
<td>(0.6600)</td>
</tr>
<tr>
<td>ca/z_{t-2}</td>
<td>-</td>
<td>-0.2094</td>
<td>1.9372</td>
<td>0.0742</td>
<td>2.2760</td>
</tr>
<tr>
<td></td>
<td>(-0.6103)</td>
<td>(0.2930)</td>
<td>(0.1731)</td>
<td>(0.3380)</td>
<td>(-1.0574)</td>
</tr>
</tbody>
</table>

Notes:
- $\alpha = 0.5, \gamma = 0.1, \beta = 0.986$ to compute the series $r^*_t$
- Lags of $ca_t$ and $ca/z_t$ are jointly insignificant to forecast any of the variables ($\Delta z_t$, %$\Delta z_t$, $r_t$, $\Delta q_t$, $r^*_t$, and $\Delta p_t$)
- Numbers in round brackets are White (1980) t-statistics
- ‘***’, ‘**’ and ‘*’ imply significance at the 1, 5 and 10 per cent levels respectively
Table 6


<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Basic</th>
<th>Generalized</th>
<th>Extended</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta z_{t+1} - \Delta z_t$</td>
<td>$-0.7348^*$</td>
<td>$-0.5103^{**}$</td>
<td>$-0.5847^*$</td>
</tr>
<tr>
<td>($-2.4085$)</td>
<td>($-2.3534$)</td>
<td>($-1.8795$)</td>
<td></td>
</tr>
<tr>
<td>$\Delta z_{t+2} - \Delta z_t$</td>
<td>$-0.0005$</td>
<td>$-0.0001$</td>
<td>$0.0007^*$</td>
</tr>
<tr>
<td>($-0.6915$)</td>
<td>($-0.1048$)</td>
<td>($1.7202$)</td>
<td></td>
</tr>
<tr>
<td>$\Delta z_{t+3} - \Delta z_t$</td>
<td>$-0.00006$</td>
<td>$0.00005$</td>
<td>$0.00007^*$</td>
</tr>
<tr>
<td>($-0.7495$)</td>
<td>($0.9373$)</td>
<td>($0.7220$)</td>
<td></td>
</tr>
<tr>
<td>$\Delta q_{t+1} - \Delta q_t$</td>
<td>$-0.0002$</td>
<td>$-0.0008$</td>
<td></td>
</tr>
<tr>
<td>($-0.3459$)</td>
<td>($0.0810$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta q_{t+2} - \Delta q_t$</td>
<td>$0.0010^{**}$</td>
<td>$0.0010^{**}$</td>
<td></td>
</tr>
<tr>
<td>($2.2941$)</td>
<td>($2.2941$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta p_{t+1} - \Delta p_t$</td>
<td>$-0.00007$</td>
<td>$-0.0001$</td>
<td>$-0.0001$</td>
</tr>
<tr>
<td>($-0.7495$)</td>
<td>($-0.8031$)</td>
<td>($-1.7978$)</td>
<td></td>
</tr>
<tr>
<td>$\Delta p_{t+2} - \Delta p_t$</td>
<td>$-0.0001$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>($-0.8031$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta p_{t+3} - \Delta p_t$</td>
<td>$-0.0001$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>($-1.7978$)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
- $\alpha = 0.5$, $\gamma = 0.1$, $\beta = 0.986$ to computer the series $r^*_t$
- Numbers in round brackets are White (1980) $t$-statistics
- ‘***’, ‘**’ and ‘*’ imply significance at the 1, 5 and 10 per cent levels respectively
Table 7


<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Basic</th>
<th>Generalized</th>
<th>Extended</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$X_t$</td>
<td>$X_t$</td>
<td>$X_t$</td>
</tr>
<tr>
<td>$ca_{t-1}$</td>
<td>-0.0942</td>
<td>-0.0708</td>
<td>-0.1342</td>
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<tr>
<td></td>
<td>(-0.7998)</td>
<td>(-0.6094)</td>
<td>(-2.4405)</td>
</tr>
<tr>
<td>$\Delta z_{t-1}$</td>
<td>0.0253</td>
<td>0.0069</td>
<td>-0.0416</td>
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<tr>
<td></td>
<td>(0.1787)</td>
<td>(0.0502)</td>
<td>(-0.2545)</td>
</tr>
<tr>
<td>$r^*_{t-1}$</td>
<td>-</td>
<td>14.8612</td>
<td>-17.7587</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.8648)</td>
<td>(-0.6897)</td>
</tr>
<tr>
<td>$\Delta p_{t-1}$</td>
<td>-</td>
<td>-</td>
<td>991.3768</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2.0782)</td>
</tr>
</tbody>
</table>

Basic Model: Joint significance of lags : p-value = 0.7220
Generalized Model: Joint significance of lags : p-value = 0.7095
Extended Model: Joint significance of lags : p-value = 0.000004***

Notes:
- $\alpha = 0.5, \gamma = 0.1, \beta = 0.986$ to compute the series $r^*$
- Series $X_t$ in the Orthogonality Test is constructed as $(ca_t - \Delta z_t - (1+r)ca_{t-1})$
- Results in Orthogonality Test is based $r = 0.05$
- Numbers in round brackets are White (1980) $t$-statistics
- ‘***’, ‘**’ and ‘*’ indicate rejection of null at the 1, 5 and 10 per cent significance levels respectively

### Granger-Causality Test (1 lag)

<table>
<thead>
<tr>
<th>Regressor</th>
<th>Basic</th>
<th>Generalized</th>
<th>Extended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δz_t</td>
<td>%Δz_t</td>
<td>r_t</td>
<td>Δq_t</td>
</tr>
<tr>
<td>ca_t-1</td>
<td>-0.3190*</td>
<td>-0.00008</td>
<td>0.00002</td>
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<tr>
<td></td>
<td>(-1.7905)</td>
<td>(-0.1801)</td>
<td>(0.7716)</td>
</tr>
<tr>
<td>ca/z_t-1</td>
<td>-0.4257***</td>
<td>-3.4114</td>
<td>0.1075</td>
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<tr>
<td></td>
<td>(-4.3396)</td>
<td>(-0.3569)</td>
<td>(0.9268)</td>
</tr>
</tbody>
</table>

### Granger-Causality Test (2 lag)

<table>
<thead>
<tr>
<th>Regressor</th>
<th>Basic</th>
<th>Generalized</th>
<th>Extended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δz_t</td>
<td>%Δz_t</td>
<td>r_t</td>
<td>Δq_t</td>
</tr>
<tr>
<td>ca_t-1</td>
<td>-0.5124**</td>
<td>0.0002</td>
<td>0.00005</td>
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<tr>
<td></td>
<td>(-2.6730)</td>
<td>(0.4779)</td>
<td>(0.8879)</td>
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<tr>
<td>ca_t-2</td>
<td>0.4101**</td>
<td>-0.0004</td>
<td>-0.00003</td>
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<tr>
<td></td>
<td>(2.0648)</td>
<td>(-0.9479)</td>
<td>(-0.5082)</td>
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<tr>
<td>ca/z_t-1</td>
<td>-0.6261***</td>
<td>2.0548</td>
<td>0.9555</td>
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<tr>
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<td>(-3.3278)</td>
<td>(0.2323)</td>
<td>(0.9608)</td>
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<tr>
<td>ca/z_t-2</td>
<td>0.3251*</td>
<td>-11.1563*</td>
<td>-1.0838</td>
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<tr>
<td></td>
<td>(1.6663)</td>
<td>(-1.6461)</td>
<td>(-0.8650)</td>
</tr>
</tbody>
</table>

Notes:
- $\alpha = 0.5, \gamma = 0.1, \beta = 0.986$ to compute the series $r*_t$
- $ca_{t-1}$ and $ca_{t-2}$ are jointly significant to forecast $\Delta z_t$ with p-value: 0.0241
- $ca/z_{t-1}$ and $ca/z_{t-2}$ are jointly significant to forecast $\Delta z_t$ with p-value: 0.0022
- Lags of $ca_t$ and $ca/z_t$ are jointly insignificant to forecast other variables ($r_t, \Delta q_t, r*_t$)
- $ca_{t-1}$ and $ca_{t-2}$ are jointly significant to forecast $\Delta p_t$ with p-value: 0.0134
- $ca/z_{t-1}$ and $ca/z_{t-2}$ are jointly insignificant to forecast $\Delta p_t$ with p-value: 0.4156
- Numbers in round brackets are White (1980) t-statistics
- ‘***’, ‘**’ and ‘*’ imply significance at the 1, 5 and 10 per cent levels respectively
Table 9

<table>
<thead>
<tr>
<th>Long Horizon Test</th>
<th>Dependent Variable</th>
<th>Basic $ca_t$</th>
<th>Generalized $ca_t$</th>
<th>Extended $ca_t$</th>
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</thead>
<tbody>
<tr>
<td>$\Delta z_{t+1} - \Delta z_t$</td>
<td>-0.5238***</td>
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<tr>
<td></td>
<td>(-2.7633)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta z_{t+2} - \Delta z_t$</td>
<td>-0.3801</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
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<td>(-1.5245)</td>
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</tr>
<tr>
<td>$\Delta z_{t+3} - \Delta z_t$</td>
<td>0.0096</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td></td>
<td>(0.0379)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r_{t+1} - r_t$</td>
<td>-</td>
<td>-0.0002</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.5059)</td>
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<td></td>
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</tr>
<tr>
<td>$r_{t+2} - r_t$</td>
<td>-</td>
<td>-0.0007</td>
<td>-</td>
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</tr>
<tr>
<td></td>
<td>(-0.7375)</td>
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</tr>
<tr>
<td>$r_{t+3} - r_t$</td>
<td>-</td>
<td>-0.0003</td>
<td>-</td>
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</tr>
<tr>
<td></td>
<td>(-0.1962)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta q_{t+1} - \Delta q_t$</td>
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<td>-0.00003</td>
<td>-</td>
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</tr>
<tr>
<td></td>
<td>(-0.4117)</td>
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<td>$\Delta q_{t+2} - \Delta q_t$</td>
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<td>-0.00006</td>
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<td>(-1.2560)</td>
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<td></td>
</tr>
<tr>
<td>$\Delta q_{t+3} - \Delta q_t$</td>
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<td>0.0000005</td>
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<tr>
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<td>(0.0067)</td>
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</tr>
<tr>
<td>$r^<em>_{t+1} - r^</em>_t$</td>
<td>-</td>
<td>-0.0003</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.6071)</td>
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<td></td>
</tr>
<tr>
<td>$r^<em>_{t+2} - r^</em>_t$</td>
<td>-</td>
<td>-0.0009</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.1890)</td>
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</tr>
<tr>
<td>$r^<em>_{t+3} - r^</em>_t$</td>
<td>-</td>
<td>-0.0003</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.1775)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta p_{t+1} - \Delta p_t$</td>
<td>-</td>
<td>-</td>
<td>-0.00002</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(-0.8461)</td>
<td></td>
</tr>
<tr>
<td>$\Delta p_{t+2} - \Delta p_t$</td>
<td>-</td>
<td>-</td>
<td>-0.00003</td>
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</tr>
<tr>
<td>$\Delta p_{t+3} - \Delta p_t$</td>
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<td>-</td>
<td>0.00002</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.5400)</td>
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</tr>
</tbody>
</table>

Notes:
- $\alpha = 0.5$, $\gamma = 0.1$, $\beta = 0.986$ to compute the series $r^*_t$
- Numbers in round brackets are White (1980) t-statistics
- ’***’, ’**’ and ’*’ imply significance at the 1, 5 and 10 per cent levels respectively
### Table 10


<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Basic</th>
<th>Generalized</th>
<th>Extended</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>$X_t$</td>
<td>$X_t$</td>
<td>$X_t$</td>
</tr>
<tr>
<td>$ca_{t-1}$</td>
<td>-0.2774</td>
<td>-0.2851</td>
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<tr>
<td></td>
<td>(-2.4437)</td>
<td>(-2.5480)</td>
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<tr>
<td>$\Delta z_{t-1}$</td>
<td>0.1161</td>
<td>0.1203</td>
<td>0.1187</td>
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<tr>
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<td>(0.8199)</td>
<td>(0.9020)</td>
<td>(0.8577)</td>
</tr>
<tr>
<td>$r^*_{t-1}$</td>
<td>-</td>
<td>6.2580</td>
<td>6.7670</td>
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<tr>
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<td></td>
<td>(0.2578)</td>
<td>(0.2692)</td>
</tr>
<tr>
<td>$\Delta p_{t-1}$</td>
<td>-</td>
<td>-</td>
<td>91.9938</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.0965)</td>
</tr>
</tbody>
</table>

Basic Model: Joint significance of lags : p-value $= 0.0475^{**}$

Generalized Model: Joint significance of lags : p-value $= 0.0898^*$

Extended Model: Joint significance of lags : p-value $= 0.1523$

**Notes:**
- $\alpha = 0.5$, $\gamma = 0.1$, $\beta = 0.986$ to compute the series $r^*_t$
- Series $X_t$ in the Orthogonality Test is constructed as $(ca_t - \Delta z_t - (1+r)ca_{t-1})$
- Results in Orthogonality Test is based $r = 0.05$
- Numbers in round brackets are White (1980) t-statistics
- ‘***’, ‘**’ and ‘*’ indicate rejection of null at the 1, 5 and 10 per cent significance levels respectively
Chapter 5: Conclusion

The deterioration of Australia’s current account deficits and the rise of the associated national debt have caused a lot of debate in Australia during the latter half of the 1980s. The above concerns suggest that the sizeable current account deficit and external debt were considered as a serious problem which required remedial policy for adjustment. Since the intertemporal approach to the current account emerged in the early 1990s, government intervention to reduce the high level of foreign debt was seen to be redundant. The intertemporal approach was originated from the permanent income hypothesis which was developed by Milton Friedman in 1957. The intertemporal model implies an optimal intertemporal path for the current account where the current borrowing of the agents in an economy is based on the expectation of future income at time which the debt is repaid.

This thesis aimed to compare the efficiencies of the three different versions of the intertemporal models to explain the current account behaviour in Australia. The basic model was developed on the basis of the consumption smoothing behaviour of the agents where a country will borrow and lend in the global capital market in order to deal with the temporary movements in national income. Thus, current account simply reflects the outcome of the rational investment and saving decisions of the agents.

The generalized model was developed by Bergin and Sheffrin (2000) which aimed to improve the fitness of the intertemporal models and match the fluctuation of the current account data better. The basic model tends to fail for many small open economies like Australia where the world real interest rate and exchange rate are considered to be relevant.
for agents’ investment and saving decision makings. The generalized model also suggests an intratemporal substitution between the tradable and non-tradable goods rather than the intertemporal substitution is responsible to improve the fitness of the present value model.

The relationship between variations in terms of trade and the current was initially studied by Harberger (1950) and Laursen and Metzler (1950) where a rise in terms of trade will eventually lead to an improvement in the current account balance. The extended model investigated by Bouakez and Kano (2008) attempts to incorporate the HLM effect in addition to the normal consumption smoothing behaviour and the effects of variations of exchange rate and interest rate into the intertemporal approach to the current account. The extension of the generalized present value model aims to investigate whether the inclusion of the terms of trade changes improves the ability of the intertemporal model to explain the current account.

This thesis employs the Granger-causality tests and long horizon tests to examine the predictability of the current account and test whether the current account Granger-causes other variables in Australia. Since the above tests do not investigate all the restrictions that the intertemporal model imposes on the data, the orthogonality test is also adopted to investigate whether the present value model is consistent to the Australian data.

The results from the above tests generally show that the basic intertemporal model is able to explain the annual variations of the current account deficit in Australia from 1960 to 2007. But the involvement of interest rate, exchange rate and the terms of trade in the present value models have found to yield no improvement to explain the current account behaviour in Australia. The basic intertemporal model may be considered as the best fit for the Australian
data. In addition, the current account has found no long run predictability for most of variables implied by the present value models. This suggests that the intertemporal approach to the current account may not be able to explain the middle and long run current account fluctuations. Moreover, the deregulation of the financial system and the opening of the Australia capital market since the early 1980s do not provide stronger support for the basic present value model which differs to the prediction of other Australian based economists (Olekalns, 1997, Cashin and McDermott, 1998, 2002, Otto, 2003). Their papers suggest that the presence of the liquidity constraints with the regulated Australia financial system is the major reason to explain the failure of the basic intertemporal model to explain the current account variations in Australia prior to the early 1980s. The contrasts in the results between previous tests and the empirical study in this thesis may due to the presence of large current account deficits and vast variations in the terms of trade in recent years that the preceding studies has not accounted for.

An interesting result has been that the current account does have some ability to forecast the terms of trade variations in the later sub-sample period. Thus, there is some evidence that relationship between the current account and the changes in terms of trade do exist during the post-deregulation period and the HLM effect seems to exhibit some power to explain the dynamics of the Australia’s current account since the early 1980s. Although the results of this empirical study generally do not support the generalized intertemporal model over the basic model, the acceleration of the external trade and the variations in the terms of Australia in coming years may lead to a better fit for the model which allows for terms of trade movements to be applied on the Australian data.
When considering the suitable interest rate to be adopted in the orthogonality tests, a range of real interest rate from 3% to 5% has been used to estimate whether the independent variables is orthogonal to the dependent variable $ca_t - A\Delta z_t - (1+r)ca_{t-1}$. The results do not differ significantly on whether to reject the present value model. The real interest rate of five percent was chosen due to its highest power to reject the basic intertemporal model. Even so, the basic model is estimated to be generally consistent with the full sample data and the earlier sub-sample data.

Despite of the mixed support of the intertemporal models and the difficulties to establish a particular model to account for all the effects on the current account, the intertemporal approach still remains to be the most explanatory framework to illustrate the current account fluctuations. The methodology in this thesis can be expanded to apply on other countries to examine the abilities of the present value models to explain the current account behaviours in other countries. Engel (2006) introduced a share approach in attempt to improve the fit of the intertemporal model by specifying the optimal consumption path as a function of discounted current and future sum of the country’s share of world output. This approach allows us to test the model without modelling the world real interest rate because the shares model implicitly captures the effects of real interest rates. The share approach can be investigated in future to examine whether it is applicable on Australian data and whether it yields a better explanation on Australia’s current account behaviour.
Appendix A: Data Set

The construction of the variables, current account and change in national cash flow, are illustrated in chapter 3. All the data required to computer these variables are on annual basis and are extracted from Table 5206.0 Australian National Accounts: National Income, Expenditure and Product (September 2007) and Table 3201.0 Population by Age and Sex, Australian States and Territories from the Australian Bureau of Statistics. The sample period covers from June 1960 to June 2007.

Changes in National Cash Flow, $z$

<table>
<thead>
<tr>
<th>Data Description</th>
<th>Units</th>
<th>Series ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Domestic Product</td>
<td>$ Millions</td>
<td>A2304617J</td>
</tr>
<tr>
<td>Gross Fixed Capital Formation</td>
<td>$ Millions</td>
<td>A2304594C</td>
</tr>
<tr>
<td>Change in Inventories</td>
<td>$ Millions</td>
<td>A2304594C</td>
</tr>
<tr>
<td>General Government Final Consumption Expenditure</td>
<td>$ Millions</td>
<td>A2304588J</td>
</tr>
<tr>
<td>Gross Domestic Product: Chain Volume Measures</td>
<td>$ Millions</td>
<td>A2304755F</td>
</tr>
<tr>
<td>Population</td>
<td>Units</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes:
- The GDP deflator is calculated as Gross Domestic Product (GDP) divided by the Gross Domestic Product: Chain volume measures (GDP: CVM)

Current account is computed as changes in national cash flow, plus the following:

Current Account, $ca$

<table>
<thead>
<tr>
<th>Data Description</th>
<th>Units</th>
<th>Series ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Households Final Consumption Expenditure</td>
<td>$ Millions</td>
<td>A2304591W</td>
</tr>
</tbody>
</table>
The time series required to form the consumption-based interest rate and the terms of trade are from the *International Financial Statistics (IFS)*. The *IFS* codes for the time series used to construct these variables are listed below:

### Consumption-based Interest Rate, $r^*$

<table>
<thead>
<tr>
<th>Data Description</th>
<th>Units</th>
<th>IFS Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States Treasury Bill Rate</td>
<td>% per annum</td>
<td>11160C..ZF...</td>
</tr>
<tr>
<td>United States Government Bond Yield: 3 Year</td>
<td>% per annum</td>
<td>11161A..ZF...</td>
</tr>
<tr>
<td>Australia Market Exchange Rate</td>
<td>AUD/USD</td>
<td>193..AE.ZF...</td>
</tr>
<tr>
<td>United States Consumer Price Index</td>
<td>Index number</td>
<td>11164...ZF...</td>
</tr>
<tr>
<td>Australia Consumer Price Index</td>
<td>Index number</td>
<td>19364...ZF...</td>
</tr>
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</table>

**Notes:**
- Inflation rates of United States and Australia are calculated as the first difference of the log of the Consumer Price Indices.
- The base year for the Consumer Price Index of both United States and Australia is year 2000.

### Changes in terms of trade, $dq$

<table>
<thead>
<tr>
<th>Data Description</th>
<th>Units</th>
<th>IFS Code</th>
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<td>Export prices</td>
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</tr>
<tr>
<td>Import prices</td>
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<td>19376.X.ZF...</td>
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</table>

**Notes:**
- The terms of trade is calculated as the export price index divided by the import price index.
- The base year for the export and import price index is year 2000.
Appendix B: Graphs of the Main Variables

**Figure 2 Australia’s Current Account Series (1960-2007)**

**Figure 3 Australia’s Movements in National Cash Flow Series (1960-2007)**

**Notes:**
- Series start in 1961 due to the constructions of the variables
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- Series start in 1961 due to the constructions of the variables
Bibliography

*RBA Research Discussion Paper 2007-02*


Campbell, J. and Shiller, R. 1987, Cointegration and tests of present value models.  

Campbell, J. and Shiller, R. 1988, Stock prices, earnings, and expected dividends  

Cashin, P. and McDermott, J. 1998, Are Australia’s current account deficits excessive?.  
*Economic Record*, vol. 74, pp. 346 – 361.


Dornbusch, Rudiger, 1983, Real interest rates, home goods, and optimal external borrowing.  


