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New Zealand's Current Account Deficit: Analysis based on the Intertemporal Optimisation Approach

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Abstract

New Zealand's Current Account of the Balance of Payments has been persistently in deficit since the early 1970's and increased markedly during the late 1990s. Is this a cause for significant concern? This paper tackles this question by evaluating New Zealand's external solvency, the degree of optimality of the intertemporal consumption smoothing through its current account, and whether its international financial capital flows have been used in an optimal (consumption smoothing) fashion. We carry out statistical tests in relation to external solvency. We also estimate a "benchmark" consumption-smoothing component for its current account based on an intertemporal optimisation model in order to carry out tests of the optimality of the size and volatility of the current account. We could not reject the hypotheses that New Zealand's current account was consistent with optimal smoothing, that the external solvency condition has been satisfied, and that there is "no excess volatility" in international financial capital flows.

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1. Introduction

New Zealand's Current Account of the Balance of Payments has been persistently in deficit since the early 1970s (see Figure 1). Two further notable features of recent history have been: the current account deficit to GDP ratio deteriorated during the period 1984 to 1986 from around 4% into the 7-9% range; and during the latter part of the 1990s moved from around 1% into a 5 to 7% band (see Figure 2). During this latter period the current account deficit to GDP ratios of New Zealand's two main trading partners, Australia and the US, also moved to historically quite high figures of around 6% and 4% respectively. A further noticeable aspect of Figure 2 is that while the deficit ratios for Australia and New Zealand have averaged around 5% during the 1980s and 1990s, New Zealand's ratio has been more volatile than Australia's.

Is this persistent and recent sharp deterioration in the current account deficit a cause for significant concern for New Zealand and lenders of international financial capital? The theoretical literature, empirical findings and policy judgements about the implications of persistent and rising current account deficits have evolved considerably over the past decade or so. For example, recent research by Milesi-Ferretti and Razin (1996, p. 161) commenced by suggesting the conventional wisdom to be that "…current account deficits above 5% of GDP flash a red light, in particular if the deficit is financed with short-term debt or foreign exchange reserves, and if it reflects high consumption spending". They concluded, however, (p. 178) that "… a specific threshold on persistent current account deficits (such as 5% of GDP for 3-4 years) is not *per se* a sufficiently informative indicator of sustainability. The size of current account imbalances should be considered in conjunction with exchange rate policy and structural factors, …". A recent analysis for New Zealand by Collins *et al.* (1998) makes a similar judgement. They concluded (p. 30), after judging that the strengths of New Zealand's wider sustainability indicators "…considerably outweigh her weaknesses.", that "…although New Zealand's current account deficit is sizeable, and will undoubtedly not remain at such an elevated level in the long-run, there are few reasons to believe that the transition to lower current account deficits will be disruptive to the economy."

The work reported in this paper takes a different approach. We carry out statistical tests in relation to external solvency. We also estimate a "benchmark" consumption-smoothing component for New Zealand's current account based on an intertemporal optimisation model and use it to test the optimality of the size and volatility of the current account.[1]

Our analytical modelling and testing follows in the tradition of the intertemporal theoretic and empirical work developed in Sachs (1982), Campbell (1987), Campbell and Shiller (1987), Sheffrin and Woo (1990), Trehan and Walsh (1991), and Ghosh (1995). Major aspects of this literature have been summarised comprehensively in

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[1] The concepts of external solvency, sustainability, and optimality have recently been defined and addressed in Milesi-Ferretti and Razin (1996) and Cashin and McDermott (1998b). External (intertemporal) solvency is satisfied when a country fully meets its external obligations, in the sense of the present discounted value of its net external liabilities, i.e. its intertemporal budget constraint (ibc) is satisfied. Sustainability, in essence, requires that a country not be subject to 'liquidity constraints' imposed by foreign lenders. i.e. in addition to the ibc having to be satisfied, factors influencing (1) willingness (as well as ability) to pay, and (2) willingness to lend, should be taken into account. Intertemporal optimality for the purposes of this paper is as explained in section 2.

Obstfeld and Rogoff (1995) (OR). We specify an intertemporal optimisation model of the current account suitable for a small open economy, estimate the consumption-smoothing current account path using vector autoregression (VAR) methodology[2] and establish it as a "benchmark" current account path, and conduct a range of statistical tests to assist in forming judgements on a number of key empirical questions.

Key aims of this study are therefore (1) to establish an illustrative intertemporally optimal or "benchmark" path for New Zealand's current account, and to identify the extent to which actual current account movements have deviated over time from the consumption-smoothed optimal path and whether international financial flows have been excessively volatile; and (2) to establish preliminary empirical conclusions relating to external solvency.

Similar work has been reported for a number of countries. For example, Ghosh and Ostry (1995) have concluded that for a majority of developing countries, the hypothesis of full consumption smoothing could not be rejected. The hypothesis could also not be rejected for the US (Ghosh, 1995). However, for Canada, Otto (1992) found virtually no support for smoothing, and suggested this might have been due to Canada's current account being "… more affected by temporary changes in the resource prices and terms of trade effects". Ghosh (1995) also found that consumption smoothing restrictions were rejected for Canada, as well as for Japan, Germany and the United Kingdom. He was, however, comfortable with the model's ability to capture current account directions and turning points in all cases.

Conclusions for Australia have varied by study, by sample period and by data source. For example, Milbourne and Otto (1992), utilising per capita data for the period 1959:3 to 1989:1, found that the consumption smoothing hypothesis was rejected either for the full sample period or for the post 1983:4 floating exchange rate period[3]. Similarly, using the extended data period 1960-61 to 1994-95, an intertemporal optimisation model based on less restrictive assumptions, and individually deflated expenditure component series, Guest and McDonald (1998) rejected Australia's having optimally smoothed consumption over their full sample period. Perhaps more importantly, though, they also reported (p. 213) "…there is less evidence for this since 1984-85, suggesting that deregulation of capital markets may have facilitated the optimal smoothing of consumption".

Two recent studies by Cashin and McDermott (1998a, 1998b) also suggest key conclusions can vary over time. Utilising annual data for the period 1954-94, they concluded that "…the Australian current account was not used to smooth consumption optimally in the period prior to the relaxation of capital controls in the early 1980s…" and that "…in the period since the mid-1980s [i.e. following the move to a fully flexible nominal exchange rate regime for the Australian dollar in December 1983 and, at the same time, the complete removal of capital and exchange controls],

[2] Milesi-Ferretti and Razin (1996, p. 163) categorise the two main approaches to empirical current account modelling as: structural estimation with focus on the degree of persistence of responses to specific shocks; and VAR estimation and analysis of "benchmark" consumption smoothed current accounts.

[3] One suggestion they made for further work (1992, p. 383) was for "relaxing the single commodity assumption…, since it introduces a role for relative prices in explaining consumption and current account behaviour. " See also Sheffrin and Woo, p. 252, and OR pp. 1755-59.

Australia's current account deficits have become excessive…". Subsequently, however, utilising quarterly data for the period 1984:1 – 1998:2, Cashin and McDermott suggested that despite their having found international capital flows to be larger than optimal during the 1980s, in the 1990s "such flows have been broadly consistent with those predicted by the consumption-smoothing approach". More specifically, they identified a structural break at 1990:4, and their overall conclusion was that "…it appears that, over time, Australia's international borrowing decisions have been increasingly determined by changes in economic fundamentals."

It is evident from this brief review that results from applying the intertemporal optimisation approach have varied by country and by time period, and that in some cases the degree of financial market regulation can influence results. The application of the intertemporal optimisation approach to New Zealand therefore complements earlier studies in several respects. The sample used for this study covers a smaller and more volatile open economy than has previously been examined, which was initially characterised by pervasive financial market regulation that was removed during the second half of the sample period. Furthermore, the latter part of the sample period includes the period of the Asian financial crisis when New Zealand's current account moved further into deficit. The structure for this paper is as follows. Section 2 introduces and explains key economic and econometric methodology. Major empirical results are presented in Section 3. Conclusions appear in Section 4.

2. Methodology

The economic model utilised is a basic intertemporal optimisation model of the current account, of the type developed and explained in Sachs (1982), Sheffrin and Woo (1990), Ghosh (1995), Ghosh and Ostry (1995), Obstfeld and Rogoff (1995), Cashin and McDermott (1998a, 1998b), and Agénor *et al*. (1999). The model reflects the permanent income theory of consumption and saving[4]. It therefore implies that temporary shocks could to a large extent be smoothed in the short term, and be reflected instead in substantial short term fluctuations in national saving and the current account.

We consider a small open economy that consumes a single good. It is inhabited by a large number of like individuals with infinite planning horizons. The economy is small in the sense that it takes the path of world real interest rates as exogenous. We assume that only riskless bonds are traded in the international capital market and that the world real interest rate on bonds is fixed[5]. There is no restriction on international

[4] In this basic form, it does not treat demographic influences explicitly, has no explicit terms of trade variables, has no explicit (time varying) risk premium, and has not utilised alternative forms of utility function. Studies which have considered these issues include those of : Guest and McDonald (1998, p 217), who utilise an additive, constant elasticity form of utility function; and OR (1995), who have postulated CES composite consumption (p 1752) and also an absolute risk aversion utility function (p 1791), have given preliminary consideration (as have Milbourne and Otto, 1992, p 383) to terms of trade related specifications (pp 1755-59), and have explicitly considered demographic factors (pp 1759-64).

[5] Bergin and Sheffrin (2000) present and test an intertemporal model which allows for variable interest rates and exchange rates. They find that for Australia and Canada, but not for the United Kingdom, including the variable interest and exchange rate influences significantly improves the fit of the model relative to a benchmark model that excludes them. The improvement is attributed primarily to the

borrowing and lending. Population size is normalized to one so that we can identify *per capita* quantity variables with national aggregate quantities.

The representative agent of this economy maximizes lifetime utility

$$\sum_{j=0}^{\infty} b^{j} \mathrm{E}_t \left[u\left(C_{t+j} \right) \right] \tag{1}$$

where b is the subjective discount factor with $0 < b < 1$ and $(1-b)/b$ is the subjective rate of time preference, E_t is the conditional expectations operator based on the information set of the representative agent at period *t*, and C is private consumption. The period utility function $u(C)$ is strictly increasing in consumption and strictly concave: $u'(C) > 0$ and $u''(C) < 0$.

The series of budget constraints faced by the representative agent is captured by the current account identity

$$CA_t \equiv B_{t+1} - B_t = Y_t + rB_t - C_t - I_t - G_t \tag{2}$$

where Y is the economy's real GDP, B is the beginning of period real net stock of outstanding foreign assets (debts if negative), $Y + rB$ is real GNP (defined as real GDP plus interest income on the outstanding stock of net foreign assets), I is real investment, G is real government consumption, and CA is the real current account balance (defined as real GNP minus real private and public expenditure, $C + I + G$).

Taking expectations of (2) conditional on the information set, and recursively eliminating future values of the stock of foreign assets, yields the intertemporal budget constraint:

$$-(1+r)B_t = \sum_{j=0}^{\infty} \left(\frac{1}{1+r} \right)^{j} \mathrm{E}_t (Y_{t+j} - C_{t+j} - I_{t+j} - G_{t+j}) + \lim_{T \to \infty} \left(\frac{1}{1+r} \right)^{T} \mathrm{E}_t (-B_{t+T+1}) \, . \tag{3}$$

Requiring that the country's budget processes be *externally solvent* rules out Ponzi schemes in which debt is continually rolled over. External solvency requires that the last term in (3) must equal zero:

$$\lim_{T \to \infty} \left(\frac{1}{1+r} \right)^{T} \mathrm{E}_t (-B_{t+T+1}) = 0 \, . \tag{4}$$

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*intra*temporal elements of the theory (i.e. allowing for substitution between internationally-traded goods and nontraded goods). The basic model specified and tested in this paper does not allow for variable interest and exchange rate influences. This is partly because the Bergin and Sheffrin paper came to our attention after the empirical work reported here was completed, and partly because (as shown in section 3) our first order, two equation (unrestricted) VAR model and benchmark consumption-smooothed current account path provides robust results and are unlikely to be improved significantly by the additional equation and variables. This could be because *intra*temporal substitution between internationally-traded and nontraded goods has not been empirically significant for New Zealand. The latter can, however, be tested in follow-up research.

If condition (4) is satisfied, the discounted value of the expected future stock of debt converges to zero as the time horizon goes to infinity. Equation (3) then implies that

$$-(1+r)B_t = \sum_{j=0}^{\infty}\left(\frac{1}{1+r}\right)^j \mathrm{E}_t(Y_{t+j} - C_{t+j} - I_{t+j} - G_{t+j}) \equiv \sum_{j=0}^{\infty}\left(\frac{1}{1+r}\right)^j \mathrm{E}_t TB_{t+j} \ . \qquad (5)$$

Current outstanding real stock of debt, $-(1+r)B_t$, must be equal to the present discounted value of current and expected future trade balance surpluses, *TB* (defined as real GDP minus real private and public expenditure, $C+I+G$).

Proposition 1 in Trehan and Walsh (1991) provides the necessary and sufficient condition for satisfying the solvency condition (4) when the real interest rate is constant. That proposition applied to our context implies that, if $(1- l\mathrm{L})TB$ is a mean zero stationary stochastic process with $0 \le l < 1+r$, then the solvency condition (4) holds if and only if there is a linear combination of *TB* and *B* that is stationary. Therefore if the current account balance *CA* (which is the linear combination of *TB* and *B* by the definition of $CA \equiv TB + rB$) is stationary, then we can say that the solvency condition is satisfied. Hakkio and Rush (1991) discuss the condition required for solvency when the real interest rate is not constant but stationary. They show that, if revenue and expenditure processes are I(1), solvency requires that the inclusive of interest revenues be cointegrated with expenditures. Proposition 2 of Trehan and Walsh (1991) applies to the more general case when the real interest rate is allowed to vary and is not necessarily stationary. In this case, stationarity of the current account deficit is sufficient to imply intertemporal solvency condition holds, as long as the expected real interest rate is positive.

With perfect capital mobility, *Fisherian separability* holds in this model. Facing an exogenously given world real interest rate, the representative agent of the small open economy determines investment and output independently of the level of consumption. We assume that government expenditure is exogenous. Therefore output, investment, and government consumption may all be treated as exogenous when choosing the optimal path for consumption.

Necessary conditions for the representative agent's optimal consumption decision problem include

$$\mathrm{E}_t[u'(C_{t+j})] = b(1+r)\mathrm{E}_t[u'(C_{t+j+1})] \qquad j = 0, 1, \cdots , \qquad (6)$$

which implies for $j = 0$ that

$$u'(C_t) = b(1+r)\mathrm{E}_t[u'(C_{t+1})]. \qquad (7)$$

With a view to empirical implementation, we consider the case in which period utility is quadratic,[6]

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[6] With a quadratic utility function, the *certainty equivalence principle* holds, which implies that the representative agent's forecasting and optimisation problems separate. The representative agent makes its decisions under uncertainty by acting as if future stochastic variables were sure to turn out equal to their expected values. This separation of forecasting from optimisation considerations is

$$u(C) = C - \frac{a_0}{2} C^2$$

with $a_0 > 0$. With quadratic period utility function, equation (6) becomes

$$1 - a_0 \mathrm{E}_t C_{t+j} = b(1+r)[1 - a_0 \mathrm{E}_t C_{t+j+1}] \qquad j = 0, 1, \cdots . \tag{8}$$

If the subjective discount factor b and the market discount factor 1/(1+*r*) are equal so that $b(1+r) = 1$, (8) implies

$$C_t = \mathrm{E}_t C_{t+1} = \cdots = \mathrm{E}_t C_{t+j} = \mathrm{E}_t C_{t+j+1} = \cdots . \tag{9}$$

Equation (9) represents the representative agent's consumption smoothing motive. When the subjective discount factor is different from the market discount factor the representative agent has a consumption tilting motive as well as a consumption smoothing motive. For example, if b is smaller than 1/(1+*r*) so that $b(1+r) < 1$, (8) implies

$$C_t > \mathrm{E}_t C_{t+1} > \cdots > \mathrm{E}_t C_{t+j} > \mathrm{E}_t C_{t+j+1} > \cdots ;$$

and the representative agent wants to have consumption tilted towards the present.

Equation (8) can be written as

$$\mathrm{E}_t C_{t+j+1} = \frac{1}{b(1+r)} \mathrm{E}_t C_{t+j} + a \qquad j = 0, 1, \cdots \tag{10}$$

where $a = \dfrac{1}{a_0}\left[1 - \dfrac{1}{b(1+r)}\right]$.

Recursions on equation (10) imply that

$$\mathrm{E}_t C_{t+j} = \left[\frac{1}{b(1+r)}\right]^j C_t + a \cdot \frac{1 - [b(1+r)]^{-j}}{1 - [b(1+r)]^{-1}} \qquad j = 1, 2, \cdots \tag{11}$$

Substituting (11) into (5) and solving for C_t gives optimal consumption

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computationally very convenient and explains why quadratic functions are assumed in much applied work. For more general functional forms, the certainty equivalence principle does not hold.
With quadratic utility, $u'''(C) = 0$ so that *variability* of future net output does not affect consumption. When $u'''(C) > 0$, agents engage in precautionary saving that depends on the variability of future net output and not just expected values. Ghosh and Ostry (1994) used constant absolute risk aversion utility function and added a precautionary effect to the kind of intertemporal optimisation current account model utilised here. The key parameter appearing in their extended model is the lifetime innovation in net output. But the length of the data series required to measure this parameter accurately is such that the extended model cannot be utilised for our study.

$$C_t^* = \left[1 - \frac{1}{b(1+r)^2}\right]\left\{(1+r)B_t + \mathrm{E}_t\left[\sum_{j=0}^{\infty}\left(\frac{1}{1+r}\right)^j (Y_{t+j} - I_{t+j} - G_{t+j})\right]\right\} + \left(\frac{-a}{r}\right),$$

which can be rewritten as

$$C_t^* = \frac{r}{q}\left\{B_t + \frac{1}{1+r}\mathrm{E}_t\left[\sum_{j=0}^{\infty}\left(\frac{1}{1+r}\right)^j (Y_{t+j} - I_{t+j} - G_{t+j})\right]\right\} + \left(\frac{-a}{r}\right) \tag{12}$$

where $q = \frac{b(1+r)r}{b(1+r)^2 - 1}$.[7]

Since

$$q = \frac{b(1+r)r}{b(1+r)^2 - 1} = \frac{b(1+r)r}{b(1+r)r + b(1+r) - 1}, \tag{13}$$

it is very clear that $q < 1$ if and only if $b(1+r) > 1$. The representative consumer wants to tilt consumption towards the future if $q < 1$. Ghosh (1995, p.113), Ghosh and Ostry (1995, p.309), Cashin and McDermott (1998a, p.351), Cashin and McDermott (1998b, p.10), and Agénor *et al*. (1999, p.4) all take an interpretation for q diametrically opposite to the above, stating that consumption is tilted towards the present when $q < 1$. Also, unlike the above analysis, they seem to have taken no explicit account of the existence of the constant term in the optimal consumption when the utility function is quadratic.

The optimal consumption level can be decomposed into the consumption smoothing part and the consumption tilting part by noting that when $b(1+r) = 1$, there is no consumption tilting. The optimal consumption level then becomes

$$r\left\{B_t + \frac{1}{1+r}\mathrm{E}_t\left[\sum_{j=0}^{\infty}\left(\frac{1}{1+r}\right)^j (Y_{t+j} - I_{t+j} - G_{t+j})\right]\right\}.$$

We use C_t^{SM} to denote consumption-smoothing component of the optimal consumption.

$$C_t^{SM} = r\left\{B_t + \frac{1}{1+r}\mathrm{E}_t\left[\sum_{j=0}^{\infty}\left(\frac{1}{1+r}\right)^j (Y_{t+j} - I_{t+j} - G_{t+j})\right]\right\}. \tag{14}$$

It is the annuity value of the representative consumer's total discounted wealth net of investment and government consumption. The consumption-tilting component is the

[7] A similar result is shown in Sargent (1987), p. 365.

difference between the optimal level of consumption C_t^* and its smoothing component C_t^{SM}. Equations (12) and (14) imply the following relationship between the optimal consumption level and its consumption-smoothing component.

$$C_t^{SM} = qC_t^* + \frac{qa}{r}$$

We define the consumption-smoothing component of the current account as

$$CA_t^{SM*} = Y_t + rB_t - I_t - G_t - C_t^{SM} = Y_t + rB_t - I_t - G_t - qC_t^* - \frac{qa}{r}. \quad (15)$$

Substituting (14) into (15) implies that the consumption-smoothing component of the current account can be represented as

$$CA_t^{SM*} = Y_t + rB_t - I_t - G_t - r\left\{B_t + \frac{1}{1+r}\mathrm{E}_t\left[\sum_{j=0}^{\infty}\left(\frac{1}{1+r}\right)^j (Y_{t+j} - I_{t+j} - G_{t+j})\right]\right\}$$

$$= Y_t - I_t - G_t - \frac{r}{1+r}\mathrm{E}_t\left[\sum_{j=0}^{\infty}\left(\frac{1}{1+r}\right)^j (Y_{t+j} - I_{t+j} - G_{t+j})\right] \quad (16)$$

$$= Z_t - \frac{r}{1+r}\sum_{j=0}^{\infty}\left(\frac{1}{1+\mathrm{r}}\right)^j \mathrm{E}_t Z_{t+j}$$

where $Z = Y - I - G$ has been termed in the literature *net output* or *national cash flow*. Rearranging terms in the right-hand side of the last equality in (16) yields

$$CA_t^{SM*} = -\sum_{j=1}^{\infty}\frac{1}{(1+r)^j}\mathrm{E}_t \Delta Z_{t+j} \,. \quad (17)$$

Equation (17) shows that the consumption-smoothing component of the current account is in deficit when the present discounted value of future net output changes is positive, and it is in surplus in the opposite case. The consumption-smoothing component of the current account deficit is the predictor of future increases in net output. According to equation (17), *permanent* shocks, which have no effect on ΔZ, leave the consumption smoothing component of the current account unaffected, whereas temporary shocks to Z (e.g. an unexpected temporary increase in G or I) would lead the current account to act as a buffer to smooth consumption.

Equation (17) shows that creating the model implied consumption-smoothing component of the current account series requires estimating the present value of expected changes in net output, where expectation is conditional on the information set used by the representative agent. As shown by Campbell and Shiller (1987) in a somewhat different context, under the null hypothesis that equation (17) is valid, the consumption-smoothing component of the current account itself should incorporate all of the representative agents' information on future net output changes. This consideration led the existing literature to estimate an unrestricted vector-autoregression (VAR) in ΔZ_{t+j} and CA_{t+j}^{SM}, where CA_{t+j}^{SM} is the actual consumption-smoothing component of the current account:

$$CA_t^{SM} = Y_t + rB_t - I_t - G_t - qC_t - \frac{qa}{r} = Z_t + rB_t - qC_t - \frac{qa}{r}. \tag{18}$$

For the VAR estimation, it is necessary to define a way to detrend the actual current account and derive the consumption-smoothing component. We explain below how to estimate q and qa/r, and derive the actual consumption-smoothing component of current account. The VAR may be written as

$$\begin{bmatrix} \Delta Z_{t+j} \\ CA_{t+j}^{SM} \end{bmatrix} = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} \begin{bmatrix} \Delta Z_{t+j-1} \\ CA_{t+j-1}^{SM} \end{bmatrix} + \begin{bmatrix} e_{1t+j} \\ e_{2t+j} \end{bmatrix}$$

where e_1 and e_2 are disturbance terms with conditional mean of zero and where ΔZ and CA^{SM} are now expressed as deviations from unconditional means. Making use of

$$\mathrm{E}_t \begin{bmatrix} \Delta Z_{t+j} \\ CA_{t+j}^{SM} \end{bmatrix} = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix}^j \begin{bmatrix} \Delta Z_t \\ CA_t^{SM} \end{bmatrix}$$

and substitution into equation (17) leads to the estimate of the model implied consumption-smoothing component of the current account

$$\begin{aligned} CA_t^{SM*} &= -\sum_{j=1}^{\infty} \left(\frac{1}{1+r} \right)^j \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix}^j \begin{bmatrix} \Delta Z_t \\ CA_t^{SM} \end{bmatrix} \\ &= -\begin{bmatrix} 1 & 0 \end{bmatrix} \left(\frac{1}{1+r} \Psi \right) \left(\mathrm{I} - \frac{1}{1+r} \Psi \right)^{-1} \begin{bmatrix} \Delta Z_t \\ CA_t^{SM} \end{bmatrix} \\ &\equiv \begin{bmatrix} \Phi_{\Delta Z} & \Phi_{CA} \end{bmatrix} \begin{bmatrix} \Delta Z_t \\ CA_t^{SM} \end{bmatrix} \end{aligned} \tag{19}$$

It remains to describe how to estimate q and qa/r so that the actual data on current account can be detrended to purge the consumption-tilting component. If net output Z is I(1), its first difference ΔZ will be stationary. Equation (17) implies that, under the null hypothesis that the actual consumption-smoothing component of the current account CA^{SM} is equal to CA^{SM*}, the actual consumption-smoothing component of the current account is also I(0). This means that the left-hand side of equation (18) is I(0). Therefore, if net output inclusive of interest earnings, $Z + rB$, and consumption, C, are both I(1), q and qa/r may be obtained from the cointegrating vector between C

and $Z + rB$. Because of the existence of qa/r, a constant should be included in the cointegrating regression.

Once the model implied consumption-smoothing component of current account has been estimated a number of tests may be performed. First, equation (17) implies that current account should Granger-cause subsequent movements in net output. This can be easily tested by using the results of the VAR estimation. Second, if the intertemporal approach embodied in (17) is true, then the theoretically predicted value of $[\Phi_{\Delta Z} \quad \Phi_{CA}]$ in equation (19) is [0 1]. The requirement that the coefficient on net output be close to zero and that on the consumption smoothing component of current account be close to unity can be tested. Third, the equality of the variances of the actual consumption smoothing component of current account and the model implied consumption-smoothing current account can be tested. Fourth, equation (17) holds if and only if

$$\mathrm{E}_{t-1}[CA_t^{SM*} - \Delta Z_t - (1+r)CA_{t-1}^{SM*}] = 0 .$$

Therefore, if the model is correct so that the model implied consumption-smoothing current account CA^{SM*} and the actual consumption smoothing component of current account CA^{SM} are equal, $R_t \equiv CA_t^{SM} - \Delta Z_t - (1+r)CA_{t-1}^{SM}$ should be statistically uncorrelated with lagged values of the series ΔZ and CA^{SM}. This restriction can be tested by constructing R_t and running appropriate regressions with lagged values of the series ΔZ and CA^{SM}. Finally, supplementary to the formal tests can be visual inspection of the actual CA^{SM} and the estimated CA^{SM*} series, and the resulting correlation coefficient between them.

The estimation and testing procedures can be summarised in four basic categories: (1) As a prelude to any cointegration relations estimated under step two, conduct appropriate unit root tests on the series *C, Z,* $Z + rB$, *TB, CA*, and their first differences, in order to check the stationarity of those series. If *TB* is either I(0) or I(1) and *CA* is I(0), then the external solvency condition is satisfied (e.g. Trehan and Walsh, 1991, Proposition 1); (2) Where appropriate, calculate the actual consumption-smoothing component of the current account as the (stationary) residual from the cointegrating regression of $Z + rB$ on *C*. This stationary consumption-smoothing component of *CA* reflects removal of the non-stationary consumption tilting component of *CA*; (3) Estimate the (first order) unrestricted VAR in ΔZ and CA^{SM}, in order to obtain an *estimated* optimal consumption-smoothing component of the current account. The *estimated* CA^{SM*} series can be compared (through graphical, correlation coefficient and variance ratio measures) with the *actual* value calculated from the cointegrating regression, and also utilised in the hypothesis tests described under step four. (4) The formal statistical tests can be performed and associated empirical measures can be considered in relation to external solvency and intertemporal consumption smoothing optimality.

3. Empirical Results

The maximum sample period available for the required quarterly real seasonally adjusted data was 1982:2 to 1999:3. It therefore reflects, amongst other things, the recent quarters during which New Zealand's real GDP growth and current account deficits were likely to have been significantly adversely affected by events relating to the "Asian Crisis". Our data series and sources are as defined in the Appendix: Data Sources.

The empirical results presented in this section of the paper come from nominal data converted to real terms by using the implicit price deflator for GDP. This is primarily because these results are much more robust than those emanating from series utilising the individual components of Gross Domestic Expenditure (GDE) available directly in real terms[8]. It is also done to facilitate comparison with results reported for other countries, including those reported recently for Australia in Cashin and McDermott (1998b).

The other key data-related issue was whether to present results in *per capita* or *non-per capita* form. An argument to support presentation in *non-per capita* form is that many policy analysts and policy makers focus greater attention on this form. However, some authors (e.g. Hakkio and Rush, 1991; Otto, 1992; Milbourne and Otto, 1992; Sheffrin and Woo, 1990) have preferred to (additionally) report their results in *per capita* form. This may have been because the *per capita* form can be more closely aligned with certain economic theoretic models, or perhaps for "normalization" reasons considered to be more relevant for a growing economy (e.g. Hakkio and Rush, 1991). Hence, because there seems no clear cut argument for preferring one form over the other, we have presented Tables including empirical results in both forms. The robustness of our empirical results will in this sense therefore be clearly evident.

- *Stationarity tests*

Unit root tests for the order of integration/stationarity of the series C, Z, $Z+rB$, TB, and CA, based on the augmented Dickey-Fuller (ADF) t-statistic test, are presented in Table 1.

The first result of note is that conclusions are consistent across the *per capita* and *non-per capita* data series.

Secondly, apart from the conventionally expected outcomes that the series C, Z and $Z+rB$ are stationary in first difference (but not level) form, the key result for both *per capita* and *non-per capita* CA is that the null hypotheses of the existence of unit roots in levels of those series are rejected quite strongly at 5% levels of significance,

[8] For example, see the noticeably different time paths for the two real seasonally adjusted CA series, presented in Figure 3: Current Account Balance, real \$m, New Zealand 1982:2 to 1999:3, Nominal Expenditure Series deflated by Implicit GDP Deflator, and Nominal GDE Components individually deflated. Eyeballing the latter series shows an *a priori* case for a structural break in the individual components series at 1993:4, but no obvious *a priori* break for the implicit GDP deflated series. In contrast to the results obtained from individually deflated series, those for the sub-sample 1982: 2 to 1993:4 for the implicit GDP deflated series were not significantly different from those for the full sample.

even though they are not rejected at 1% levels. So if we are content with 5% level of significance, *CA* series are stationary in the level form. Also there is clear rejection of the null hypotheses of the existence of unit roots in levels of the *TB* series. As pointed out above in section 2, there are a couple of key implications of these results. First, *CA*, which is equal to $TB + rB$, is a linear combination of *TB* and *B*. Proposition 1 of Trehan and Walsh (1991) applied to our case implies that intertemporal solvency is satisfied as long as *CA* is stationary.[9] The second key implication of unit root tests on the *CA* series is that stochastic detrending of *CA* series using the cointegration regression (and hence the estimation of the parameter *q*) is not required if we are content with the 5% level of significance, but is required if we insist on the 1% level of significance.[10] We obtained empirical results, both with and without stochastic detrending, in order to gauge the sensitivity of the results to the decomposition between the consumption-tilting and consumption-smoothing components.

- *Cointegration regressions, and estimates of q*

These results appear in Table 2, and again the key results are consistent for both *per capita* and *non-per capita* data. Based on the ADF t-test statistics reported in Table 2, the null hypothesis of no cointegration is rejected at the 5% level of significance, though not at the 1% level. This further supports external solvency satisfied during the sample period. If we apply Hakkio and Rush (1991)'s result to our context, solvency requires that $Z + rB$ be cointegrated with *C*.

The constant term in the cointegration regression is not significant in either case, and the consumption tilting parameter q has values robustly in the range 0.90 to 0.92, whether the constant term is explicitly included or not[11].

We use the residual from the cointegration regression as the consumption smoothing component of the current account in the following tests on optimal consumption smoothing.

- *Estimation of the VAR model, and computation of actual and estimated consumption smoothed current account series and variances*

Parameter estimates for the (first order) unrestricted VAR model, together with their t-statistics, are presented in Table 3. As indicated in section 2, one way of evaluating whether intertemporally optimal consumption smoothing can be rejected is to conduct a test for whether the CA^{SM} variable Granger causes (i.e. helps predict) changes in net output (i.e. in *Z*). In Table 3, all the coefficients on lagged CA^{SM} in regressions of ΔZ are negative so that the CA^{SM} deficit is predicting future *increases* in net output *Z*. Futhermore, they are significant at standard conventional significant levels. The

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[9] Intuition is very clear. *TB* and *CA*≡*TB*+*rB* stationary implies that *B* is stationary. With stationary *B*, $\lim_{T\to\infty}[1/(1+r)^T]\mathrm{E}_t(-B_{t+T+1}) = 0$ so that external solvency holds.

[10] It is now well known that unit root tests typically have very low power against the alternatives of roots less than but close to one. Because of the low power of unit root tests, some researchers apply even 10% level of significance. In our case, even with relatively short sample period, the existence of unit root is rejected strongly at 5% level of significance.

[11] This robustness is not maintained for the individually deflated data set, where q ranges between 0.37 and 0.91.

results are consistent in all cases with rejecting the null hypothesis of no Granger causality at the 5% level of significance, i.e., our results are consistent with Granger causality and therefore optimal consumption smoothing.

Table 4 reports the results of regressions of $R_t \equiv CA_t^{SM} - \Delta Z_t - (1+r)CA_{t-1}^{SM}$ on lagged ΔZ and CA^{SM}. As predicted by the model, coefficients are all insignificant so that $R_t \equiv CA_t^{SM} - \Delta Z_t - (1+r)CA_{t-1}^{SM}$ is uncorrelated with the lagged ΔZ and CA^{SM}.

As shown in Section 2, Φ_{CA} should be equal to unity and $\Phi_{\Delta Z}$ should be zero if the model used is valid. These two parameter restrictions can be tested individually by the standard t-test and jointly by the Wald test. The Wald statistic for the joint test has a c^2 distribution with degrees of freedom equal to the number of restrictions, which is equal to two. Estimated values of $\Phi_{\Delta Z}$ and Φ_{CA} implied by the VAR coefficient estimates together with the t-statistics for the deviations of those values from their respective theoretical values, and the Wald (c^2) statistics necessary for testing the joint (non-linear) restrictions are presented in Table 5.[12] In all cases, one is unable to reject the restrictions at a high level of confidence. These results therefore imply that New Zealand has been optimally smoothing its private consumption by using the current account as a buffer against unexpected temporary movements in net output.

The *actual* consumption smoothed current account path (computed from the residuals of the cointegration regression) and the consumption smoothed current account path *predicted* from the model are illustrated (for the *non-per capita*, with constant term, case) in Figure 4. Visual inspection shows the actual and predicted observations move in remarkably similar directions, and Table 6 shows the corresponding correlation coefficient $r(CA^{SM}, CA^{SM*})$ to be 0.991.

In order to check the statistical significance of the deviation between the actual and predicted observations, we have estimated a 95 percent confidence interval using bootstrap simulations.[13] Figure 6 shows the comparison of the actual current account balance, expressed as a percentage of GDP, with the predicted current account balance and the estimated 95% confidence band.[14] Almost all of the observations for the actual current account balance fall within the 95% confidence band. For the few

[12] As shown by equation (19) of Section 2, estimates of $\Phi_{\Delta Z}$ and Φ_{CA} are functions of the world interest rate r. For the empirical results reported here, we used $r = 0.04$ per annum.

[13] The bootstrap algorithm to evaluate confidence intervals for predicted current account series works as follows: (i) calculate the residuals from the original bivariate VAR(1) estimation for current account and net output; (ii) independent disturbances are obtained by sampling randomly, with replacement, from the VAR residuals, keeping the timing the same across equations to preserve contemporaneous correlations; (iii) artificial data for the current account and the net output are generated using the coefficients of the original VAR, and the disturbances drawn in step (ii), and the same initial values as the actual series; (iv) reestimate the predicted current account series by feeding artificial data into equation (19); (v) repeat steps (ii)-(iv) a large number of times – in our case 10,000 times; (vi) for each time period, sort the series of predicted current account values generated into ascending order to produce a distribution; (vii) 95% confidence interval is given by taking the 2.5 and 97.5 percentiles from this distribution for each period. We thank Paul Cashin and John McDermott for allowing us to utilize their bootstrap simulation programme and for access to their Australian data.

[14] Figure 6 corresponds to the *non-per capita* case. In presenting the series in Figure 6, consumption tilting component of the current account that was removed through stochastic detrending has been added back.

cases where the observations lie outside the confidence band, the magnitude is very small. This confirms the robustness of the VAR model used to estimate New Zealand's current account balance and is in sharp contrast to the results obtained for Australia by Cashin and McDermott (1998b, Figure 1, lower panel)[15].

Of further note, though, is that the actual and predicted series are somewhat less similar in their amplitudes and hence in the variance ratios of actual to predicted. The point estimates used in computing the variance ratios reported in Table 6 are in the range 1.8 to 2.1, suggesting they could be substantially different from unity, and hence consistent with some degree of "excess volatility" of international financial capital flows. This is in the sense of Ghosh's (1995) joint test of the assumption of a high degree of capital mobility and the validity of the intertemporal model of the current account. However, perhaps surprisingly, the c^2 test statistics and p-values also presented in Table 6 are such that the null hypothesis of equality of the variances cannot be rejected at conventional significance levels, and are therefore consistent with "no excess volatility" of international financial capital flows.[16] i.e. in the face of shocks, New Zealand's consumption smoothed current account flows have not been more volatile than justified by expected changes in (national cash flow) fundamentals.

- *Sensitivity analysis*

In order to gauge the sensitivity of the results to the decomposition between the consumption-tilting and consumption-smoothing components, we also obtained empirical results without stochastic detrending. This is equivalent to assuming no consumption tilting and imposing the parameter q to be equal to one. This did not alter our results in any material way. Figure 5 shows that the predicted current account still tracks the actual current account extremely well.[17] The correlation between the actual and predicted current account series, $r(CA^{SM}, CA^{SM*})$, remains very high at 0.99. The marginal significance level for the Wald test statistic for the overall fit of the model is 0.38, which implies that the model without consumption tilting is not rejected.

We also investigated the sensitivity of our result with respect to the value of the world real interest rate used. We tried various real interest rates between 1 and 8% per annum and got very similar results.[18]

- *Implications for external solvency and optimality*

The *external solvency condition* appears to have been satisfied over the sample period. Two pieces of evidence support this. First, the current account balance series,

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[15] For example, their VAR model was unable to explain a number of large movements in Australia's actual current account deficit, including those in the mid-and late-1980s, and mid- and late- 1990s.

[16] This result is consistent with conclusions reached from Ghosh (1995, Table 5) and Ghosh and Ostry (1995, Table 4) that, for a number of their countries with quite high (and low) variance ratios, the ratios are not statistically different from unity.

[17] Figure 5 corresponds to the *non-per capita* case. Results are very similar with other cases.

[18] In order to reduce the number of Tables, detailed results pertaining to sensitivity analysis are not attached. They are available on request from the authors.

CA, is stationary at the 5% level of significance (though not at the 1% level);[19] secondly, the hypothesis of no cointegration between $Z + rB$ and C is rejected at the 5% level (though again not at the 1% level). The conclusion is robust across the *per capita* and *non-per capita* data sets, and whether the constant term is included in the cointegration regression or not.

Optimal consumption smoothing: It has been shown that Granger causality tests, Wald tests on nonlinear restrictions, and visual inspection all imply non-rejection of the optimal consumption smoothing hypothesis. The result is consistent with New Zealand's having optimally smoothed its private consumption by using the current account as a buffer against unexpected temporary movements in net output.

"No-excess volatility" of international financial capital flows?: Whilst the empirical results presented above are consistent with external solvency conditions having been satisfied and optimal consumption smoothing not being rejected, the point estimate evidence from the variance ratio of actual to model implied (consumption smoothed) current account movements, suggests the possibility of "excess volatility" in (foreign) financial capital flows and hence possibly inappropriate utilisation of these flows for domestic consumption purposes. The c^2 test statistics and p-values presented in Table 6 are, however, such that the null hypothesis of equality of the variances cannot be rejected at conventional significance levels, and are therefore consistent with "no excess volatility" of international financial capital flows

4. Conclusion

There has been a long-standing debate concerning the implications and appropriate policy response to New Zealand's persistent current account deficit. This debate has been heightened by the substantial increase in the current account deficit during the 1990s, especially following the Asian financial crisis in the late 1990s. This paper contributes to this debate by evaluating New Zealand's external solvency, the degree of optimality of the intertemporal consumption smoothing through its current account, and whether its international financial capital flows have been used in an optimal (consumption smoothing) fashion. We carried out statistical tests in relation to external solvency. We also estimated a "benchmark" consumption-smoothing component for its current account based on an intertemporal optimisation model and used it to test the optimality of the size and volatility of the current account.

[19] A note of caution is in order here. The current account series that we used do not reflect the effect of the exchange rate changes on the value of existing foreign liabilities. Theoretically, a country's real current account balance over a period is the change in the value of its real net claims on the rest of the world. In order to match with the theoretical concept, the actual current account data should be adjusted for the change in the real value of existing foreign liabilities caused by inflation or changes in the exchange rate. This kind of adjustment can rarely be done because of data limitations. One possible way to overcome this problem is to use the first difference of the data on real net foreign liabilities as the data on the real current account deficit. Trehan and Walsh (1991) used the first difference of the data on real net foreign liabilities in their empirical investigation of external solvency of the U.S. economy. However, while Statistics New Zealand publishes data for New Zealand's Net International Investment Position, to date the series (in nominal terms) are not sufficiently long, comprehensive, or consistent for use in this study.

Specific results are: (1) Despite substantial deterioration in New Zealand's current account deficits during the late 1990s, its current account movements over our sample period as a whole have been consistent with its intertemporal budget constraint and hence its formal external solvency condition has been satisfied; (2) The current account balance predicted by the simple intertemporal optimisation model used in this paper has satisfactorily reflected the actual directions and turning points for the consumption smoothing component of the current account. The null of the No-Granger causality hypothesis that the current account has not signalled subsequent changes in net output has been rejected. Furthermore, a Wald test of nonlinear restrictions implied by the model has not been rejected. All of these results are consistent with optimal smoothing having been achieved; (3) We also examined the sensitivity of the results to the decomposition between the consumption-tilting and consumption-smoothing components, by obtaining empirical results without stochastic detrending. This is equivalent to imposing no consumption tilting. This did not alter our results in any material way; (4) Finally, it can be noted that the variance ratio of our actual and model implied current account series is consistent with "no excess volatility" in international financial capital movements for consumption smoothing purposes.

APPENDIX: DATA SOURCES

Two basic data sets were constructed for the period 1982:2 to 1999:3. One set was converted from nominal to real terms, by using the implicit price deflator for GDP; the other utilises series for the individual components of GDE published directly in real terms. The latter are therefore the standard national system of accounts constant price measures.

Seasonally adjusted series for private final consumption expenditure (*C*), gross fixed capital formation and increase in stocks (*I*), general government final consumption expenditure (*G*), and GDP (gross domestic expenditure, *Y*), in current and constant 1991-92 prices were taken from Statistics New Zealand's (SNZ) September 1999 quarter release of *Gross Domestic Product* data. The implicit price deflator for GDP series was computed as the ratio of our current price and constant price GDP series, and is the same (after converting to base 1991-92 =100) as SNZ's published series.

The Gross National Product (i.e. $Y + rB$) series are obtained by adding to GDP SNZ's Balance of Payments' (BoP) series "Balance on (International) Investment Income". The *rB* series in current price form was seasonally adjusted using X11 (and deflated by the GDP deflator). The nominal series for our sample period was taken primarily from the recently released BoP statistics compiled using the IMF's BoP Manual, 5th edition (BPM5), and for observations prior to 1986:4 from BPM4. No official series exists in real seasonally adjusted form. The *rB* series have negative values for all observations in our sample period.

Our current account series (*CA*) in current and constant price terms were computed (in residual fashion) from $(Y + rB) - (C + I + G)$, and when converted to year ended current account to GDP ratios at quarterly intervals, follow very closely the corresponding ratios published by SNZ using BPM4.

"National Cash Flow"/"Net Output", *Z*, was calculated from $Y - I - G$; and the population series used to convert our data to *per capita* form was obtained by linking (at 1991:2) SNZ's series for *de facto* mean population (SBEC) and resident mean population (SEIC). The value imposed for the real world interest rate, *r*, was the conventionally used 4% per annum.

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Figure 1: Balance on Current Account, New Zealand
Nominal NZ$m, March Years 1950/51 to 1998/99

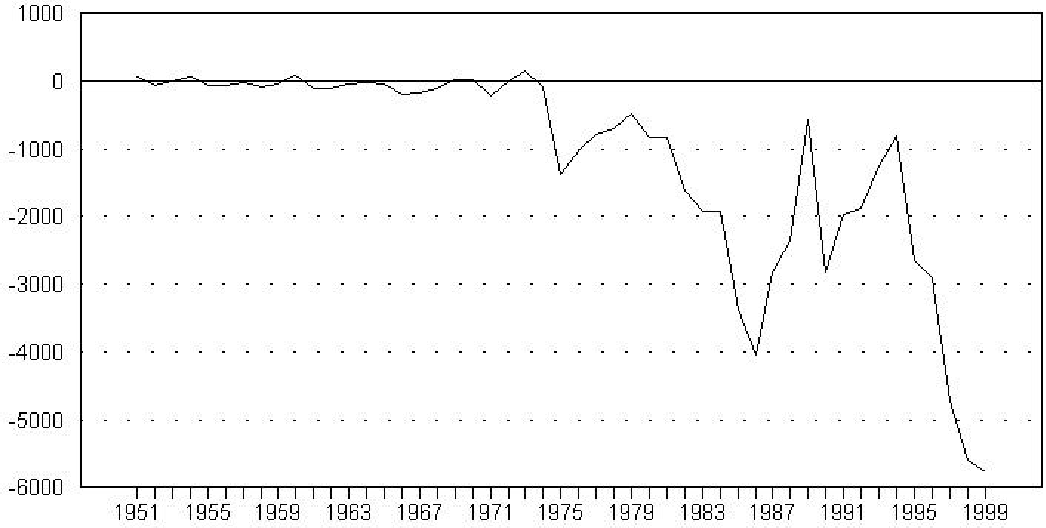


Figure 2: Current Account to GDP (%)
New Zealand (IMF 4th ed.), Australia

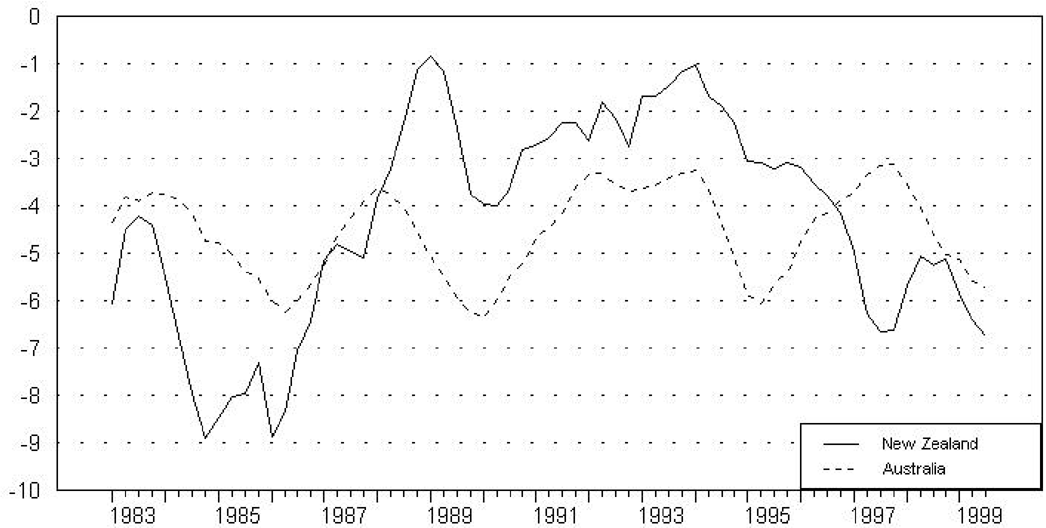
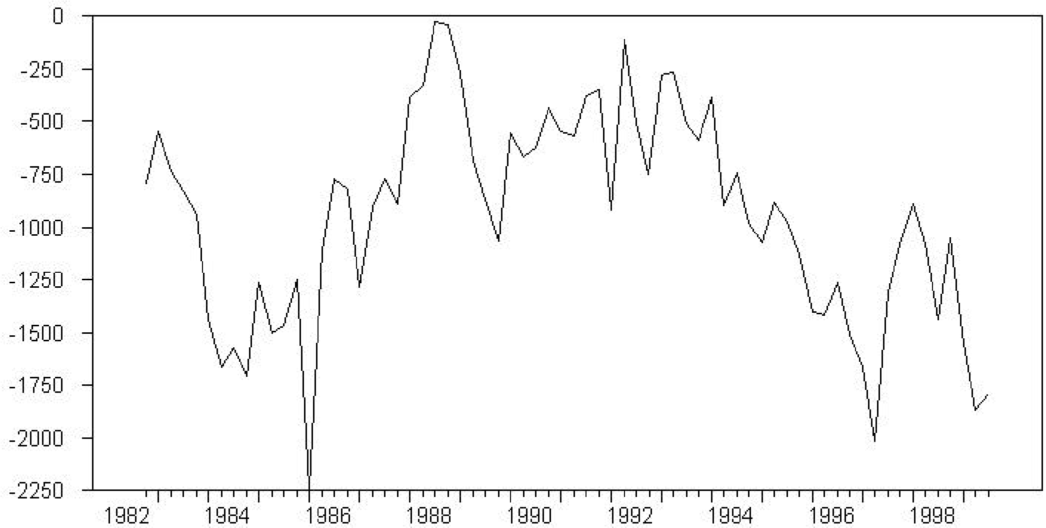


Figure 3: Real Current Account Balance

Based on Nominal Expenditure Series Deflated by the GDP Deflator



Based on Real Expenditure Series

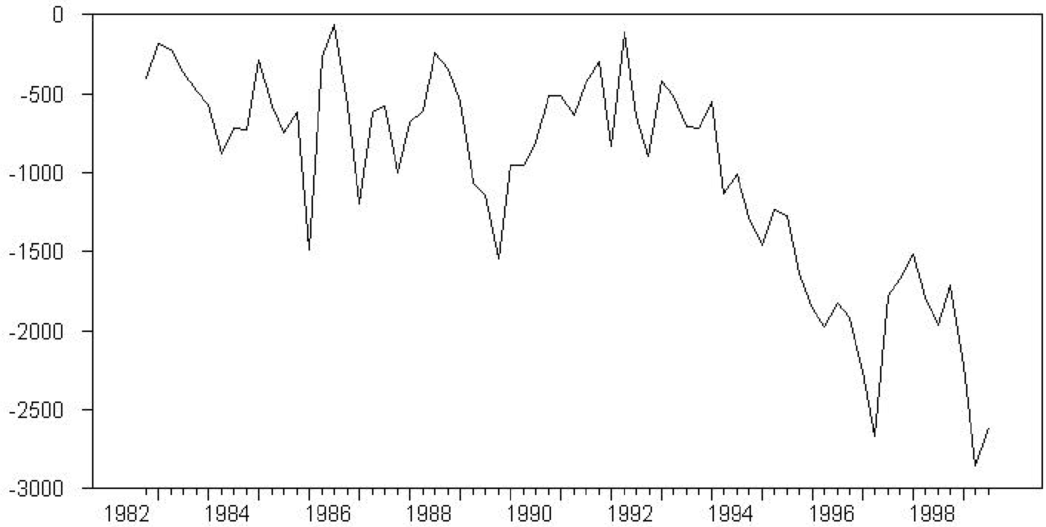


Figure 4: Actual and Predicted Current Account
Demeaned and Detrended, 1991/92 NZ$m, *r* = 0.04 p.a.

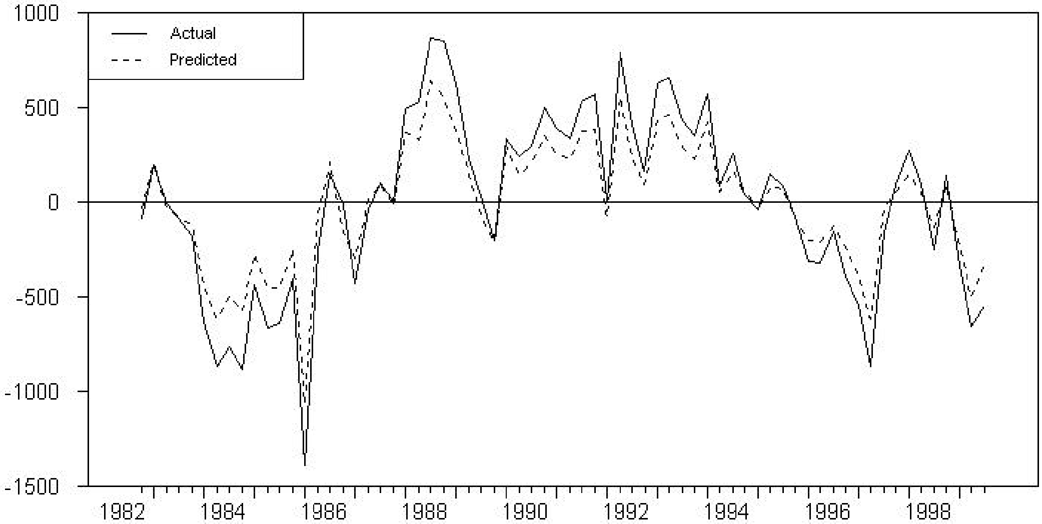


Figure 5: Actual and Predicted Current Account
Demeaned but Not Detrended, 1991/92 NZ$m, *r* = 0.04 p.a.

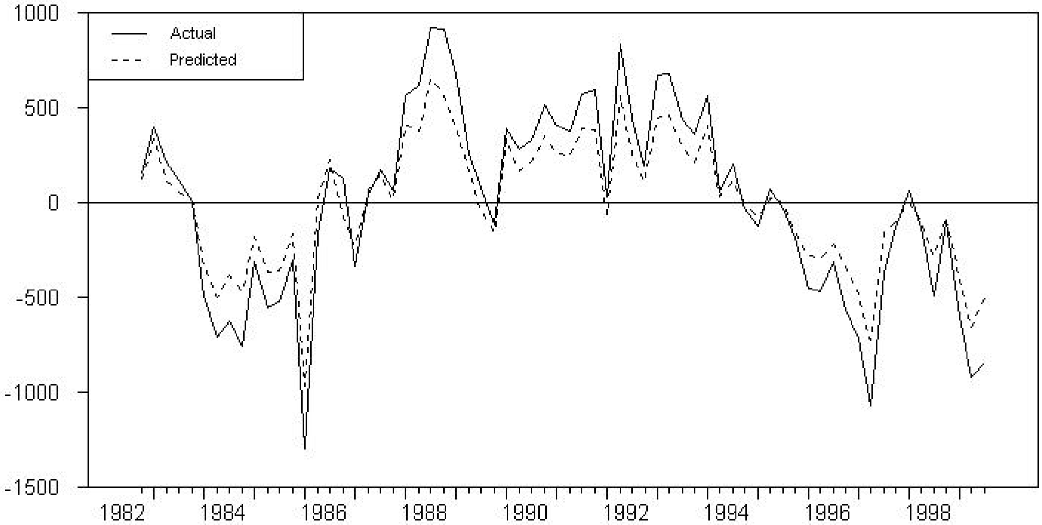


Figure 6: Actual vs. Predicted Current Account with 95% Confidence Band

in percent of GDP, *r* = 0.04 p.a.

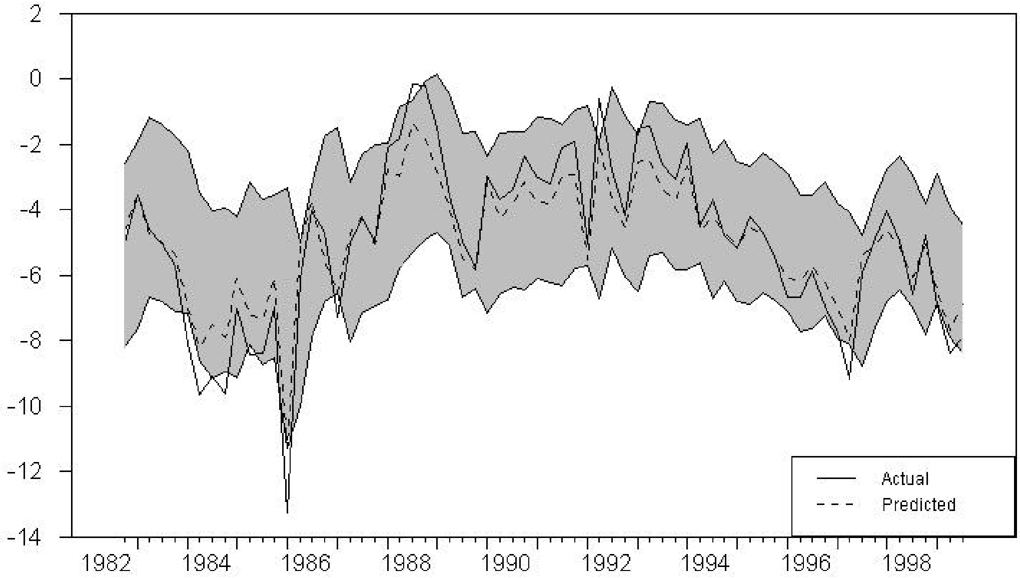


Table 1:Tests for Unit Roots
Series Deflated by GDP Deflator, 1982:3 – 1999:3
(Augmented Dickey-Fuller t-statistic)

	Non-per capita data		*Per capita* data	
	Level	1st difference	Level	1st difference
C	0.51	-12.15**	-0.39	-12.41**
Z	-1.44	-9.39**	-2.34	-9.40**
Z + *rB*	-1.63	-9.29**	-2.57	-9.28**
TB♠	-3.92**	-10.44**	-4.00**	-10.37**
CA	-3.07*	-10.58**	-3.32*	-10.60**

Asymptotic critical values are: 1%, -3.51; 5%, -2.89; 10%, -2.58
*   Null hypothesis of unit root rejected at 5% level of significance, in favour of stationarity
** Null hypothesis of unit root rejected at 1% level of significance, in favour of stationarity
♠ Means of series are all positive at $122.26m, $17.10m, $32.60, and $5.31, respectively.

Table 2:Cointegration Regressions and Estimates of q
Series Deflated by GDP Deflator, 1982:2 – 1999:3

	Non-per capita data		*Per capita* data	
	Constant Term	No Constant Term	Constant Term	No Constant Term
Cointegration Regression				
Constant	191.82		49.72	
(t-stat)	(0.40)		(0.21)	
q	0.90	0.92	0.90	0.92
(t-stat)	(22.01)	(189.92)	(12.91)	(185.69)
ADF t-stat♣	-3.53*	-3.47*	-3.56*	-3.53*

♣ Asymptotic critical values are: 1%, -3.96; 5%, -3.37; 10%, -3.07
* Null hypothesis of unit root rejected at 5% level of significance, in favour of stationarity

Table 3: VAR Parameters, 1982:4 – 1999:3
Series Deflated by GDP Deflator, Cointegration Regression Used

	Non-per capita data				*Per capita* data			
	Const.Term		No Const. Term		Const. Term		No Const.Term	
	ΔZ_t	CA_t^{SM}	ΔZ_t	CA_t^{SM}	ΔZ_t	CA_t^{SM}	ΔZ_t	CA_t^{SM}
ΔZ_{t-1}	-0.20	-0.08	-0.20	-0.08	-0.19	-0.08	-0.20	-0.08
(t-stat)	(-1.73)	(-0.74)	(-1.73)	(-0.73)	(-1.67)	(-0.75)	(-1.67)	(-0.74)
CA_{t-1}^{SM}	-0.20	0.74	-0.20	0.75	-0.22	0.74	-0.21	0.75
(t-stat)	(-2.23)	(8.61)	(-2.19)	(8.64)	(-2.33)	(8.66)	(-2.30)	(8.67)

Table 4: Tests based on R_t, 1982:4 – 1999:3
Series Deflated by GDP Deflator, Cointegration Regression Used

	Non-per capita data		*Per capita* data	
	Const. Term	No Const. Term	Const. Term	No Const. Term
ΔZ_{t-1}	0.12	0.12	0.11	0.12
(t-stat)	(1.21)	(1.22)	(1.18)	(1.18)
CA_{t-1}^{SM}	-0.06	-0.06	-0.05	-0.05
(t-stat)	(-0.79)	(-0.79)	(-0.66)	(-0.67)

Table 5: Wald Tests of the Model, 1982:4 – 1999:3
Series Deflated by GDP Deflator, Cointegration Regression Used

	Non-per capita data		*Per capita* data	
	Const. term	No Const. Term	Const. Term	No Const. Term
Coefficient, $\Phi_{\Delta Z}$	0.12	0.12	0.11	0.11
(t-statistic, $\Phi_{\Delta Z} = 0$)	(1.02)	(1.02)	(0.90)	(0.90)
Coefficient, Φ_{CA}	0.67	0.67	0.72	0.71
(t-statistic, $\Phi_{CA} = 1$)	(-1.39)	(-1.40)	(-1.14)	(-1.15)
Wald test statistic, c^2	1.97	1.97	1.29	1.36
(p-value)	(0.37)	(0.37)	(0.52)	(0.51)

Table 6: Variance Ratios and Correlations, 1982:4 – 1999:3
Series Deflated by GDP Deflator, Cointegration Regression Used

	Non-per capita data		*Per capita* data	
	Const. Term	No Const. Term.	Const. Term	No Const. Term
$s(CA^{SM})/s(CA^{SM*})$	2.06	2.07	1.82	1.86
c^2 test statistic♣	3.09	3.12	1.92	2.01
(p-value)	(0.08)	(0.08)	(0.17)	(0.16)
$r(CA^{SM}, CA^{SM*})$	0.9910	0.9908	0.9930	0.9927

♣ Test statistic for the null hypothesis that $s(CA^{SM*}) = s(CA^{SM})$