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The Present Value Model and New Zealand's Current Account*

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Abstract

This paper tests the present value model of the current account on New Zealand data. There is some evidence in favour of the PVM – the current account tests as stationary and Granger-causes changes in national net income. However, the cross-equation restrictions implied by the model are rejected both individually and jointly. This result holds for both the linear and non-linear versions of the tests. The orthogonality test results are consistent with rejection due to the presence of a transitory demand shock. We conclude that a richer model is needed to understand current account dynamics.

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1 Introduction

In June 2006, New Zealand's current account deficit was 9.7 per cent of GDP, a level that is among the highest in the OECD and one that is not sustainable over a prolonged period without a marked increase in already high external liabilities. The large deficit has led to concern among some market commentators and policymakers. We view the current account deficit from three perspectives: balance of payments transactions; net capital inflows; and the savings-investment gap. None of these, however, tells us about causality. To understand the causes of the deficit we need a structural model.

This paper asks whether the widely-considered present value model (PVM) can help us in understanding the dynamics of the New Zealand current account balance. The PVM is a simple one-shock model that focuses on the savings-investment decisions of a representative utility maximising household. It is analytically solvable, implies testable restrictions and has appealing intuition for current account dynamics.[1] However, the tractability of the PVM is at the cost of some extreme assumptions, such as that of perfect capital mobility, a simplistic representation of household preferences and a single source of shocks.

For most countries, the observed data fail the cross equation restrictions (CER) implied by the PVM; restrictions on which most of the statistical tests of the PVM are based. This rejection is difficult to interpret as it could reflect an overly simple model, data that do not reflect optimising behaviour, or an inappropriate statistical representation.

Nevertheless, the New Zealand current account is an appealing candidate for tests of the PVM in many respects. It has a liberalised domestic financial system with a high degree of capital market integration; it is small relative to international capital flows; and it has a floating exchange rate. Together these suggest few restrictions on domestic or international borrowing. A relatively high degree of mean reversion in the current account (table 1 and figure 1) is consistent with a shock-absorber role.

This model has been most recently tested on New Zealand data by Kim, Buckle,

[1] The PVM was originally proposed by Sachs (1981). Empirical tests are set out in Campbell (1987) and Campbell and Schiller (1987). Bergin and Scheffrin (2000) extend the model and tests to include a variable interest rate. Gruber (2002) extends the model to include habit in consumption. Kano (2003) shows the observational equivalence between habit in consumption and a transitory consumption shock. There is a large body of empirical work, which tests the PVM for a variety of countries; Obstfeld and Rogoff (1995) provide a review.

and Hall (2006). Following a similar approach and by using a longer sample, we find that conclusions in Kim, Buckle, and Hall (2006) are sensitive to the small sample size. Further, we use Bayesian sampling to assess the robustness of the results on both non-linear and linear cross-equation restrictions (CER) implied by the PVM. By considering both sets of CERs, we illustrate and avoid a potential problem with the use of the non-linear version.

The rest of the paper is structured as follows. Section 2 provides a brief overview of the present value model and implications for the data. Section 3 updates the PVM tests for by including data from 1999 to 2005. Section 4 concludes.

2 The Present Value Model of the Current Account

The present value model of the current account is a simple, one-shock model, built around a representative, infinitely-lived consumer who maximizes the present value of expected future utility from consumption:

$$\max_{C_{t+j}} \sum_{j=0}^{\infty} \beta^j E_t[u(C_{t+j})], \tag{1}$$

where β is the subjective discount rate, $u(\cdot)$ is the felicity/instantaneous utility function and C_t is consumption at time t.

The intertemporal resource constraint is derived from the national accounts identity,

$$Y_t = C_t + I_t + G_t + NX_t, \tag{2}$$

where Y_t is GDP, C_t is consumption, I_t is investment, G_t is government spending, and NX_t is the level of net exports.

Assets and debt are accumulated through holdings of a single riskless bond, B, denominated in units of consumption. The economy is small and open so that the bond is traded freely with non-residents at a world real interest rate which is assumed to be fixed. The law of motion of bonds is

$$\begin{aligned} B_{t+1} - B_t &= rB_t + NX_t \\ &= CA_t \end{aligned} \tag{3}$$

The current account is the sum of interest income from bonds $r_t B_t$ (or payments on debt) and net exports, NX_t, and is financed by the change in bond holdings, the left hand side of (3).

Solving (3) forward, the intertemporal budget constraint can be written,

$$-(1+r)B_t = \sum_{j=0}^{\infty}\left(\frac{1}{1+r}\right)^j NX_{t+j}, \tag{4}$$

subject to a transversality (solvency) condition that prevents agents from running up infinite debt or infinitely rolling over debt:

$$\sum_{\lim_{j\to\infty}} \beta^j B_{t+j} = 0. \tag{5}$$

For solvency, the current outstanding stock of debt plus current interest (the left hand side of (4)) cannot exceed the value of current and future trade surpluses required to repay the debt. The Euler equation from intertemporal utility maximisation sets the marginal utility of consumption in period t equal to $(1+r)$ times the expected discounted marginal utility of consumption in period $t+1$

$$(1+r)\beta E_t[u'(C_{t+1})] = u'(C_t) \tag{6}$$

Assuming quadratic preferences,[2] $u(C_t) = C_t - a_0 C_t^2/2$, and combining (4) and (6), consumption can be written as a function of initial wealth (bond holdings) and a discounted sum of future net income, NY_t $(= Y_t - I_t - G_t)$:[3]

$$C_t = \frac{r}{\theta}\left\{B_t + \frac{1}{(1+r)}E_t\left[\sum_{j=0}^{\infty}\frac{NY_{t+j}}{(1+r)^j}\right]\right\} - \frac{\alpha}{r}, \tag{7}$$

where

$$\theta = \frac{\beta(1+r)r}{\beta(1+r)^2 - 1} \qquad \text{and} \qquad \alpha = \frac{1}{\alpha_0}\left[1 - \frac{1}{\beta(1+r)}\right].$$

The optimal consumption smoothing component of consumption is defined as the component of C consistent with $\beta = 1/(1+r)$,[4] so that $\theta = 1$ and $\alpha = 0$

$$\begin{aligned} C_t^* &= rB_t + \frac{r}{(1+r)}E_t\left[\sum_{j=0}^{\infty}\frac{NY_{t+j}}{(1+r)^j}\right] \\ &= \theta C_t + \frac{\theta\alpha}{r}. \end{aligned} \tag{8}$$

[2] Quadratic preferences provide the necessary curvature of the utility function in a tractable functional form.

[3] See Kim, Buckle, and Hall (2006).

[4] The the marginal investment return is equalised with the rate at which that future return is discounted by arbitrage.

Under rational expectations, consumption changes in response to changes in the value of wealth B_t, or in response to changes in expected future net income which alter the permanent income path.

Unit root tests and cointegration

Using the identity $CA_t = NY_t + rB_t - C_t$ and equation (8), the optimal smoothing component of the current account (CA_t^* that relates to optimal consumption C_t^*) can be estimated empirically as the residual of a regression of $NY_t + rB_t$ on consumption,

$$\begin{aligned} NY_t + rB_t &= C_t^* + CA_t^* \\ &= \theta C_t + \theta \frac{\alpha}{r} + CA_t^*. \end{aligned} \tag{9}$$

This provides a basis for detrending the current account data, or in the case of $\beta = 1/(1+r)$ (ie, $\theta = 1$), demeaning the current account. If $(NY_t + rB_t)$ and C_t are I(1) and cointegrated, then CA_t^* should be I(0).

Cross equation restrictions

The current account path consistent with the optimal consumption smoothing path can be expressed analytically by substituting (8) into (9):

$$CA_t^* = -\sum_{j=1}^{\infty} \frac{E_t \Delta NY_{t+j}}{(1+r)^j}. \tag{10}$$

This is the current account present value relationship – the current account is the present discounted value of future changes in net income.

If the relationship between ΔNY_t and CA_t, which are both I(0), can be represented by the vector autoregression (VAR):[5]

$$W_t \equiv [\Delta NY_t, \Delta NY_{t-1}, CA_t^*, CA_{t-1}^*]' = DW_{t-1} + \varepsilon_t \tag{11}$$

[5] In fact, the relationship is a VECM in $Z_t = [\Delta NY_t, \Delta C_t^*]'$ since NY_t and C_t are cointegrated. This suggests a VARMA rather than a VAR. If there are significant MA terms, then the VAR will have autocorrelated residuals. The residual AR tests (table 5), however, show no evidence of autocorrelated residuals.

then the unrestricted forecast of W_{t+j} is,

$$E_t[W_{t+j}] = D^j W_t\,. \tag{12}$$

This can be used to construct the restricted (in sample) model forecast, in (10):

$$\begin{aligned} CAf_t &= -F_1 \frac{D}{1+r}\left[I - \frac{D}{1+r}\right]^{-1} W_t \\ &= HW_t \end{aligned} \tag{13}$$

where $F_1 = [\ 1\ 0\ 0\ 0\ ]$.

If the restricted model forecast of the current account, HW_t, is equal to the observed current account then,

$$CA_t \equiv [\ 0\ 0\ 1\ 0\ ]W_t = HW_t \tag{14}$$

and the cross equation restriction holds, ie, $H = [\ 0\ 0\ 1\ 0\ ]$.

The right hand side of equation (13) is non-linear in D and may lead to inappropriate inferences if the eigenvalues of $D/(1+r)$ are close to unity such that $[I - D/(1+r)]$ is near rank-deficient.[6] To avoid inverting $[I - D/(1+r)]$, Campbell and Schiller (1987) rewrite the equality as

$$[\ 0\ 0\ 1\ 0\ ]\left[I - \frac{D}{1+r}\right] = -[\ 1\ 0\ 0\ 0\ ]\frac{D}{1+r}, \tag{15}$$

These cross equation restrictions are linear in D, and do not require the inversion of $[I - D/(1+r)]$. They can be tested individually with a t-test and jointly with a Wald test.

Taking the first element of the infinite sum on the right hand side of equation (10), $E_t\Delta NY_{t+1}/(1+r)$, it can be seen that the linear cross equation restrictions correspond to a single period rather than a multiperiod test of equation (10):

$$\begin{aligned} CA_t &= \frac{E_tCA_{t+1} - E_t\Delta NY_{t+1}}{1+r} \\ &= \frac{F_pD - F_1D}{1+r}W_t; \qquad F_p = [\ 0\ 0\ 1\ 0\ ] \\ &= GW_t \end{aligned} \tag{16}$$

[6] Mercereau and Miniane (2004) show that even eigenvalues quite far from unity may lead to incorrect inferences.

Using G (or H) a model-consistent forecast GW_t (or HW_t) of the current account can be constructed. The correlation between the model consistent forecast and the observed current account can then be examined. Further, the variance of the forecast can be tested for equality with the variance of the observed current account.

Orthogonality condition

Equation (10) can be written,

$$CA_t^* = \Delta NY_t + (1+r)CA_{t-1}. \tag{17}$$

With rational expectations, the error $\varepsilon_t = CA_t^* - \Delta NY_t - (1+r)CA_{t-1}^*$ should be orthogonal to information available at time $t-1$, that is uncorrelated with lagged W_t, or in the presence of serially uncorrelated demand shocks, with W_{t-2}, W_{t-3}, ... as shown in Campbell (1987). This tests the orthogonality condition *ex post*, while the linear cross equation restriction (16) tests it in terms of VAR forecasts.

The predictions of the canonical PVM can be summarised as follows:

- net income and consumption are cointegrated so the current account (the error correction term) is stationary;
- the current account Granger-causes changes in net income (the fundamental);
- for a p^{th} order VAR, the $p+1^{\text{st}}$ element of the cross equation restriction G (or H) is unity and other elements are zero;
- the variance of GW_t (or HW_t) is equal to the variance of the observed current account;
- ε_t is orthogonal to ΔNY_{t-1}, ΔNY_{t-1} ... and CA_{t-1}^*, CA_{t-2}^* ... or in the presence of serially uncorrelated, ie unforecastable, demand shocks, ε_t is orthogonal to NY_{t-j} and CA_{t-j} for $j \geq 2$.

We document all of these for the observed data, but focus on the distributions of the elements of the linear cross equation restriction, G, for model comparisons.

3 Testing the New Zealand data

Unit root tests and cointegration

Empirical tests in this section are carried out using real per capita data which are discussed in more detail in appendix A. Unit root tests are shown in table 2. C and $(NY + rB)$ test as I(1) and their first differences as stationary. The current account series derived from the national accounts, (NY+rB-C), also tests as stationary.

We test for cointegration between $NY + rB$ and C using the Engle-Granger approach (see table 3).[7] The OLS estimate of the coefficient on consumption, θ in (9), is significantly different from unity for recent samples.[8] In the theoretical framework of the PVM, this implies that arbitrage has not equalised the world interest rate and the domestic rate of time preference, ie, $\beta \neq 1/(1+r)$. In practice, the trend is the result of divergence between $NY + rB$ and C in recent periods as shown in figure 2. In the framework of a richer model, this is consistent with a nonzero steady state debt stock/GDP and growth in real per capita variables which implies growth in the real per capita current account $NY + rB - C$. The trend also reflects the recent deterioration of the current account at the end of a small sample, and may reflect medium term developments such as increasing capital market integration or recent exogenous factors such as the increase in Asian reserves.

We have a choice between detrending the current account using equation (9) or simply demeaning the current account, which imposes a coefficient of unity on θ. In the long run, this coefficient will tend toward unity and, in practice, the choice makes little difference for tests on the observed sample. However, in some simulated samples (which are also short samples for comparability), the trend may be important so we adopt the detrending approach to ensure that the VARs are estimated using stationary data.

Unit root tests show that the consumption-smoothing component of the current account is stationary. Figure 2 shows the data and figure 3 the estimated residual: the optimal consumption smoothing component of the current account, CA_t^*, and the component that is not modelled. The large negative mean mainly reflects the

[7] The Johansen method has weak power for short samples and rejects cointegration between C and $(NY + rB)$ for New Zealand data. The trace and maximum eigenvalue test statistics are both 3.8 compared to critical values of 15.5 and 14.3.

[8] Estimates can sometimes be improved through dynamic OLS (DOLS) by adding leads and lags of ΔC on the right hand side to improve the distributions of the residuals. DOLS was not found to normalise the residuals in this case.

investment income payments on the outstanding external stock of liabilities.

Cross equation restrictions

VAR lag order selection criteria select a lag length of 2 (table 4). VAR(2) estimation results are shown in table 5. One of the implications of the present value model is that the current account Granger-causes changes in net income. As shown in table 5, lagged current account terms are significant in the net income equation, as confirmed by a Granger causality test. The parameter on CA^*_{t-2} in the ΔNY equation is -0.32 and significant: a current account deficit (surplus) precedes an increase (decrease) in net income. The linear (G) estimates of the cross equation restriction are significantly different from [0 0 1 0], as shown in table 6.

Bayesian sampling is used to generate 5000 draws from the companion matrix, D, and distributions of G and H are constructed (see figure A).[9] The third element of H is significantly below, and the first and fourth elements are significantly above their respective theoretical values of one and zero. Consistent with individual elements of G being different from their theoretical values, the joint Wald test also fails (table 6) leaving the distribution of this test statistic mainly to the right of the critical value (figure 6).

This rejection of the CER is common in international surveys of the PVM. There are several reasons that have been proposed for this failure ranging from the criticism that the PVM is an overly simple economic model to that economic agents may not rationally smooth consumption over time. In an attempt to identify some plausible culprits for the failure of the CER, Nason and Rogers (2006) construct a calibrated general-equilibrium model that nests the PVM as a special case. Using Bayesian sampling methods similar to those employed here, Nason and Rogers (2006) conclude that international credit risk premia, international capital immobility, habit formation in consumption, and intertemporal 'impatience' in consumption can help explain the failure of the PVM on Canadian data. In an early replication exercise based on a similar model, we found that the general equilibrium model moves closest to the New Zealand data when it incorporates habit in consumption, risk premia, and shocks that 'revalue' New Zealand's external debt position.

[9] Computations reported in this section were undertaken in part using the Bayesian Analysis, Computation and Communication software (http://www2.cirano.qc.ca/ bacc/).

Variance ratio test

The model-implied forecasts GW_t are similar to the observed current account (figure 7). However, this is not because the data fit the model well (G, $H \neq [0\,0\,1\,0]$), but because the elements of G that differ from their theoretical values (eg., CA_t^* and CA_{t-1}^*) are roughly offsetting. The linear CER is closer to the model, as measured by the correlation of GW_t and HW_t with the observed current account and the variance ratio test (table 6).

As shown at the bottom of table 6, the variance of the observed current account is not significantly different from that implied by the linear cross equation restriction. Bayesian sampling allows us to examine the distributions of the variance ratios (figure 8). In the linear case $(\text{var}(GW_t)/\text{var}(CA_t))$ the distribution of the variances is clustered around unity. In the non-linear case $(\text{var}(HW_t)/\text{var}(CA_t))$, the distribution is much more dispersed, but given a large standard deviation, the hypothesis of equal variances cannot be rejected. While the variance ratio test cannot be rejected, like the visual inspection of the model-consistent series, the acceptance is for incorrect reasons.

Draws from G and H are used to generate error bands around the model-consistent series GW_t and HW_t (see figure 9). Forty-two percent of observations of CA_t are within the linear 5 and 95 percentile error bounds of GW_t and 78 per cent of observations are within the error bounds of HW_t. The error bounds of HW_t generally include zero, suggesting that tests based on nonlinear cross equation restriction are not very informative.

Orthogonality condition

The residual $R_t = CA_t^* - \Delta NY_t - (1+r)CA_{t-1}^*$ is not orthogonal to ΔNY_{t-1}, ΔNY_{t-2}, $\ldots$ and CA_{t-1}^*, CA_{t-2}^* $\ldots$ (see table 7). However, it is orthogonal to NY_{t-2}, NY_{t-3}, $\ldots$ and CA_{t-2}^*, CA_{t-3}^*, $\ldots$, suggesting that a transitory demand shock may be an explanation for the failure of the cross equation restriction (see Campbell 1987).

4 Conclusion

The results of the analysis in this paper show that the cross equations restrictions implied by the present value model of the current account are rejected by the New

Zealand data. Choosing a lag order of 2 for a VAR that forecasts the current account on the basis of future changes in national net income, we find that the CER restrictions are rejected both individually and jointly – a result in line with tests of these restrictions using data from other countries.

This rejection is difficult to interpret since the tests involve multiple hypotheses: (i) the model is correct (there are no excluded variables in the statistical tests), (ii) behaviour of New Zealand households is optimal, and (iii) the statistical tests – VAR (rather than VECM) representation, lag length, and sample size – are appropriate.

Nason and Rogers (2006) pursue the first explanation, building a richer model to examine structural reasons for the rejection. For example, habit formation in consumption[10] and nonseparability in preferences affect agents' intertemporal decisions, in turn affecting the degree of smoothing in consumption and the volatility of the current account. In Munro and Sethi (2006) we examine the effects of these factors on the current account, together with those of credit risk premia, international risk, rates of time preference different from trading partners, and external valuation and other shocks.

Finally, in considering both non-linear and linear CER, this paper illustrates the matrix invertibility problems that may lead to incorrect inferences.

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[10] See also Kano (2003) which shows that the time series effect of habit formation in consumption is indistinguishable from that of transitory demand shocks.

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Appendices

A Data

Empirical tests of the PVM

Data on GDP, consumption, investment and government spending are seasonally adjusted data in current prices from Statistics New Zealand (SNZ). Investment includes a measure of the change in stocks. The investment income balance (rB) is from SNZ's Balance of Payments accounts in current prices; the data do not exhibit seasonality. Nominal data are deflated by the GDP price deflator and divided by working age population which is seasonally adjusted. Our sample period is 1982Q2 to 2005Q2.

We use the GDP deflator for all series rather than SNZ's individual price deflators to maintain ratios observed in the nominal data. This best matches the allocative decisions made by the representative agent in each period. Our series for investment is somewhat different from the individually deflated official SNZ series for investment. The investment deflator includes quality adjustment and grows more slowly than the other deflators implying an upward trend in the investment/GDP ratio. This trend is subsequently removed in the regression of $NY + rB$ on consumption, yielding similar VAR, Wald, LM and variance ratio test results. On balance, the individually deflated data are closer to the PVM with a Wald statistic of 0.22 compared with 0.28 for the nominal data deflated by the GDP deflator for a VAR(2). So, in terms of our test results, we report somewhat less support for the PVM than would be implied by a flatter deflator on investment.

Table 1
Persistence of Australian, New Zealand and US current account/GDP ratios

	New Zealand	Australia	United States
Unit root tests			
ADF	-4.34**	-2.63	-0.25
Ng Perron	-22.51**	-9.39*	1.96
Phillips Perron	1.21**	3.15	39.00
AR(1) estimates			
constant	-0.017	-0.007	-0.001
t-value	-3.95**	-2.59*	-1.15
beta	0.646	0.840	.994
t-value	7.91**	-13.73**	38.9**
Implied half life (quarters)	2	4	>100
Implied steady State	-4.8	-4.7	-14.0

Note: data are seasonally adjusted current account as a share of seasonally adjusted GDP for period 1982Q2 to 2005Q2. Sources: Australian Bureau of Statistics, Statistics New Zealand, US Bureau of Economic Analysis.

Table 2
Unit root tests

		ADF 1/	Ng-Perron 1/	Philips-Perron 2/
$NY + rB$	level	-1.13	0.59	-1.94
	1st difference	-10.95**	-2.60	-16.98**
Consumption	level	0.64	2.28	0.55
	1st difference	-15.26**	-37.12**	-15.26**
CA (BOP)	level	-2.73	-8.16*	-4.01**
CA (NY+rB-C)	level	-3.93**	-10.64*	-3.90**

Data are real, seasonally adjusted per capita. The results are therefore not directly comparable to those in table 1. ** indicates significance at the 1% level; * at the 5% level; † at the 10% level.
1/ lag length based on Schwartz information criterion.
2/ lag length based on Newey-West bandwidth.
Sample: 1982Q2 - 2005Q2.

Table 3
Cointegration regression

Dependent variable NY+rB:			
	coeff	t-value	$H_0: \theta = 1$
			t-test
θ	0.79	19.7**	-5.25**
$\theta\alpha/r$	0.61	3.04**	
R^2			0.83
R^2_{adj}			0.83
SEE			0.18
DW			0.69
implied α			0.0035
implied β	(r = 4% p.a.)		0.992
Residual unit root tests			
ADF			-4.04**
Ng-Perron			-17.97**
Philips-Perron			-4.00**

See notes to Table 2. 1985Q3-2005Q3.
** indicates significance at the 1% level; * at the 5% level.

Table 4
VAR lag order selection criteria

Endogenous variables: ΔNY, CA^*

Lag	LogL	LR	FPE	AIC	SC	HQ
1	109.1	NA	0.00025	-2.63	-2.51	-2.58
2	123.9	28.05*	0.00019*	-2.90*	-2.66*	-2.80*
3	125.0	2.06	0.00020	-2.82	-2.47	-2.68
4	125.6	1.07	0.00022	-2.74	-2.26	-2.55

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion
Sample: 1985Q1-2005Q4, 84 observations

Table 5
VAR estimates

	Unrestricted		Restricted	
	DNY	CAS	DNY	CAS
$\Delta NY(-1)$	-0.76	-0.21	-0.48	-0.48
	*-5.58***	*-1.60*	*-5.07***	
$\Delta NY(-2)$	-0.40	-0.29	-0.35	-0.35
	*-4.00***	*-3.01***	*-4.90***	
$CA^*(-1)$	0.29	0.77	0.03	1.03
	1.89	*5.25***	*0.25*	
$CA^*(-2)$	-0.48	-0.04	-0.26	-0.26
	*-3.16***	*-0.30*	*-2.46**	
R-squared	0.38	0.48	0.35	0.44
Adj. R-squared	0.36	0.46	0.32	0.42
Sum sq. residuals	1.46	1.31	1.54	1.39
S.E. equation	0.14	0.13	0.14	0.13
F-statistic	15.92	23.63		
Log likelihood	48.81	53.30		
Granger Causality Test[a]				
χ^2 test	10.97	9.36		
p-value	0.004**	0.009**		
Largest eigenvalue	0.89			
Residual Tests (p-values)				
AR $\chi^2(3)$	0.80	0.60		
Heteroskedasticity $\chi^2(8)$	0.24	0.73		
Normality (Jarque Bera)	0.00**	0.36		
ARCH F(1,79)	0.10	0.62		

Sample: 1985Q3 - 2005Q4, 82 observations

Notes: t-values are in italics.

* indicates significance at the 5% level; ** indicates significance at the 1% level.

[a] Granger Causality test: joint exclusion of the CA^* terms from the ΔNY equation and vice versa. This is rejected in both cases: CA^* Granger-causes ΔNY and ΔNY Granger causes CA^*.

Table 6
Cross-equation restriction

	Theory:		G (Linear)		H (Nonlinear)
ΔNY_t	0		0.56		0.45
t-value			*5.12*	**	
ΔNY_{t-1}	0		0.14		0.12
t-value			*1.58*		
CA_t^*	1		0.48		0.41
t-value		$\stackrel{?}{=} 0$	*3.98*	**	
		$\stackrel{?}{=} 1$	*-4.38*	**	
CA_{t-1}^*	0		0.49		0.26
t-value			*4.00*	**	
Wald Test, χ^2 :			28.2		
p-value			*0.00*		
Corr(CA^*,CA^R)			0.93		0.91
Variance. Ratio Test:					
$\sigma^2_{CA^*}/\sigma^2_{CA^R}$			1.03		1.91
χ^2 p-value[a]			*0.45*		*0.00***
% Observations in 5-95% error bounds			49		82

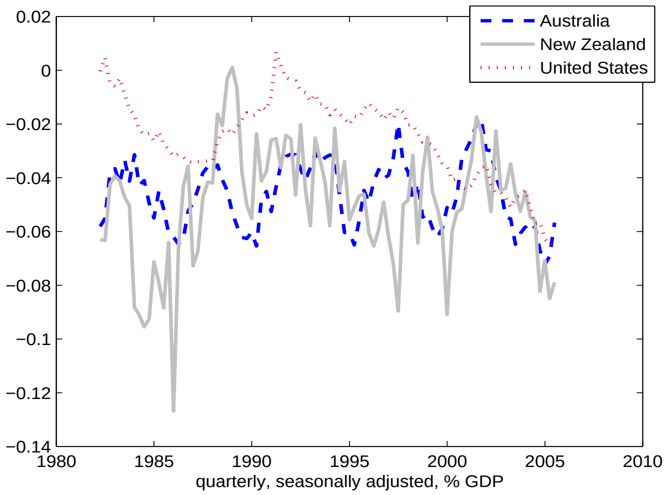
Calculated from VAR estimates in Table 5

Table 7
Orthogonality tests

	PVM			PVM with transitory demand shock	
	coeff	t-value		coeff	t-value
ΔNY_{t-1}	0.56	5.20	**		
ΔNY_{t-2}	0.12	1.52	**	-0.14	1.15
ΔNY_{t-3}				-0.02	-0.20
CA_{t-1}	-0.54	-4.39	**		
CA_{t-2}	0.44	3.67		0.14	0.96
CA_{t-3}				0.20	-1.41
R^2		0.27			0.03
SEE		0.11			0.12
DW		2.07			2.86
LM test		29.6	**		1.43
5% critical value					

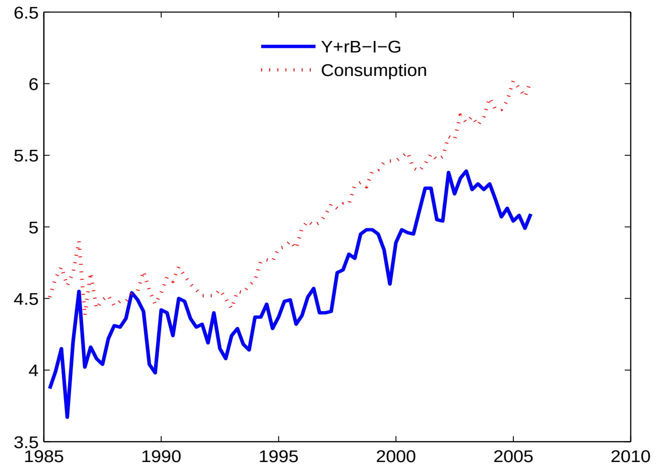
Sample 1985Q1 - 2005Q4
Dependent variable: $R_t = CA_t - \Delta NY_t - (1+r)CA_{t-1}$
** indicates significance at the 1 % level; * at the 5 % level.

Figure 1
Australia, New Zealand and US current accounts



Note: Quarterly, seasonally adjusted data from Balance of Payments Accounts.
Sources: Australian Bureau of Statistics, Statistics New Zealand, US Bureau of Economic Analysis.

Figure 2
Consumption and net national income



Note: Real seasonally adjusted data are constructed by deflating nominal seasonally adjusted data by the GDP deflator and dividing by working age population.
Source: Statistics New Zealand

Figure 3
Consumption smoothing component of current account

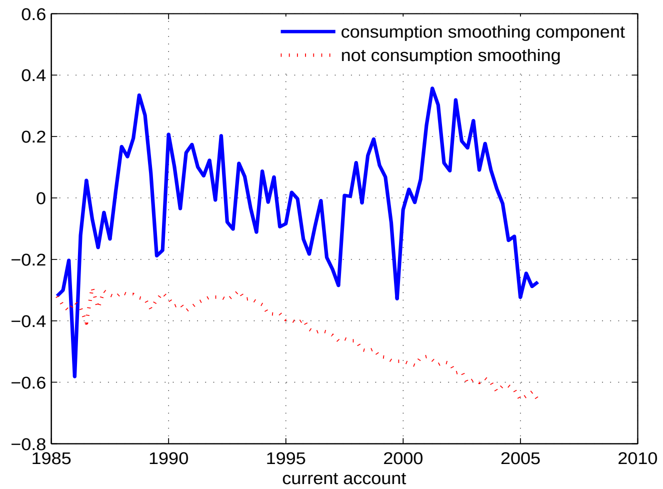


Figure 4
VAR(3) companion matrix

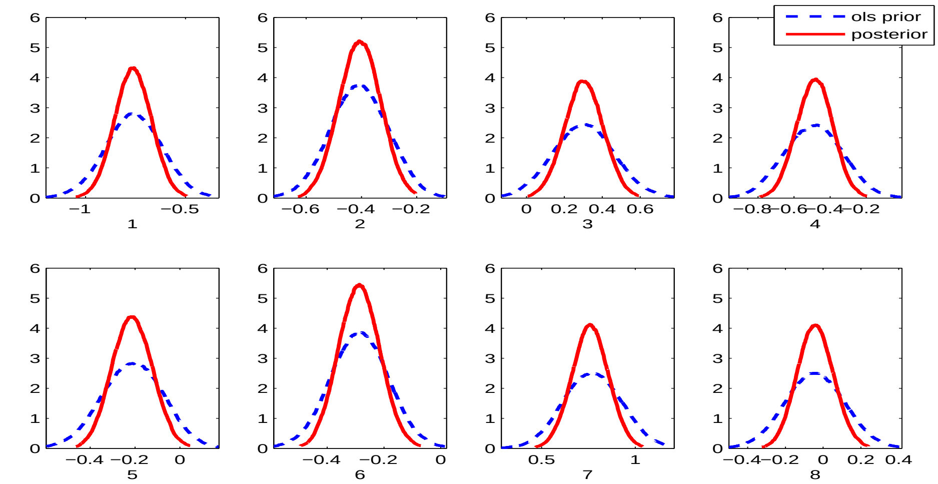
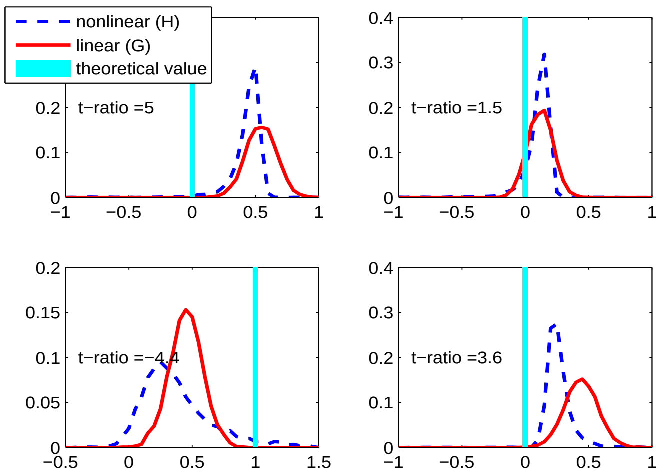


Figure 5
VAR(2) Cross equation restriction: Distributions of G and H-vectors.



Note: Detrending achieved by regression of $NY + rB$ on C; t-ratios apply to linear (G) distribution.

Figure 6
VAR(2) empirical Wald test distribution

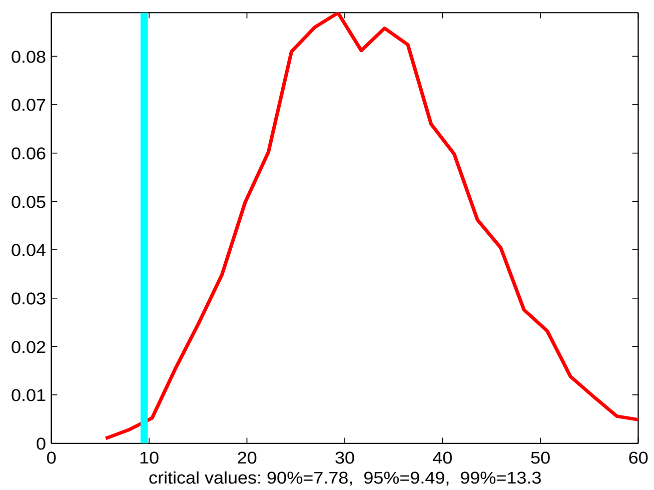


Figure 7
VAR(2) In-sample model-consistent current account forecast

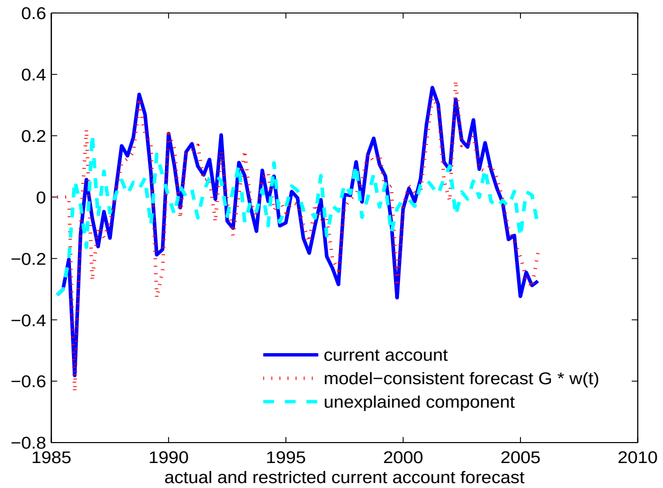


Figure 8
VAR(2) Distribution of variance ratios

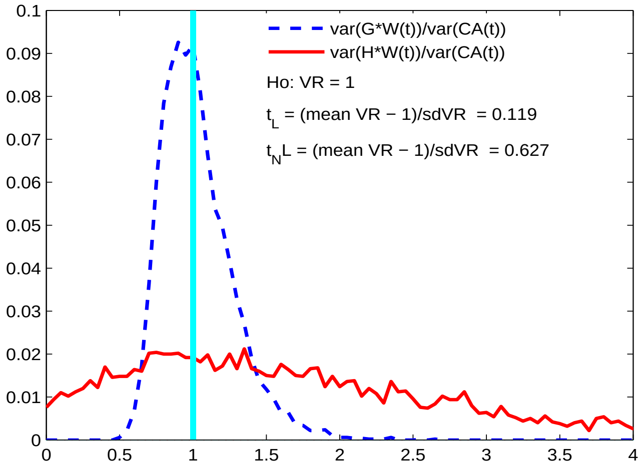


Figure 9
VAR(2) In-sample forecast error bands