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Modelling New Zealand Consumption Expenditure over the 1990s

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Modelling New Zealand Consumption Expenditure over the 1990s

Khoon Lek Goh and Richard Downing

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D I S C L A I M E R

The views expressed in this Working Paper are those of the author(s) and do not necessarily reflect the views of the New Zealand Treasury. The paper is presented not as policy, but with a view to inform and stimulate wider debate.

Abstract

This paper presents two models of consumption for the primary purpose of forecasting consumption expenditure growth in New Zealand. The models, which are consistent with a range of consumption functions including the life-cycle and permanent income hypothesis, are error correction models with the long-run equations estimated using both the conventional ordinary least squares procedure as well as the Stock and Watson procedure of leads and lags. Unlike earlier New Zealand studies, actual data on household net wealth, rather than proxies or derived series were used. This allowed the wealth variable to be modelled in disaggregated form. Mortgage equity withdrawal by households and funds brought into the economy by immigrants are two novel variables included in the consumption models. Migrant transfers were found to have an influence on short-run consumption growth, but not mortgage equity withdrawal although the latter did contribute to a higher overall model fit. Net non-financial wealth was found to have short-run influence on consumption but not in the long-run.

JEL CLASSIFICATION D12, D91, E21, E27

KEYWORDS Forecasting; consumption functions; wealth; migrant transfers; mortgage equity withdrawal.

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Modelling New Zealand Consumption Expenditure over the 1990s

1 Introduction

Consumption expenditure is the largest component of total spending in the New Zealand economy, accounting for around three-fifths of expenditure based gross domestic product (GDP) since the late 1980s. Despite a growing international literature on consumption modelling, past research on New Zealand consumption models is scarce. The main New Zealand research is McDermott (1990), Corfield (1992) and Rae (1997). One shortfall of all three studies is the inadequate measurement for the wealth variable. McDermott (1990) and Corfield (1992) used housing value, M3 money supply and equity prices as proxies for gross wealth, but no adjustments were made to account for household debt. Rae (1997) derived a net wealth measure based on data from various sources. This is not a criticism of the earlier studies. Comprehensive measures of household assets and liabilities were not available at that time, and the authors had to improvise with whatever data were available.

This paper presents two models of consumption, building upon earlier work done by Downing (2001). The primary purpose of this consumption modelling is for forecasting. While it is possible to set up models to test various hypotheses, such as the impact on consumption from rising house or equity prices, that is not the main intended purpose.

An improvement over earlier New Zealand consumption models is the use of the household wealth information from the WestpacTrust Household Savings Indicators (HSI). In addition, new variables are introduced into the modelling to capture short-run variations in consumption growth specific to New Zealand, aimed at addressing some of the criticisms cited by Hendry et al. (1990), who argue that the basic formulation for most consumption functions used for forecasting omits five potentially important influences on consumer behaviour. These are income uncertainty, credit constraints, demographic changes, liquidity, and dynamic adjustment.

The unemployment rate, common in the consumption literature, is used to capture income uncertainty. New Zealand households hold a disproportionately large proportion of their assets in housing compared to other industrialised countries. Households are increasingly borrowing against the value of their housing assets for consumption or other purposes. Introducing a mortgage equity withdrawal variable is aimed at capturing the credit constraints and liquidity elements. Due to New Zealand's small population, net migration has a larger impact on population growth than other industrialised countries. Modelling consumption on a per capita basis only addresses part of the net migration

impact. A net migrant transfers variable, which measures the amount of funds brought into the country, is introduced to capture the consumption impact from net migration.

Data availability restricts the analysis to the 1989:4 to 2002:1 period. This restriction does not qualify any conclusions from the modelling. However, one advantage of the restricted time period is that the data series are unlikely to suffer from any structural breaks, as most of the economic reforms and financial deregulations in New Zealand occurred in the mid-1980s. The tests performed on the models support the absence of structural breaks.

This paper is structured as follows. Section 2 discusses the modelling approach and model specifications, including data choice and properties. In Section 3, the empirical results of the models are presented. Out-of-sample forecast comparisons from the models are also presented in Section 3, along with a historical decomposition of New Zealand consumption growth over the 1990s. Concluding remarks and possible extensions are contained in Section 4.

2 Modelling Approach

2.1 Model specification

The approach taken here is the error correction model (ECM) approach employing the Engle-Granger two-step procedure. The ECM was first used by Sargan (1964), but became popular in the consumption literature after it was used by Davidson et al. (1978) to model consumption expenditure in the United Kingdom. A major advantage of the ECM approach is that the long-run effects are distinguished from the short-run effects, with specification of the long-run effect drawing on economic theory while allowing the short-run to be in dis-equilibrium.

The intuition behind the ECM approach is that households adjust their consumption towards the long-run equilibrium, as defined by the long-run consumption function. However, in the short-run households' consumption may deviate from equilibrium, which they correct for in the long-run. The Engle-Granger two-step procedure is used to include the lagged residuals from the long-run equation as an explanatory variable in the short-run equation. The Engle-Granger procedure takes advantage of the superconsistency property of ordinary least squares (OLS) estimates of a single cointegrating relation by treating these superconsistent parameter estimates as fixed in the short-run regression.

As a first step, the long-run consumption function is estimated in the following form:

$$(1) \quad \log(c_t) = \beta_0 + \beta_1 \log(y_t) + \beta_2 \log(w_t) + ecm_t$$

where c is consumption, y is income, w is wealth, and ecm is the independent and identically distributed residual term. Equation (1) is consistent with a range of consumption functions including Modigliani and Brumberg's (1954) life-cycle hypothesis and Friedman's (1957) permanent income hypothesis.¹ The central theme of most consumption functions is that households divide their consumption between the present and the future based on estimates of their ability to consume in the long-run (ie households try to smooth their consumption over time and workers save to spend in retirement). Households choose their level of consumption based on their overall stock of wealth, which includes human capital wealth as well as financial and non-financial wealth.

¹ For more detailed reading on the consumption theory literature, Deaton (1986) and Attanasio (1998) provide comprehensive surveys of the literature.

However, human capital wealth is unobservable and the most common approach is to assume that human wealth is proportional to current income, hence the specification of equation (1) of consumption as a function of current income and current wealth.

The wealth variable in equation (1) can be expressed either as an aggregate net wealth variable w (defined as total assets less total liabilities), or disaggregated into net non-financial wealth nfw (defined as total housing assets less mortgages) and net financial wealth nf (defined as the balance of w less nfw). Muellbauer (1994) favours separating net wealth into liquid and illiquid assets, on the grounds that the marginal propensities to consume vary depending on liquidity.

In the second step, the short-run consumption function is estimated in the following form:

$$(2) \quad \Delta \log(c_t) = \alpha_0 + \sum_{i=0}^j \gamma_i \Delta \log(y_{t-i}) + \sum_{i=0}^j \phi_i \Delta \log(w_{t-i}) + \sum_{i=1}^j \vartheta_i \Delta \log(c_{t-i}) + \sum_{i=0}^j \xi_i z_{t-i} + \alpha ecm_{t-1} + e_t$$

where z is a vector of other possible determinants of consumption over the short-run, and ecm is the residual from the long-run equation (1), or also known as the error correction term. Including lagged growth rates of income, wealth and consumption help to capture additional short-run dynamics in the reactions of these variables to transitory shocks that do not affect the long-run level of consumption (Davis and Palumbo, 2001). The existing consumption literature is relied upon in choosing the appropriate variables for z .²

Past researchers have sought to capture the influence of uncertainty on consumption by using proxies, since uncertainty is not directly observable. The most common proxies is the unemployment rate and the rate of inflation, although consumer sentiment measures have become popular recently. Despite a growing empirical literature on the usefulness of consumer sentiment measures in forecasting consumption, starting with Acemoglu and Scott (1994) and Carroll et al (1994), the evidence to date has been mixed. For this reason, and also for reasons of practicality (to our knowledge, there are no forecasts of consumer sentiment), measures of consumer sentiment are excluded. The unemployment rate is used to capture uncertainty.

Another variable used for z is the real interest rate, which is commonly used to model the short-run behaviour of consumption. The use of the real interest rate variable is to reflect substitution effects, which can be thought of as the time preference of households to consume now or at some time in the future.

Financial liberalisation in New Zealand from the mid-1980s may have eased liquidity constraints facing households, raising the short-run variations in consumption. Fernandez-Corugedo and Price (2002) found that several different liberalisation proxies have been used in the literature. Since the composition of New Zealand households' wealth is strongly biased towards housing (Thorp and Ung, 2000), mortgage equity withdrawal is used as a proxy for increases in liquidity, as it is essentially borrowing that is secured on the housing stock but not invested in it. Therefore, it represents additional funds available for reinvestment or to finance consumption spending. Because it is a form of household borrowing, mortgage equity withdrawal can be thought of as an alternative to personal loans, overdraft facilities and credit card borrowing. As such, some elements of mortgage equity withdrawal may be driven by the same influences as other forms of household borrowing. Although some housing equity may be withdrawn with the specific purpose of funding consumption, the funds could also be put to a variety of other uses,

² Useful studies include Church et al. (1994), Boone et al. (1998), Ludvigson and Steindel (1999), Tan and Voss (2000), Boone et al. (2001), Case et al. (2001), and Bertaut (2002).

such as the purchase of financial assets, investment in businesses, transfers abroad, or to pay off other higher interest debts. Conversely, mortgage equity injection lowers the amount of money available for consumption.

One variable not used in any existing consumption study, but which could be a significant determinant of New Zealand consumption, is migrant transfers. Due to New Zealand's small population base, net migration has a large effect on overall population growth. Since the late 1980s, net migration has accounted for between -0.3% and 0.8% of the population base in New Zealand. Migrant transfers are the funds that immigrants bring with them to New Zealand and emigrants take to other countries. The net migrant transfers amount (incoming transfers by immigrants less outgoing transfers by emigrants) can be regarded as an additional injection of funds into the country, available for investment or consumption. Over the last two decades, net migrant transfers have fluctuated from between -0.7% to 4% of total household disposable income.

2.2 Data

The consumption variable c is the official New Zealand real private consumption series. The choice of income variable y is restricted by the lack of an official quarterly disposable income series. Interpolating the annual disposable income series into a quarterly series is not satisfactory as it is not possible to capture significant quarterly variations, limiting the ability of the interpolated series to explain variations in consumption. Hence, a derived after-tax labour income series, which includes wages and salaries and government transfer payments, was used. The literature does not favour the use of labour income over disposable income, but Rae (1997) argues that using disposable income can lead to the double counting of property income. Rae also argues that at a more practical level, disposable income includes the highly volatile entrepreneurial income component, which should be excluded. In the New Zealand case, farm income makes up a large proportion of entrepreneurial income, and perhaps has a more significant share of disposable income than most other developed countries, ranging from between 2% to 7% . However, the official farm income series is only available on an annual basis, and interpolation to a quarterly basis renders the series meaningless. The use of after-tax labour income in this paper for y remains a short-coming until such time when an official disposable income series becomes available.

There are two data sets for measuring household net wealth in New Zealand. The first is the Reserve Bank of New Zealand (RBNZ) data on household financial assets and liabilities, first reported by Thorp and Ung (2000). The second is the WestpacTrust Household Savings Indicators (HSI) measurement of household assets and liabilities. Both data sets provide comprehensive breakdown of household wealth, but the HSI is the only series available on a quarterly basis. The RBNZ data is annual. For this reason, the data from the HSI was used for the aggregate net wealth variable w , as well as the disaggregated net non-financial wealth nfw and net financial wealth nf variables.

The official Household Labour Force Survey (HLFS) measure of the unemployment rate, was used for unr , and the 90-day bank bill rate was used as the interest rate variable ir . The net migrant transfers series, $migr$ come from the balance of payments capital accounts, while the mortgage equity withdrawal series, mew is measured as the difference between the change in household claims against housing and the nominal value of residential investment.

Where relevant, all variables are quarterly, seasonally adjusted, and measured in real per capita terms. There is no clear preference in the literature on how the dependent variable of the consumption function is specified (aggregate, per capita, or as a percentage of income). For the New Zealand case, it is preferable to model consumption in per capita terms to account for the small population base, which tends to be influenced by large fluctuations in net migration.

The implicit price deflator for consumption is used to adjust all nominal variables into real variables. The full sample period is restricted to 1989:4 to 2002:1 because the quarterly household wealth data from the HSI is available only from 1989:4. While it is possible to interpolate the data using the RBNZ annual series, as Tan and Voss (2000) did for Australian data, the backdated data would be spurious as it will be difficult to take into account short-term asset movements in the run-up to the 1987 sharemarket crash, or short-term liability movements after financial liberalisation in the mid-1980s. The short sample period is an obvious limitation of this paper. But one advantage is the absence of structural breaks due to financial liberalisation, which is present in many other studies using longer sample periods. For further information on the data used in this paper, refer to Appendix A.

A necessary condition for variables to cointegrate in a long-run relationship like equation (1) is that they are integrated processes of order 1 or $I(1)$, that is they are non-stationary. All variables were tested for stationarity using the standard Augmented Dickey Fuller (ADF) procedure. The appropriate lag length for the ADF test was chosen by minimising the Schwartz criteria. For the level and log-level variables, the chosen specification included an intercept in the equation, but no trend except for c and y . For the first difference variables, all the chosen specification included an intercept only.

The results are presented in Table 1. All the variables are $I(1)$ except for the unemployment rate and mortgage equity withdrawal variables. There is evidence to suggest that the mortgage equity withdrawal variables could be stationary or $I(0)$, and that the unemployment rate may be $I(2)$. However, when the unemployment rate was tested over a longer time period (from 1985:4), it was found to be $I(1)$ at the 10% level. Based on this, it was assumed that the unemployment rate is $I(1)$.

Table 1 – Results of ADF tests

Level		Log-level		1st difference	
Variable	Critical values	Variable	Critical values	Variable	Critical values
c	-2.515	$\log c$	-2.534	$\Delta \log c$	-4.528**
y	-1.569	$\log y$	-1.777	$\Delta \log y$	-3.205*
w	-1.486	$\log w$	-1.478	$\Delta \log w$	-4.031**
nfw	-1.807	$\log nfw$	-1.776	$\Delta \log nfw$	-3.797**
fw	-1.643	$\log fw$	-1.730	$\Delta \log fw$	-4.919**
unr	-1.833	-	-	Δunr	-2.478
ir	-2.107	-	-	Δir	-5.714**
$migtr$	-2.088	-	-	$\Delta migtr$	-2.924*
mew	-3.403**	-	-	Δmew	-5.168**

** Stationarity at the 1% level (MacKinnon critical values).

* Stationarity at the 5% level (MacKinnon critical values).

Note: All variables were tested over the 1989:4 to 2002:1 period.

3 Empirical Results

3.1 Long-run estimation

Table 2 lists the key results from the long-run equation (1). The log of consumption was regressed against the log of income and the log of net wealth (Model A) using OLS, shown in column 2 of Table 2. The existence of a cointegrating relationship was not

supported by the ADF test. However, because the test has low power in small sample sizes, it is assumed that a cointegrating relationship exists.

Since the estimated standard errors and the associated t -values of the estimated coefficients from a cointegrating regression are not valid, Stock and Watson's (S&W) procedure of including leads and lags to estimate valid t -values for the estimated coefficients was used. In the interests of preserving the degree of freedoms, two leads and two lags were used. The results, presented in column 3 of Table 2, suggest that while the income variable is significant, the net wealth variable is not.

Table 2 – Estimated long-run models³

	Model (A)		Model (B)		Model (C)	
	OLS	S&W	OLS	S&W	OLS	S&W
Constant	-0.171 (-0.901)	-0.046 (-0.080)	-0.188 (-1.556)	-0.045 (-0.241)	-0.190 (-2.354)	-0.057 (-0.281)
log y	1.049 (23.307)	1.088 (4.469)**	0.865 (17.881)	1.076 (8.368)**	0.865 (18.275)	0.840 (8.764)**
log w	0.131 (2.549)	0.090 (0.562)				
log nfw			-0.001 (-0.029)	-0.001 (-0.021)		
log fw			0.226 (6.487)	0.122 (1.678)	0.226 (6.560)	0.191 (2.292)*
Adjusted R-squared	0.934	0.954	0.960	0.976	0.961	0.972
ADF statistic (1 lag)	-2.64		-2.95		-2.95	

Note: The sample period for the OLS procedure is 1989:4 to 2002:1. Normal t -values are reported in parentheses. The sample period for the Stock and Watson procedure is 1990:3 to 2001:3. Adjusted t -values are reported in parentheses. The leads and lags variables are not reported.

* Significant at the 5% level. ** Significant at the 1% level.

Equation (1) was re-estimated, this time with the wealth variable disaggregated into net non-financial and net financial wealth (Model B). The results from the OLS and S&W estimation of Model B are presented in columns 4 and 5 of Table 2. Again, the adjusted t -values from the S&W estimation suggest that the income variable is significant, but neither of the two wealth variables are. Another regression was run, this time excluding the net non-financial wealth variable (Model C). Columns 6 and 7 of Table 2 show the results of the OLS and S&W estimation of Model C. The income variable remains consistently significant at the 1% level, but this time the net non-financial wealth variable is significant at the 5% level.⁴

The coefficients of the log-levels of income and non-financial wealth can be interpreted as long-run elasticities of consumption. Based on Model C, the estimated long-run elasticity of income is significantly larger than that for wealth at between 0.84 (OLS estimate) and

³ The migrant transfers variable was incorporated in the long-run model, together with the income and wealth variable to test if it had long-run effects on consumption. The adjusted t -values from the S&W procedure suggest that migrant transfers was not significant. The result of this estimation is not reported.

⁴ To examine whether there is some degree of collinearity between the net non financial and net financial variables affecting the estimation, equation (1) was estimated with the log of consumption against the log of income and the log of net non-financial wealth. The income variable was found to be significant, but not the net non-financial wealth variable. This result of this regression is not reported.

0.86 (S&W estimate). For net financial wealth, the elasticity is between 0.19 and 0.23. The income elasticity estimates are much higher than those found by McDermott (1990), Corfield (1992) and Rae (1997), but the wealth elasticity was broadly similar. For income elasticities, McDermott's ranged from 0.463 for non-durables to 0.783 for services, and Corfield's ranged from 0.153 for services to 0.683 for durables, but Rae found small and seemingly insignificant income elasticity estimates for aggregate consumption. For financial wealth elasticities, McDermott and Corfield found estimates of 0.214 and 0.205 respectively for non-durables (based on M3 variable), and Corfield also had an elasticity of 0.393 for services. Rae found a very strong net wealth elasticity at 0.66. Although the non-financial wealth variable was found to be insignificant, McDermott and Corfield found elasticities ranging from 0.139 to 0.317 (based on house price variable).

Differences in the coefficients between the estimated model and previous New Zealand research is not surprising, due to different estimated time periods and choice of variables. Ludvigson and Steindel (1999) found that the trend relationship linking consumption, wealth and labour income exhibits some instability. Poterba (2000) argues that the marginal propensity to consume out of wealth may vary over time due to shifts in consumer preferences over the wealth composition.

The finding that net non-financial wealth (essentially housing wealth) is not significant deserves comment, since it has become generally accepted that changes in house prices has an influence on consumption in New Zealand. Intuitively, the effect of housing wealth on consumption is not immediately obvious, since housing is illiquid and incurs significant transactions costs to liquidate. Even though households experience an increase in overall net wealth from rising house prices, it is also possible that households may not feel wealthier since their implicit rental costs have also increased. While it is possible that homeowners can borrow against the higher value of their housing for consumption (mortgage equity withdrawal), at the same time, an offset occurs from prospective homebuyers needing to save more for higher deposits by reducing their consumption. The empirical evidence on the role of housing wealth in determining consumption is mixed for major industrialised countries (Girouard and Blöndal, 2001).

3.2 Short-run estimation

Tables 3 and 4 lists the key results from the short-run error correction models of equation (2), based on the long-run relationship of Model C in Table 2. The models presented in Table 3 uses the long-run relationship of Model C estimated using the OLS procedure, while the models presented in Table 4 uses the long-run relationship of Model C estimated using the S&W procedure.

For both short-run models, an initial equation ECM was estimated based on the general structure of equation (2), with contemporaneous as well as lagged differences of log income, log net non-financial wealth, log net financial wealth, unemployment rate, real 90-day interest rate, real net migrant transfers, real mortgage equity withdrawal, and log of consumption (lagged differences only). Due to the limited sample period, 2-lags as opposed to the 4-lag structure commonly used by other researchers was employed. The initial ECM equation therefore is represented by following form:

$$(3) \quad \Delta \log(c_t) = \alpha_0 + \sum_{i=0}^2 \gamma_i \Delta \log(y_{t-i}) + \sum_{i=0}^2 \varphi_i \Delta \log(nfw_{t-i}) + \sum_{i=0}^2 \vartheta_i \Delta \log(fw_{t-i}) + \\ \sum_{i=0}^2 \xi_i unr_{t-i} + \sum_{i=0}^2 \mu_i ir_{t-i} + \sum_{i=0}^2 \omega_i migr_{t-i} + \sum_{i=0}^2 \psi_i mew_{t-i} + \sum_{i=1}^2 \rho_i \log(c_{t-i}) + \tau ecm_{t-1} + e_t$$

In both initial ECMs, all the variables were not significant, including the error correction terms. The F -statistics for both initial ECMs were also not significant. This could be due

to over-specification given the relatively small number of observations. Parsimonious ECMs were obtained using Hendry's general to specific modelling approach. Lagged structures were preserved where appropriate to adequately model the dynamic effects.

In both the parsimonious ECMs, the overall models are significant. The error correction terms have the expected negative signs and are significant, implying that when consumption is below (above) the target consumption level as implied by the long-run relationship, consumption growth is faster (slower) than usual in the following quarter to close the gap. The error correction coefficients from the two parsimonious ECMs are also broadly similar. A negative percentage point consumption deviation from the long-run in the current quarter leads to an additional 0.22 percentage point increase in consumption growth in the following quarter according to ECM (A), and an additional 0.27 percentage point increase according to ECM (B).

Income growth was found to have a positive contemporaneous effect on consumption growth, but no lagged impact. McDermott (1990) and Corfield (1992) found similar contemporaneous effects in their short-run models. Households respond immediately to changes in their income growth, but the magnitude differs between ECM (A) and ECM (B). A 10% increase in income growth in the current quarter leads to a 2.9% increase in consumption in the same quarter according to ECM (A), but only a 1.7% increase according to ECM (B), although the income coefficient in ECM (B) does not appear to be significant.

Unlike the long-run equation, non-financial wealth was found to have contemporaneous as well as lagged effects on consumption growth. However, financial wealth was not found to have significant short-run influence although it was found to have a long-run effect on consumption. This suggests that while financial wealth influences consumption in the long-run, households react to changes in their non-financial wealth in the short-run. Because the non-financial wealth variable is essentially housing wealth, this implies that households react to changes in house prices over the short-term, but if their consumption levels exceed the long-run levels, then consumption growth needs to be curbed further out. A 10% rise in non-financial wealth leads to a 1.9% increase in consumption within a year according to ECM (A), and 2.1% increase according to ECM (B).

The change in the unemployment rate has a negative impact on consumption growth over two quarters, but no contemporaneous effects. This implies that uncertainty leads households to reduce their consumption but this adjustment does not take place immediately. The uncertainty impact is not large, with a 1 percentage point increase in the unemployment rate leading to between 0.0015% and 0.0024% decrease in consumption within a year, indicating perhaps that households smooth through periods of uncertainty.

Table 3 – Estimated short-run error correction model: ECM (A)

	Based on OLS procedure from long-run Model (C)			
	Initial Equation		Parsimonious Model	
Constant	0.003	(1.236)	0.004	(3.151)**
$\Delta \log y_t$	0.225	(1.076)	0.289	(2.396)*
$\Delta \log y_{t-1}$	0.016	(0.068)		
$\Delta \log y_{t-2}$	-0.006	(-0.027)		
$\Delta \log nfw_t$	0.135	(1.285)	0.156	(2.520)*
$\Delta \log nfw_{t-1}$	-0.120	(-1.097)	-0.096	(-1.349)
$\Delta \log nfw_{t-2}$	0.140	(1.324)	0.127	(2.041)*
$\Delta \log fw_t$	0.025	(0.293)		
$\Delta \log fw_{t-1}$	-0.042	(-0.548)		
$\Delta \log fw_{t-2}$	0.016	(0.182)		
Δunr_t	-0.001	(-0.259)		
Δunr_{t-1}	0.005	(0.988)	0.004	(1.372)
Δunr_{t-2}	-0.006	(-1.177)	-0.005	(-1.879)^
Δir_t	0.000	(0.031)		
Δir_{t-1}	0.000	(-0.201)		
Δir_{t-2}	-0.001	(-0.528)		
$\Delta migr_t$	0.119	(1.156)	0.157	(2.781)**
$\Delta migr_{t-1}$	-0.013	(-0.133)		
$\Delta migr_{t-2}$	0.006	(0.067)		
Δmew_t	0.015	(0.641)		
Δmew_{t-1}	0.021	(0.844)	0.008	(1.308)
Δmew_{t-2}	0.007	(0.430)		
$\Delta \log c_{t-1}$	-0.013	(-0.062)		
$\Delta \log c_{t-2}$	0.138	(0.610)		
ecm_{t-1}	-0.210	(-1.614)	-0.222	(-3.011)**
Sample period	1990:3 to 2002:1		1990:3 to 2002:1	
Adjusted R-squared	0.12		0.43	
DW <i>d</i> -stat	2.09		2.05	
DW <i>h</i> -stat	-0.32			
F-stat	1.27		4.82	

Note: Normal *t*-values are reported in parentheses. Refer to Appendix B for more detailed diagnostic tests.

** Significant at the 1% level.

* Significant at the 5% level.

^ Significant at the 10% level.

Table 4 – Estimated short-run error correction model: ECM (B)

	Based on S&W procedure from long-run Model (C)			
	Initial Equation		Parsimonious Model	
Constant	0.002	(0.749)	0.004	(3.170)**
$\Delta \log y_t$	0.006	(0.028)	0.174	(1.326)
$\Delta \log y_{t-1}$	0.114	(0.500)		
$\Delta \log y_{t-2}$	0.082	(0.386)		
$\Delta \log nfw_t$	0.101	(0.925)	0.183	(2.756)**
$\Delta \log nfw_{t-1}$	-0.121	(-1.026)	-0.102	(-1.346)
$\Delta \log nfw_{t-2}$	0.144	(1.296)	0.131	(1.957)^
$\Delta \log fw_t$	0.063	(0.687)		
$\Delta \log fw_{t-1}$	-0.024	(-0.290)		
$\Delta \log fw_{t-2}$	0.094	(1.061)		
Δunr_t	-0.002	(-0.329)		
Δunr_{t-1}	0.005	(0.934)	0.004	(1.222)
Δunr_{t-2}	-0.006	(-1.175)	-0.006	(-2.049)*
Δir_t	0.000	(-0.118)		
Δir_{t-1}	0.000	(-0.072)		
Δir_{t-2}	-0.001	(-0.472)		
$\Delta migr_t$	0.114	(1.014)	0.109	(1.752)^
$\Delta migr_{t-1}$	-0.010	(-0.096)		
$\Delta migr_{t-2}$	-0.024	(-0.264)		
Δmew_t	0.023	(0.506)		
Δmew_{t-1}	0.024	(0.837)	0.010	(1.301)
Δmew_{t-2}	0.011	(0.624)		
$\Delta \log c_{t-1}$	-0.012	(-0.050)		
$\Delta \log c_{t-2}$	0.217	(0.890)		
ecm_{t-1}	-0.215	(-1.246)	-0.270	(-2.350)*
Sample period	1990:4 to 2001:4		1990:4 to 2001:4	
Adjusted R-squared	0.07		0.37	
DW-stat	2.07		1.95	
DW <i>h</i> -stat	-0.23			
F-stat	1.13		3.93	

Note: Normal *t*-values are reported in parentheses. Refer to Appendix B for more detailed diagnostic tests.

** Significant at the 1% level.

* Significant at the 5% level.

^ Significant at the 10% level.

Figure 1 – Actual, fitted and residual values from parsimonious ECM (A)

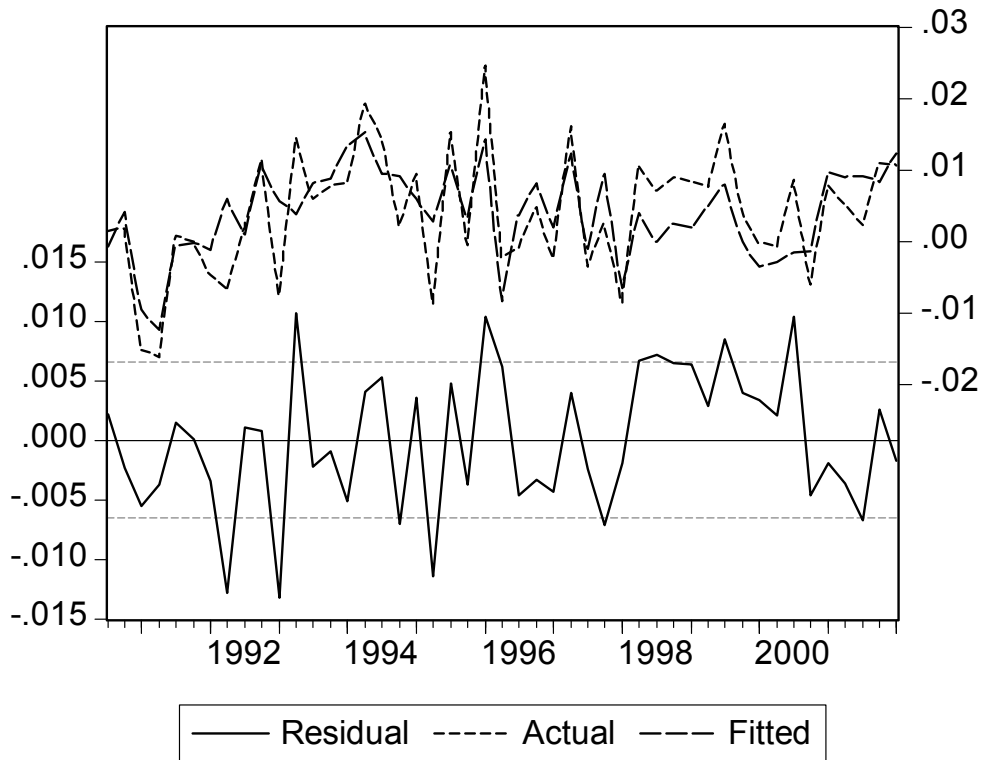
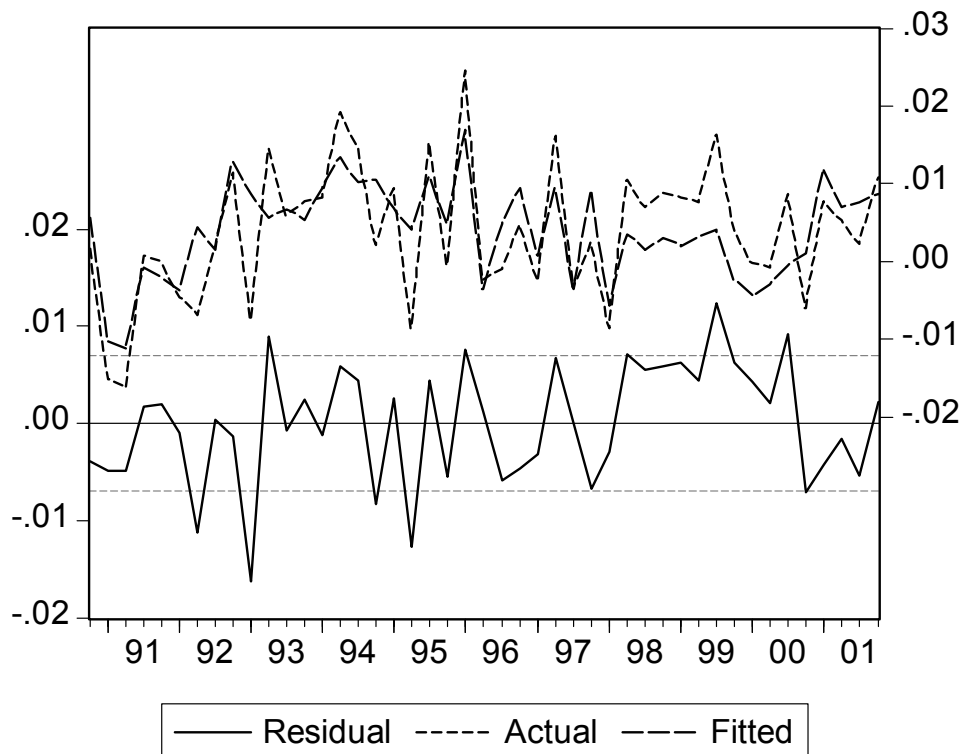


Figure 2 – Actual, fitted and residual values from parsimonious ECM (B)



The change in migrant transfers was found to have a significant positive contemporaneous impact on consumption growth, with no lagged effects. Migrant transfers can be seen as a windfall gain to the economy from funds brought in by immigrants that are available for consumption. An additional \$1,000 per capita increase in net migrant transfers would result in a 0.16% increase in consumption based on ECM (A), and a 0.11% increase based on ECM (B).

A change in mortgage equity withdrawal was found to have a positive one-quarter lagged effect on consumption growth, indicating that funds raised in excess of residential investment find their way into consumption. However, the impact on consumption is not large. An \$1,000 increase in per capita mortgage equity withdrawal would result in between 0.008% to 0.01% increase in consumption, although the coefficients were not found to be significant in either parsimonious ECMs.

Interest rates were not found to have any significant short-run influence on consumption, a similar finding to Rae (1997). Cross-country studies done by Boone et al (1998), Boone et al (2001) and Bertaut (2002) found mixed evidence for the significance of the interest rate variable in the short-run consumption function. A priori, changes in the interest rate may be expected to have an impact on consumption, with consumption rising when interest rates fall and vice versa. A number of different formulations of the real interest rate were estimated, to determine whether misspecification of the interest rate variable may have been leading to the insignificant finding. Alternative formulations included deflating nominal interest rates by the consumers price index, rather than the consumption deflator, and deflating with a forward-looking measure of inflation.⁵

The only interest rate variable that showed up as significant was when the nominal rate was deflated with a forward looking measure of inflation. The fourth, fifth and sixth lags of the interest rate were significant, suggesting that the effect of changes in interest rates took 12-18 months to flow through to per capita consumption. However, the coefficients on the lags of the real interest rate effectively cancelled each other out, such that the net impact was close to zero. For this reason the interest rate variable was excluded from the parsimonious ECMs.

The fitted and residual values from the parsimonious ECMs are presented in Figures 1 and 2. The models fit actual quarterly consumption growth well apart from a two and a half year period from 1998:1 to 2000:2 when the model consistently under-fitted consumption growth. That period coincided with the “Asian crisis”, two severe droughts, and a falling New Zealand dollar. Surprisingly, consumption growth remained resilient during that period, indicating that the models may be missing a variable to capture the dynamic of that period.

Out-of-sample forecasts were constructed for both parsimonious ECMs. For comparability, the both models were re-estimated up to 1999:4 and out-of-sample forecasts produced eight quarters out from 2000:1 to 2001:4. Figure 3 presents the forecasting performance of both models compared with actual out-turns over that period.

The out-of-sample performances of both parsimonious ECMs are broadly similar over the eight quarters. Neither managed to predict the large decline in consumption growth in 2000:4, but both over-estimated consumption growth over most of 2001, although the forecast from ECM (B) for the 2001:2 quarter was closer to actual than the forecast from ECM (A). Table 5 presents some forecast evaluation statistics for the out-of-sample forecasts. ECM (B) had a smaller root mean squared error, indicating better out-of-sample forecast performance. The statistics indicate that systematic bias is not a major issue in both models, and they have the ability to replicate the variability of actual consumption growth.

⁵ The forward looking measure used inflation in period $t + 4$ to deflate the nominal interest rate.

Figure 3 – Out-of-sample forecasts of parsimonious ECMs: quarterly percentage change in per capita consumption growth

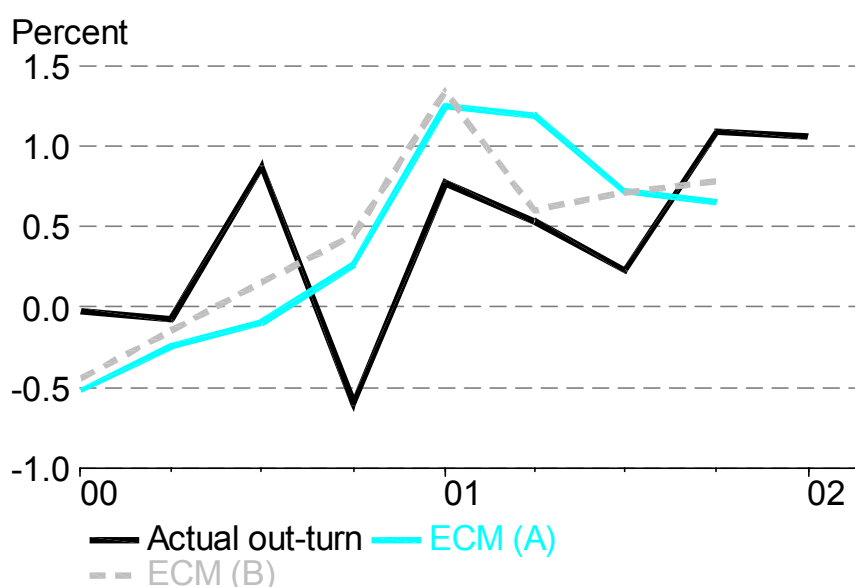


Table 5 – Out-of-sample forecast evaluation

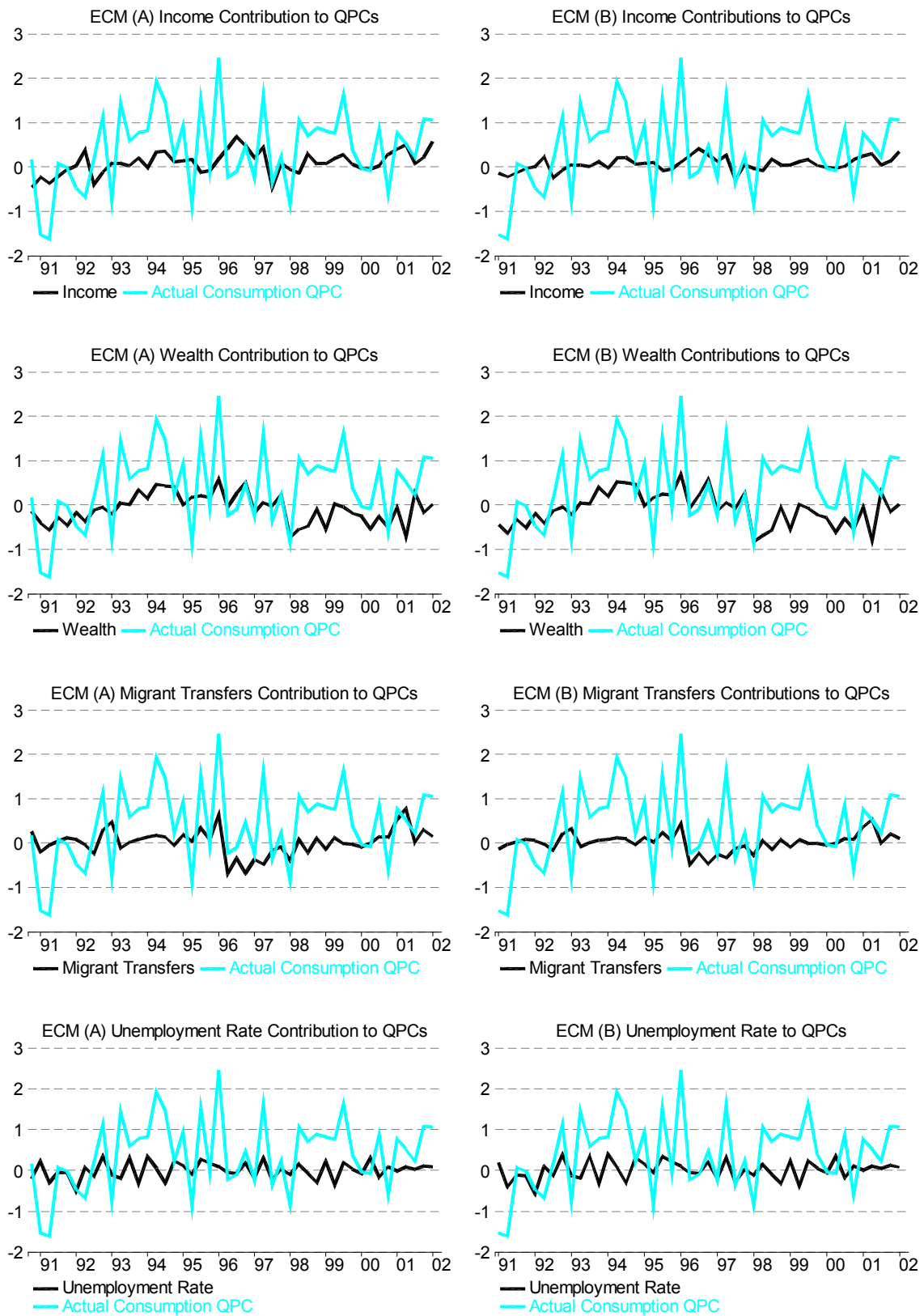
	ECM (A)	ECM (B)
Root mean squared error	0.6158	0.5520
Theil's inequality coefficient	0.4503	0.4199
Bias proportion	0.0075	0.0225
Variance proportion	0.0204	0.0001
Covariance proportion	0.9720	0.9774

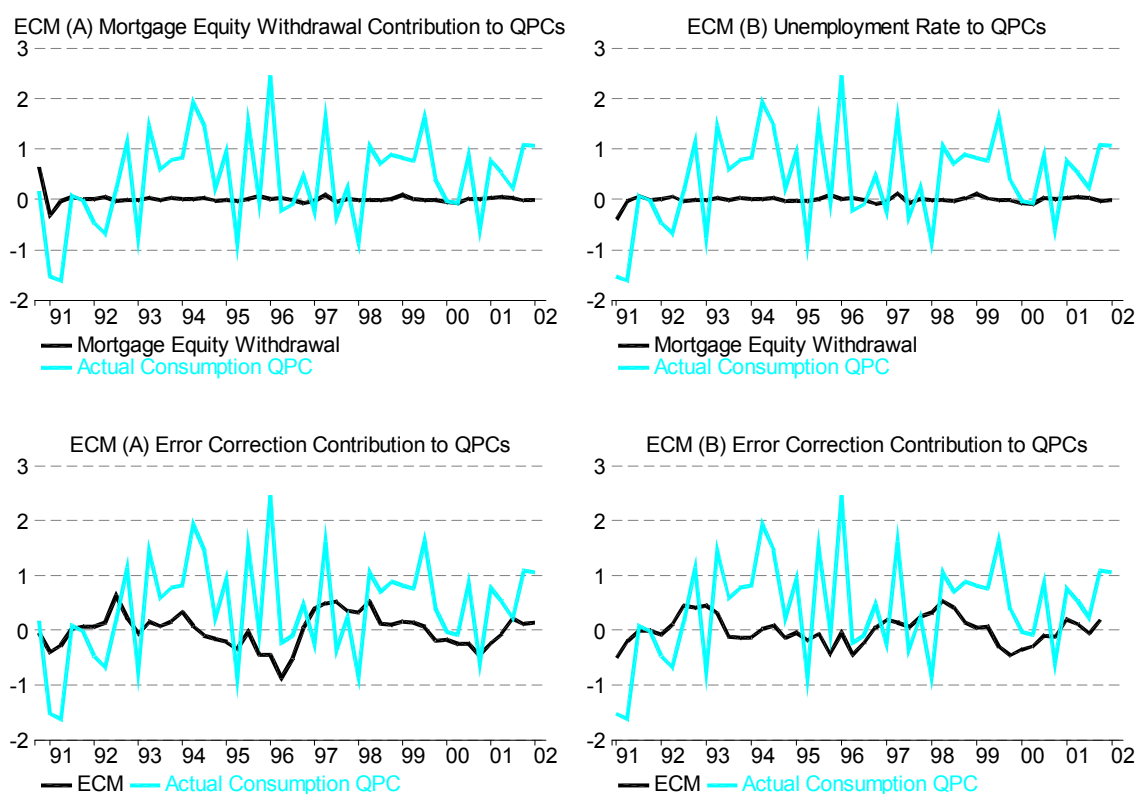
Note: Forecast evaluation is for the period 2000:1 to 2001:4.

3.3 Historical decomposition

ECM (A) and (B) can both be used to describe the behaviour of consumption over the 1990:1 to 2002:1 period. Figures 1 and 2 above showed that both models in general perform well in explaining fluctuations in consumption spending over recent history. However, there is a two-year period from the beginning of 1998 where the models do not match the data as closely as earlier in the period. The graphs in Figure 4 below show the contribution of each independent variable in the models to per capita consumption growth. The graph highlights the key drivers of consumption in ECM (A) and (B) over time. One drawback of using the models to explain consumption over history is that the models may not include all relevant variables.

Figure 4 – Contributions to consumption growth since the 1990s





3.3.1 1990-1993

Per capita consumption growth was weak in the early 1990s with a number of periods of negative quarterly growth, before picking up in 1993. Both models fitted the weak consumption growth up to 1992 well, but not the turning point in mid-1992. Poor income and non-financial wealth growth appears to be key drivers of weakness in consumption growth in the early 1990s. Changes in wealth had a negative impact on consumption in both models until early 1993. Both models also saw negative contributions from changes in income until 1992, reflecting weak labour market conditions and welfare reforms during this time period. The error correction terms were contributing to the negative consumption growth over the early part of the 1990s, suggesting that consumption was above its long-run equilibrium level during that time.

Changes in the unemployment rate initially had a positive impact on consumption. However, both models suggested that the increasing unemployment rate of the early 1990s had a negative impact on consumption from 1991 to early 1993. The impact of mortgage equity withdrawal is minimal.

3.3.2 1994-1997

Per capita consumption grew solidly over much of the 1994-1997 period, notwithstanding two or three quarters of declines. Changes in non-financial wealth made a positive contribution to consumption in both models over most quarters until 1997, with some particularly large impacts in 1994. Changes in income growth, boosted by solid employment growth over the 1994-1997 period, made a positive contribution in every period up until the middle of 1997, except for two periods in 1995. Labour market performance, and therefore income growth, was weaker from mid-1997 through 1998, when the economy was affected by the 'Asian crisis' and two summer droughts.

Both ECMs suggest a substantial positive impact from migrant transfers over 1994-1996, reflecting a build up in migrant transfers over this period as net migration increased. The sharp turnaround in net migration and migrant transfers from around 1997 appears to have had a negative impact on consumption from 1997 right through until mid-1999. There were a number of periods of positive and negative contributions to consumption from changes in the unemployment rate between 1994 and 1998. The error correction term generally had a negative impact on consumption in both models over the 1994-1997 period, indicating that consumption was running in excess of its long-run equilibrium level.

3.3.3 1998-2002

Per capita consumption grew solidly through 1998 and 1999 before slowing in 2000 and picking up again during 2001. Both models performed poorly over 1998 and 1999, when the fitted values were expecting weak consumption growth but actual consumption growth remained strong. The non-financial wealth variable appeared to be a key driver of the poor performance of the models with a large negative wealth effect predicted over the period, due to falling house prices. Alternatively, the models may not have given a large enough role to income growth over this period.

Both models showed substantial negative wealth effects right through from 1998 until 2001. The models expected a solid impact on consumption from changes in income, with a particularly large impact from 2001. This observation appears consistent with the strength in the labour market in late 2000/2001, including solid growth in wages in 1999 and in employment from 1999 onwards.

The error correction term had a positive impact in both models, largely due to the low predicted consumption in 1998. The turnaround in net migration and consequent pick up in migrant transfers in 2000/2001 appears to have had a positive impact on consumption.

4 Conclusions

This paper presented two error-correction models of consumption for the primary purpose of forecasting consumption expenditure growth in New Zealand. An improvement over earlier New Zealand studies is the use of the WestpacTrust Household Savings Indicators (HSI) wealth data, allowing the wealth variable to be modelled in disaggregated form. In addition, two novel variables were included in the modelling to address the criticisms raised by Hendry et al. (1990). A mortgage equity withdrawal variable was used to proxy for increased liquidity by households able to borrow against the value of their housing assets. Although the mortgage equity withdrawal variable was not found to be significant, it did contribute to a higher overall model fit. The other variable used was net migrant transfers, to capture the effect of funds brought into the country by immigrants which are available for investment or consumption. The migrant transfers variable was found to have a significant contemporaneous effect on short-run consumption growth.

Non-financial wealth was found to have contemporaneous as well as lagged effects on consumption growth in the short-run, but no effect in the long-run. In contrast, financial wealth was not found to have any significant short-run influence although it had a long-run effect on consumption. The non-financial wealth variable is essentially capturing housing wealth, implying that households react to changes in house prices over the short-term. However, the long-run level of consumption depends on the level of households' financial wealth.

The out-of-sample forecast performance of both models appear reasonable, with no evidence of major systematic bias. Although both models over-estimated consumption growth over most of 2001, the models had the ability to replicate the variability of consumption growth. ECM (B), the parsimonious model based on the Stock and Watson

estimated long-run model, performed better than ECM (A), which was based on the ordinary least squared estimated long-run model, over the out-of-sample forecast period. However, ECM (B) lacks one observation point due to the Stock and Watson lead-lag structure.

There are two major shortcomings in this paper, both data related. While there is now a comprehensive breakdown of household wealth data available, the data series is relatively limited. For this reason, the period of analysis is restricted to the 1989:4 to 2002:1 period. The second shortcoming is the absence of a quarterly disposable income series. An after-tax labour income series was derived, which excludes the potentially important farm income. Data limitations are not unique to this paper, it is a common frustration for many empirical researchers seeking to analyse New Zealand data. Further research and model improvement include incorporating farm income into the income variable, a longer time period for estimation, and testing other variables that may explain the period where consumption growth was consistently higher than expected over the 1998:1 to 2001:2 period.

Appendix A: Data definitions and sources

Real private consumption

This is the sum of household outlays on consumer goods and services and the final consumption expenditure on non-capital items of private non-profit organisations serving households. Quarterly data are seasonally adjusted in millions of dollars, expressed in 1995/96 prices. Data source is Statistics New Zealand, and the official series starts from 1987:2. (*Statistics New Zealand series identifier code is SNCQ.S2RP30GS*).

Consumption deflator

This is the implicit price deflator for consumption, calculated by dividing the seasonally adjusted current price quarterly series (*Statistics New Zealand series identifier code is SNCQ.S2NP30GS*) by the equivalent constant price series (*Statistics New Zealand series identifier code is SNCQ.S2RP30GS*). Data source is Statistics New Zealand, and the official series starts from 1987:2. The consumption deflator was used to deflate all nominal series.

After-tax labour income

This series was derived using data from Statistics New Zealand, The Treasury, and the Ministry of Social Development. After-tax labour income is defined as wages and salaries less social security contributions and tax plus transfer payments:

$$LY = (WAGES - ACC - TAXES) + (TRANSFERS)$$

WAGES is the quarterly wage bill constructed by multiplying the average weekly earnings series (*Statistics New Zealand series identifier code is EESQ.SASZ9A*) by the total number of wage and salary earners (full-time equivalent adjusted) (*Statistics New Zealand series identifier code is HLFQ.SLA3HA*), and scaling it into a quarterly series. *ACC* and *TAXES* are calculated from the *WAGES* series based on the official statutory *ACC* and income tax rates obtained from The Treasury.

TRANSFERS is derived by multiplying the relevant weekly net benefit rates by the estimated number of beneficiaries, and scaling it into a quarterly series. There are three main beneficiary groups in *TRANSFERS*. The weekly benefit rates are based on the actual main statutory rates obtained from the Ministry of Social Development. The number of beneficiaries are estimated from population and labour market data from Statistics New Zealand.

Population

This is the New Zealand resident population estimates at the end of each quarter, expressed in thousands. The data source is Statistics New Zealand, and the official series starts from 1991:1. This series was backdated by splicing it with the de facto resident population estimates. The population series was used to express all aggregate series into per capita terms. (*Statistics New Zealand series identifier code is DPEQ.SDAC*).

Wealth

All wealth data comes from the WestpacTrust Household Savings Indicators (HSI). The series starts from 1989:4, and the unit is in millions of dollars. Data is available via subscription only from Morningstar (www.morningstar.net.nz).

Total net wealth is defined as all household holdings of M3 funds, government securities, private share holdings, managed fund assets, life insurance surrender value, solicitors trust accounts and value of housing assets less all borrowings from financial and other institutions.

Total net non-financial wealth is defined as total housing assets less all borrowings from financial institutions for housing.

Total net financial wealth is defined as all non-housing assets less non-housing borrowings.

Unemployment rate

The unemployment rate is the proportion of people in the labour force actively seeking work but not currently employed. Quarterly data are seasonally adjusted in percentage terms. Data source is Statistics New Zealand, and the official series starts from 1985:4. (*Statistics New Zealand series identifier code is HLFQ.S1F3S*).

Interest rate

The interest rate used in this paper is the quarterly average 90-day bank bill yield as at 11am. Data source is the Reserve Bank of New Zealand, and the official series starts from 1985:1. (*Data available at www.rbnz.govt.nz/statistics/exandint/index.html*).

Migrant transfers

Migrant transfers are defined as individuals (other than students, medical patients or diplomatic, military or similar personnel stationed abroad) who move to a new country and are expected to stay there for at least a year. In principle, migrant transfers include all the net worth of the migrant in his or her former persona as a non-resident (immigrant) or resident (emigrant). Net migrant transfers is calculated as all transfers by immigrants (*Statistics New Zealand series identifier code is BOPQ.S5AC2A1021*) less all transfers by emigrants (*Statistics New Zealand series identifier code is BOPQ.S5AD2A1021*). Quarterly data are seasonally adjusted in millions of dollars. Data source is Statistics New Zealand, and the official series starts from 1987:3.

Mortgage equity withdrawal

Mortgage equity withdrawal is borrowing that is secured on the housing stock but not invested in it. It represents additional funds available for reinvestment or to finance consumption spending. Mortgage equity withdrawal is estimated as the difference between net lending secured on dwellings and households' gross investment in housing. Mortgage equity withdrawal is derived as the quarterly change in household borrowings against housing less the nominal value of residential investment for the quarter. The derived series is in millions of dollars. Household borrowing data comes from the HSI and residential investment data comes from Statistics New Zealand (*Statistics New Zealand series identifier code is SNCQ.S3RP51AN1110S*).

Appendix B: Diagnostic tests

This appendix presents the results of the various diagnostic tests of the short-run error correction models in more detail.

Table A1 below presents the pairwise correlation matrix between the contemporaneous variables contained in the initial and parsimonious ECMs. The correlations do not appear too strong, with the strongest between the change in the unemployment rate and income growth at -0.48 . This suggests that there is no presence of strong multicollinearity in the EMCs. The pairwise correlation matrix was also done for all the lagged variables (not reported), with a similar conclusion.

Table A1 – Pairwise correlation matrix

	$\Delta \log y_t$	$\Delta \log nfw_t$	$\Delta \log fw_t$	Δunr_t	Δir_t	$\Delta migr_t$	Δmew_t
$\Delta \log y_t$	1.0000						
$\Delta \log nfw_t$	0.2701	1.0000					
$\Delta \log fw_t$	0.0190	0.1760	1.0000				
Δunr_t	-0.4847	-0.2675	0.0839	1.0000			
Δir_t	0.1258	0.1242	-0.0836	-0.1268	1.0000		
$\Delta migr_t$	-0.0678	0.0974	-0.0201	-0.1361	0.0206	1.0000	
Δmew_t	0.0482	-0.0260	-0.1123	-0.1578	0.2511	0.0663	1.0000

The results for the test for normality using the Jarque-Bera method is presented in Table A2 below. In all cases, the Jarque-Bera statistic was not significant, indicating that the residuals from the ECMs are normally distributed.

Table A2 – Jarque-Bera test for normality

	Based on ECM in table 3		Based on ECM in table 4	
	Initial	Parsimonious	Initial	Parsimonious
JB-statistic	0.472	0.655	0.675	1.303
p -value	0.790	0.721	0.713	0.521

The presence of redundant variables was tested only for the parsimonious ECMs, with the F -statistics presented in Table A3 below (the null hypothesis being that the variable tested is redundant). In both parsimonious ECMs, a number of redundant variables are present. However, in most cases the variables are included in the models to preserve the lag structure in order to adequately model the dynamic effects. While inclusion of redundant variables will mean that the estimated coefficients are inefficient, the estimates themselves remain unbiased and consistent.

Table A3 – Redundant variable test

	ECM (A)	ECM (B)
$\Delta \log y_t$	5.741**	1.758
$\Delta \log nfw_t$	6.348*	7.594**
$\Delta \log nfw_{t-1}$	1.820	1.812
$\Delta \log nfw_{t-2}$	4.167*	3.828^
Δunr_{t-1}	1.882	1.494
Δunr_{t-2}	3.531^	4.199*
$\Delta migr_t$	7.732**	3.069^
Δmew_{t-1}	1.710	1.692
ecm_{t-1}	9.068**	5.52*

Note: Reported values above are F -statistics.

** Reject null hypothesis that variable is redundant at the 1% level.

* Reject null hypothesis that variable is redundant at the 5% level.

^ Reject null hypothesis that variable is redundant at the 10% level.

Ramsey's Reset test against a quadratic form was used to test for mis-specification error in the ECMs, with the results presented in Table A4. At both the 1% and 5% levels, the null hypothesis of mis-specification can be rejected for all the models. However, mis-specification cannot be rejected at the 10% level for the parsimonious ECM (B).

Table A4 – Reset test

	Based on ECM in table 3		Based on ECM in table 4	
	Initial	Parsimonious	Initial	Parsimonious
F -statistic	1.430	1.953	1.411	2.595^
p -value	0.263	0.157	0.270	0.090

Note: Estimated based on 2 fitted values.

^ Cannot reject null hypothesis that model is mis-specified at the 10% level.

The Chow test was used to look for evidence of structural breaks over the estimated period of the models. Due to insufficient observations, the Chow test could not be applied to the initial ECMs. Based on the residual plot in Figures 1 and 2, the most likely point for a structural break in the parsimonious ECMs could be in 1998, the period where the models consistently under-estimated the actuals. Table A5 below presents the F -statistics from the Chow test for each quarter of 1998. The null hypothesis of no structural break cannot be rejected over the entire 1998 period. For completeness, the Chow test was carried out over every quarter of 1996 and 1997 (not reported). In all cases, there was no evidence of a structural break.

Table A5 – Chow test for structural break

	Based on ECM in table 3		Based on ECM in table 4	
	Initial	Parsimonious	Initial	Parsimonious
1998:1	n/a	1.095	n/a	1.425
1998:2	n/a	1.387	n/a	1.494
1998:3	n/a	1.041	n/a	1.218
1998:4	n/a	0.568	n/a	0.922

Note: Reported values above are F -statistics. The initial equations have insufficient observations to carry out the Chow test.

To test for the presence of serial correlation, the Breush-Godfrey Lagrange multiplier test was used, with the F -statistics from the test reported in Table A6 below. The null hypothesis is that there is no serial correlation in the residuals. The result of the Breush-Godfrey test suggests that serial correlation is not present up to order four.

Table A6 – Breush-Godfrey test for serial correlation

	Based on ECM in table 3		Based on ECM in table 4	
	Initial	Parsimonious	Initial	Parsimonious
1 lag	0.154	0.038	0.352	0.014
2 lags	0.144	0.473	0.085	0.758
3 lags	0.212	0.317	0.092	0.557
4 lags	0.426	0.259	0.181	0.492

Note: Reported values above are F -statistics.

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