THE TRANSMISSION OF INTEREST RATE CHANGES IN THE NEW ZEALAND ECONOMY

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Abstract

The objective of this paper is to investigate the way New Zealand retail rates respond to changes in wholesale rates. The paper tests the lenders response to changes in the Overnight Cash Rate and other benchmark market rates using an Error Correction Model.
The results obtained here show that response of retail rates to changes in market rates differs across financial products, in particular floating retail rates adjust slower to changes in market rates than fixed rates.

Key words: monetary policy pass through, banking, mortgage market.
JEL classification: E4, E5, E45, E52, G2, G21.

1. Introduction

Economists typically agree that monetary policy actions have an effect on the real economy, at least in the short-run. Changes in official interest rates are followed by banks and other financial intermediaries changing the retail interest rates accordingly.

However there is a little agreement on which is the transmission mechanism of those effects. When the monetary authority makes some policy induced change in either short-term interest rates or money stock there are three possible channels of transmission[1] (Mishkin, 1995):

The first in the *interest rate channel*: The main idea is the traditional Keynesian postulate that the money supply is demand determined: so to reduce the supply of money one must reduce the demand for it by raising the level of interest rates first. The cost of financing is one of the main factors to consider when borrowing and investing therefore higher interest rates affect households and companies' *demand for bank credit* for investment and consumption and ultimately the level of prices.

The introduction of information asymmetry between borrowers and lenders and the differences in cost between internal and external finance lead to the *credit channel*, and its two hypotheses: the bank lending channel and the balance sheet channel. In both cases the monetary policy influences the supply for bank credit.

The bank lending channel focuses on banks' balance sheets and how changes in short-term interest affect the availability and types of loans offered by banks, causing amplification or attenuation of the monetary policy effects. For example, an increase in interest rates or a reduction on bank's reserves will reduce the volume of deposits and therefore the volume of loanable funds which if it cannot be offset with other sources of funding (because of information asymmetry) will imply a reduction in the banks' volume of loans (via a shift upward of the supply curve).

The *balance-sheet channel* looks at the balance-sheet of firms and households: An increase in interest rates affects borrowers' net worth and therefore reduces the value of their available collateral and results in a perceived increase of adverse selection. With respect to business the drop in net worth aggravates the moral hazard problem. In both cases the loan supply curve shifts upwards.

Understanding the transmission mechanism is very important for policy makers. For example, if the interest rate channel is important the monetary authority should target some official interest rate; if the bank lending channel is important the monetary authority should focus on bank's

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[1] If we consider an open economy there is also an *exchange rate channel.*

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balance sheets; in any case banks play a very important role in the transmission of the monetary policy, therefore analysing the way banks set interest rates contributes to understand the transmission mechanism.

This paper attempts to provide some evidence on the transmission of the monetary policy in the New Zealand economy by investigating the speed and extent of adjustment of fixed and floating mortgage rates to changes in the Overnight Cash Rate (OCR) and other market rates.

The next section provides a short summary of the relevant literature. Section 3 describes the operation of the NZ monetary policy. Section 4 describes the data and the Error Correction Methodology. Section 5 reports and analyses the econometric results, and Section 6 concludes.

2. Literature Review

There is a big body of literature which looks at interest rate pass-through in different economies and for different financial products.

Most of the research finds that retail interest rates are sticky, i.e. when the monetary authority changes the interest rate retail rates take time to respond and in some cases there is an incomplete pass-through of the initial impulse on the interest rate.

In general two aspects of the banking sector have an effect on the pass through of monetary policy changes to retail rates: competition and innovations in the market. Cottarelli and Kourelis (1994) found that the pass-through is not the same across countries and structural parameters such as competitive structure of the market (costs of switching a bank), individual bank policies in relation to market share, deposit structure, business cycle, credit risk and interest rate volatility make the pass-through incomplete. They found that interest rates are quite sticky in the short run and possibly also in the long run. For example they explain deposit interest rate stickiness as a consequence of an economy's competitive structure. Banks deposit interest rate will not respond to the changes in official rates if the market is very competitive because the marginally better interest rate does not compensate for the high switching costs.

In less competitive markets banks might act in a collusive manner and therefore reaching a new equilibrium after a change in market rates only happens slowly. In addition, the degree of contestability of the banking market affects the level of competition and therefore the pass-through (Hannan and Berger, 1991; Neumark and Sharpe, 1992; Angbazo, 1997; Hannan, 1997; Wong, 1997; and Corvoisier and Gropp, 2001).

Banks will also try to exploit consumer inertia and consumers' own perception of switching costs which they deem inaccurately too high (Klemperer, 1987).

The banks might also want to avoid high sunk and/or menu costs, which would be incurred every time a change in rate has to be administered and advertised to new and existing customers; the banks might only pass-through rate changes when the revenues from changing the rate are greater than the costs of changing and/or when changes are considered more permanent (i.e. not likely to be reversed in the short-term) (Lowe and Rohling, 1992; and Nabar et al., 1993).

Increase in competition narrows banks lending margins and makes them more responsive to market rates which should increase the speed and the degree of the pass through.

Financial innovation, especially innovations in the funding side like securitisation should also make retail lending more responsive to market rates (Ryding, 1990; Kolari, Fraser and Anari, 1998; and Pais, 2005. Alternatively a depository institution which is mainly funded with core deposits (less responsive to market interest rates) is less exposed to market rates and can delay passing increases in market rates to borrowers, i.e. the depository lender is in a better position to offer risk sharing opportunities to their borrowers, which is typical of traditional bank lending[1].

[1] Berlin and Mester (1999) propose a model in which banks' liability structure explains banks' relationship lending, in particular interest rate smoothing. They suggest that core deposits, which are mostly inelastic, protect banks from economic shocks; that protection permits bank to insulate borrowers against exogenous credit shocks.

3. NZ Monetary Policy

Since March 1999, the Reserve Bank of New Zealand implements its monetary policy by setting the Official Cash Rate. Banks can borrow and lend overnight from the Reserve Bank at 0.25% above and below the OCR respectively. The Reserve Bank reviews the OCR eight times a year; if there are exceptional circumstances, the Reserve Bank might change the OCR out of the normal timetable

According to the Reserve Bank: "..by setting the OCR, the Reserve Bank is able to substantially influence short-term interest rates, such as the 90-day bill rate, floating mortgages and the like". "The key point is that the Reserve Bank is able to lend or borrow overnight money in whatever volumes are needed to hold the market interest rate at the Bank's OCR level. By controlling short-term interest rates in this way, the Reserve Bank can influence short-term demand in the economy". "The OCR was introduced as a device to implement monetary policy in March 1999. Compared to earlier systems used by the Reserve Bank, it is simpler and more easily understood" (RBNZ Fact Sheet no. 4).

In the New Zealand case the monetary authority is concerned with the interest rate pass-through from short term interest rate decisions to wholesale market rates across all the range of maturities and also to banks' retail lending rates. The monetary policy operates more efficiently the faster and the more complete the pass-through is.

Mortgage markets are of crucial importance for the of the monetary policy operation. A residential mortgage is usually the largest financial commitment for most of the households, and their house is the largest asset. A buoyant property market has effects on household consumption and investment because home owners feel wealthier, and also because many of them will realise a part of the increase in net worth by borrowing more against the equity in the home. When households feel wealthier they will increase consumption and that will push prices up. The effect on overall inflation is quite considerable as private consumption represents a large chunk of GDP (over 60% in New Zealand-Bollard (2004)).

Household borrowing represents more than 50% of the aggregate loan portfolio of New Zealand financial institutions, and residential mortgages accounts for 90% of the total household borrowing (RBNZ Financial Stability Report May, 2005). Housing and the mortgage market are also important for the financial stability of the whole economy as a prolonged boom in the housing sector makes banks and households more vulnerable to a fall in housing prices which can ultimately lead to an economy wide recession. Consequently the RBNZ regards the efficient transmission of changes on the OCR to mortgage rates as essential for the operation of the monetary policy. Given the dominant role of the banks in the mortgage sector banks play a very important role in the transmission of the monetary policy.

Two characteristics of the New Zealand banking system may have an impact on the effectiveness of the monetary policy: first, the New Zealand savings rate is very low and the banks heavily rely on overseas borrowing (see Figure 1); second, the banking sector is mostly foreign-owned and a significant part of their overseas funding comes for their parents banks, which also explains the NZ banks' low levels of liquidity (Tripe, 2004). This means that the relevant wholesale rate is outside the control of the monetary authority

4. Description of Data and Methodology

4.1. The Choice of Market Rate

Mortgage markets are of crucial importance for the operation of the monetary policy. The first one is the OCR, which is the tool used by the RBNZ to implement the monetary policy: According to the bank: "no commercial bank is likely to offer short-term loans at a rate significantly higher than the Official Cash Rate. That's because other banks would undercut that, using credit from the Reserve Bank. Similarly a bank is not likely to lend short-term at below the OCR because the same bank can lend to the Reserve Bank and receive interest at the OCR level".

The second rate examined is the 90 day bill rate; the commercial bill market is used by banks as a tool to fund assets and price liabilities, therefore it can be considered like the marginal cost of funds for banks who want to maximise profits.

This paper also looks at the 5-year fixed mortgages. Banks fund fixed rate mortgages in the international bond market, and they use interest rate swaps to hedge the interest rate risk created by the mismatch between their floating liabilities and fixed rate assets. Therefore the market rate for this segment is the 5-year swap rate.

The comparison of the degree and extent of pass-through from market rates to fixed and floating rate mortgages will help to understand the type of competition in the mortgage market.

4.2. The Mortgage Rates

To examine and compare how different banks set mortgage rates the *Investment Research Group* database is used. This database contains information on weekly rates and other characteristics of mortgage products (i.e. whether fixed or floating) offered by all the New Zealand mortgage lenders. The data cover the period between January 2000 and May 2004. Unfortunately there are some gaps in the data so to maximise the number of observations per lender, the econometric analysis is limited to the banks reported in Table 1.

The sample includes the five (now four[1]) systemically[2] important banks: BNZ, ASB, ANZ, National Bank, and Westpac. These banks are all foreign-owned and account for 85% of the total assets of the banking sector. (RBNZ *Financial Stability Report,* November 2004). It also includes Kiwibank and TSB Bank, two small New Zealand owned banks; BankDirect, which is a branchless bank owned by ASB; and AMP Banking and HSBC, two wholesale banks. This sample represents over 99% of banks share of the mortgage market[3] (see Table 1).

The use of individual bank data allows the examination of differences in pricing behaviour amongst banks and also avoids problems of aggregate data.

The NZ mortgage market is currently dominated by fixed rate mortgages (see Table 2), especially since 2003: at the beginning of 2000 floating mortgages accounted for around 43% of the market; this ratio has being slowly falling since January 2003 and it currently stands at around 20%.

The empirical analysis looks at two sectors of the mortgage market: floating mortgages and 5-year mortgages. Investigating the pricing of floating-rate mortgages is important because this is the sector where one would expect to observe a closer relationship between the mortgage rate and the OCR. The paper also looks at the 5-year mortgages offered by the same banks to examine pricing differentials between the two sectors, i.e. whether banks have a heterogeneous behaviour dependent on competition conditions in different market sectors.

4.3. Methodology: Cointegration and Error-Correction Models

Error-correction models (ECMs) allow the identification of long-run relationships between economic variables. The time-path of cointegrated variables is affected by the fact that they must always return to their long-run equilibrium. If the variables considered are interest rates, the ECM can be used to measure the extent and speed at which one interest rate adjusts to changes in other rates. It is assumed that there is a long-run linear relationship between mortgage interest rates and the market rates. If the gap between those rates gets too "large" relative to the long-run equilibrium, then the mortgage rate has to change to close the gap. The short-run dynamics between the

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[1] National Bank was purchased by ANZ in December 2003.

[2] "A systemically important bank is one whose size and nature of business is such that their failure and inability to operate could spread and cause damage to the financial system as a whole. The Reserve Bank's definition of a systemically important bank is one whose liabilities net of amounts due to related parties exceed $10 billion" (RBNZ News Releases November 2004).

[3] No bank lenders, i.e financial institutions, building societies and credit unions account for around 5% of the mortgage market (Money, Credit and Financial Statistics- RBNZ).

variables is therefore influenced by deviations from the long-run relationship, since the system has to converge to the long-run equilibrium.

A more formal exposition is as follows.

If two economic series (y_t and x_t) are integrated of order 1 [I(1)], there might be a linear combination between them which is stable around some fixed value (Greene, 1993), i.e., the linear combination might be stationary, [I(0)]:

$$\varepsilon_t = y_t - \beta x_t \,, \tag{1}$$

where
ε is the error
β is a vector of parameters.

If the error term is stationary, the series is said to be cointegrated and the vector [1, $-\beta$] is the *cointegrating* vector.

The hypothesis to be tested here is that in a competitive mortgage market there is a long-run equilibrium relationship between the market rates (either OCR, 90-day bill rate or the 5-year swap) and either floating or five year fixed mortgage rates respectively. If the mortgage rates deviate from such equilibrium, economic forces will restore it to the long-term level. Equation (2) represents the long-term equilibrium between mortgage and market rates.

$$M_{it} = C_i + B^*R_t \tag{2}$$

where
M_{it} is the mortgage rate charged by the *i*th lender at time t,
R_t is the market interest rate,
C_I is a constant, and
B is a coefficient.

Restating equation (1) in terms of interest rates results in the following expression:

$$e_{it} = M_{it} - B^*R_t - C_i \tag{3}$$

where
e_{it} is the “error” in the mortgage rate offered by the *i*th lender at time t.

If mortgage rates are cointegrated with capital market rates, e_{it} will be a stationary process.

Testing for cointegration requires that the time series involved are I[1] processes. Augmented Dickey-Fuller (ADF)[1] tests were conducted on all of the lenders' mortgages rates and market rates. The null hypothesis of nonstationarity could not be rejected at the 95% level for all the series, except for HSBC floating rate mortgages.

The Johansen maximum likelihood procedure is employed to test for the presence of cointegration relationships among the variables. This method is based on modeling the nonstationary time series using a vector autoregressive approach (VAR).

Vector z_t is defined as a (Nx1) vector of n endogenous variables; it is possible to model z_t as a VAR:

$$z_t = A_1 z_{t-1} + ... + A_p z_{t-p} + \alpha + T + u_t \,, \tag{4}$$

where
A_i is a (NxN) matrix of parameters,
α is a vector of constants,

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[1] Dickey and Fuller (1979).

u_t is a vector of Gaussian errors, and
T=1..t is a time trend.

Each variable is therefore regressed on past lagged values of itself, lagged values of the other variables, and if required, a constant and a time trend. All regressions have the same explanatory variables. For each mortgage lender, the vector z_t=(M_t, R_t), is defined and modelled as a VAR.

This equation can be transformed into a vector error-correction which separates long-run from short-run effects.

$$\Delta z_t = \Gamma_1 \Delta z_{t-1} + ... + \Gamma_{p-1} \Delta z_{t-p} + \Pi z_{t-p+1} + \alpha + T + u_t , \quad (5)$$

where
Γ_1, .. $\Gamma_{p\text{-}1}$, and Π are matrices of unknown parameters.

The Johansen method focuses in the matrix Π. Equation (5) is estimated subject to the restriction that Π has reduced rank, i.e. r<N. The rank "r" of Π will be the number of cointegrating relationships among the variables in z_t. The rank of the matrix is equal to the number of its non-zero characteristic roots (eigenvalues), which is equal to the number of non-zero of columns of v, the speed of adjustment. If this restriction is not met, then there is no cointegrating relationship.

If Π has reduced rank then there is a representation of Π such that

$$\Pi = \alpha \beta' , \quad (6)$$

Π is the "long-run" "levels" solution where α, which is called the adjustment matrix, represents the speed of adjustment of the variables with respect to a shock in the system; and β, which is called the cointegrating matrix, is a matrix of long-run coefficients representing the cointegrating relationships and ensuring that the system returns to the long-run equilibrium.

Prior to estimating the number of cointegrating relationships and cointegrating vectors, the order of VAR for each equation must be determined. The lag length represents the length of adjustment to deviations from the log-run equilibrium. Choosing the appropriate order is done by using a model selection criterion: the Akaike Information Criterion, the Schwarz Bayesian Criterion or by log-likelihood tests. The results from the three criteria are usually consistent: if there are inconsistencies the lowest order VAR is chosen to avoid possible over-parameterization. A high VAR order indicates that disturbances to the system work their way through it very slowly.

Once the order of the VAR is known the number of cointegrating relationships in each VAR is estimated. This is equal to "r", the rank of the matrix of coefficients of the "levels" variables (Π) in equation (5).

To determine the number of cointegrating relationships in each VAR, the Johansen method performs two types of tests: the "maximum eigenvalue statistic" and the "trace statistic". The "maximum eigenvalue statistic" tests the null hypothesis of

H_0: Rank (Π) = r

Against the alternative

H_a: Rank (Π) = r+1

Whereas the "trace statistic" uses the alternative

H_a: Rank (Π) > r+1

Tables 2, 4 and 6 present the results of such estimations for the selected order VAR. The results are reported with an intercept in the VAR, but not a time trend, because it was found not to be statistically significant in earlier regressions. The existence of one cointegrating relationship could not be rejected in all cases but two, the Kiwibank floating rate and both the OCR and the 90-day bill rate.

The F-test for serial correlation indicates the presence of serial correlation in the residuals of the regressions for the *TSB* and the OCR and NB and the five year swap. The Johansen method requires Gaussian residuals. To correct for serial correlation different order VARs were tried. Unfortunately increasing the order of the VAR failed to show a cointegrating relationship between the rates.

The cointegrating vectors are estimated using maximum likelihood. The Johansen method does not impose normalization of one of the coefficients when estimating the number of cointegrating relationships. However to make economic sense of the cointegrating parameters one variable must be assigned a coefficient of unity. Normalization is done by dividing all coefficients by the one chosen to be normalized. Following equation (3) a value of unity is assigned to the mortgage rate coefficient[1].

Tables 3, 5 and 7 report the cointegrating vectors for all mortgage rates. These cointegrating vectors represent the long-run relationship between mortgage rates and the market rate. They also report the error correction form of the cointegrating relationships in the VAR model. The error correction form shows the short-run dynamics of the system. The dependent variable is the weekly change in mortgage rates. The coefficient for ecm(-1) shows the speed of adjustment to the long-run equilibrium within one week.

All the coefficients for the ecm(-1) variable have the correct sign and are highly significant.

Table 8 shows percentage of error corrected each week for each retail rate and corresponding market rate. It is obtained dividing the coefficient for ecm(-1) by the order of VAR.

5. Analysis of Results

In a competitive market the coefficient for the money market rate would be expected to be close to unity, indicating that changes in the lenders' marginal costs of funds are immediately and completely passed to the borrowers.

Unity coefficient tests were conducted for all the lenders. For the 5-year equations the hypothesis of unity coefficients cannot be rejected for any of the lenders. For the OCR equations the hypothesis of unity coefficients cannot be rejected for all the lenders except for AMP and ASB. For the 90-day equations the hypothesis of unity coefficients cannot be rejected for all the lenders except for ANZ and WP.

For the OCR and 90-day equations all the intercept terms are around 2 and significant. A coefficient of less than unity coupled with a large positive intercept indicates those firms are engaging in interest rate smoothing: this is very typical of depository institutions funded with core deposits which are less exposed to market rates and can delay passing increases in market rates to borrowers.

For the 5-year swap equations the intercept terms are much smaller and non significant except for ASB, BD and WP. Smaller intercepts and coefficient closer to unity indicate that the 5-year mortgage rate responds faster to changes in market rates than the floating mortgage rates.

Floating rate mortgages adjust very slowly to changes in the OCR: only around 2.5% of the error is closed in one week, so it takes around 40 weeks for the pass-through to be completed. Although floating mortgages and the OCR move together there are persistent deviations because of low speed of adjustment.

The banks rate setting is heterogeneous; there is some evidence of segmentation because the 5-year fixed market seems much more competitive than the floating one. This could indicate the absence of menu costs (which should affect all rates equally) which are sometimes used to explain why banks do not pass rate changes immediately.

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[1] In equation 3: $e_{it} = M_{it} - B*Ir_t - C_i$, so the coefficient for the mortgage rate, M_{it}, is already unity.

6. Conclusions

The objective of this paper was to examine the transmission of interest rate changes in New Zealand. The paper examines the adjustment of different mortgage rates to changes in market rates using Error Correction methodology.

There are four important results:

1. Floating rate mortgages adjust very slowly to wholesale rate changes. As a consequence the percentage corrected each week is very small for floating rate mortgages and the changes in the OCR and 90-day bill rates.
2. The long-run pass-through is nearly 100% for both fixed and floating mortgages but there are differences across banks and markets.
3. The equations for the floating rate mortgages have large intercepts which indicates banks include a large mark up on their pricing for mortgages.
4. There seems to be a degree of market segmentation: the 5-year fixed mortgages market is much more competitive than the floating segment.

The implications of the above findings for the effective operation of the monetary policy are quite significant. Floating rate mortgages seem to be priced off the 90-day bill rate; possibly the Reserve Bank of New Zealand should do open market operation selling and buying in the 90-day bill market. The 90-day market anticipates the next monetary policy action making policy implementation more difficult.

Fixed mortgages (which currently dominate the mortgage market) are mainly funded offshore, so the relevant rates are out of reach for the RBNZ.

Could there be a balance-sheet channel for the transmission of the monetary policy? Housing inflation is more important to households net-worth than increases in OCR, which anyway are not reflected in retail rates. Also for banks the value of collateral keeps increasing so they face less adverse selection.

Could there be a bank lending channel? Bank lending channel hypothesis relies on deposit insurance, which does not exist in New Zealand. NZ Banks depend heavily on wholesale funding, particularly offshore (only about 50% of funding from retail). This wholesale funding is mostly short-term: frequent re-pricing reduces information asymmetries, but also makes the funding very responsive to changes in banks quality. But on the other hand, NZ banks are very illiquid when compared with other banks.

Is the OCR working? On the 10th of February 2006, the RBNZ and the Treasury published a joint report looking at possible ancillary tools that the Reserve Bank could use to improve the transmission of the monetary policy, specially with regard to the housing market and residential mortgage lending. The RBNZ was concerned with the speed and extent of the pass-through of OCR increases to mortgage rates. The slow adjustment means that a tightening in monetary policy takes a long time to produce results and it makes difficult for the bank to read the market: "if we mis-read the lags there is the risk that policy tightening undertaking now will start to bite just at the point when domestic demand is already cooling" (RBNZ, *Monetary Policy Statement*, December 2005).

However from the point of view of financial stability a higher responsiveness of retail rates to market rates could be undesirable: a more complete pass-through implies that the rates of retail loans are not protected from economic shocks, and there could be more macroeconomic volatility.

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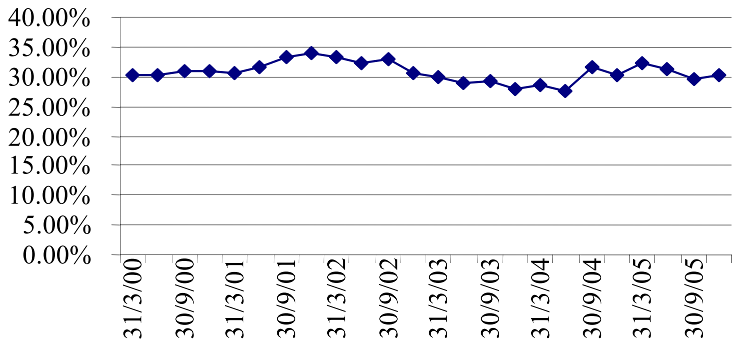

Fig. 1. Non-Resident Funding to Total Funding in the Banking Sector

Table 1

Banks included in the sample with their share of the mortgage market % Share of the Mortgage Market

Banks included in this Sample		2000	2001	2002	2003	2004
AMPBANK	AMP	2.90%	3.00%	2.70%	2.20%	0.00%
ANZ	ANZ	17.80%	17.20%	16.30%	15.00%	14.00%
ASB	ASB	17.30%	18.80%	18.80%	20.205	22.10%
BD	Bank Direct	na	na	na	na	na
BNZ	Bank of New Zealand	15.10%	15.10%	15.40%	15.50	15.80%
HSBC	HSBC	1.10%	0.90%	1.10%	1.50%	3.20%
KIWIBANK	Kiwibank	na	na	0.01%	0.50%	1.00%
NB	National Bank	22.30%	22.00%	23.00%	23.10%	22.10%
TSB	TSB Bank	0.90%	1.00%	1.20%	1.20%	1.30%
WP	Westpac	22.20%	21.50%	21.20%	20.70%	20.40%
Total for Sample		99.60%	99.50%	99.71%	99.90%	99.90%

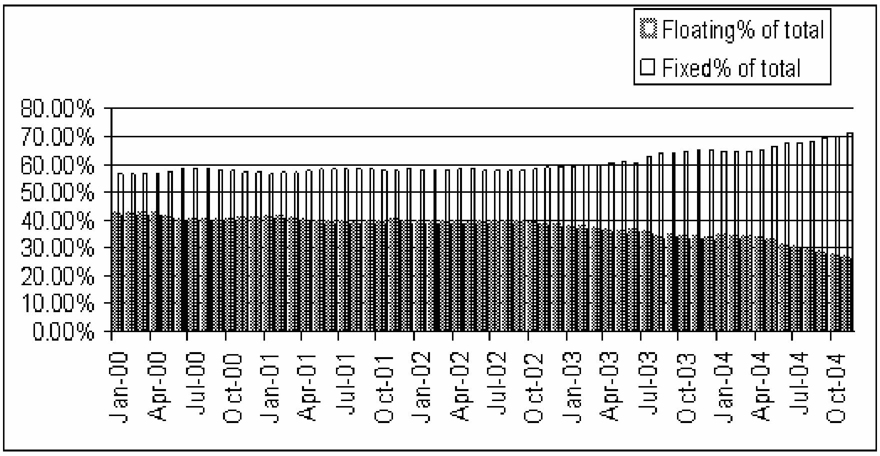

Fig. 2. Market Share-Floating versus Fixed Mortgages

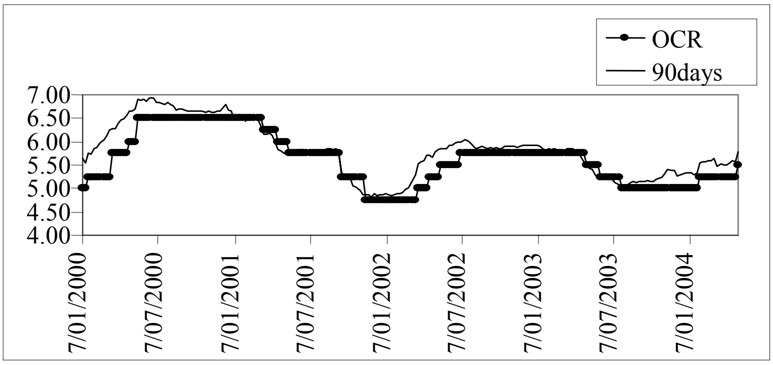

Fig. 3. OCR versus 90-day Bill Rate

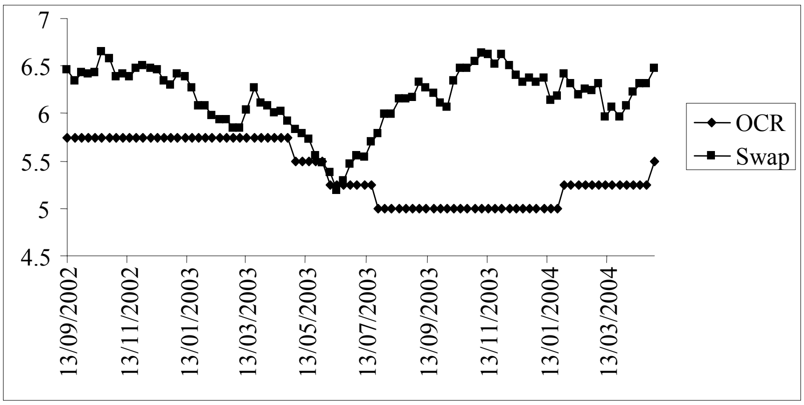

Fig. 4. OCR versus 5-year swap

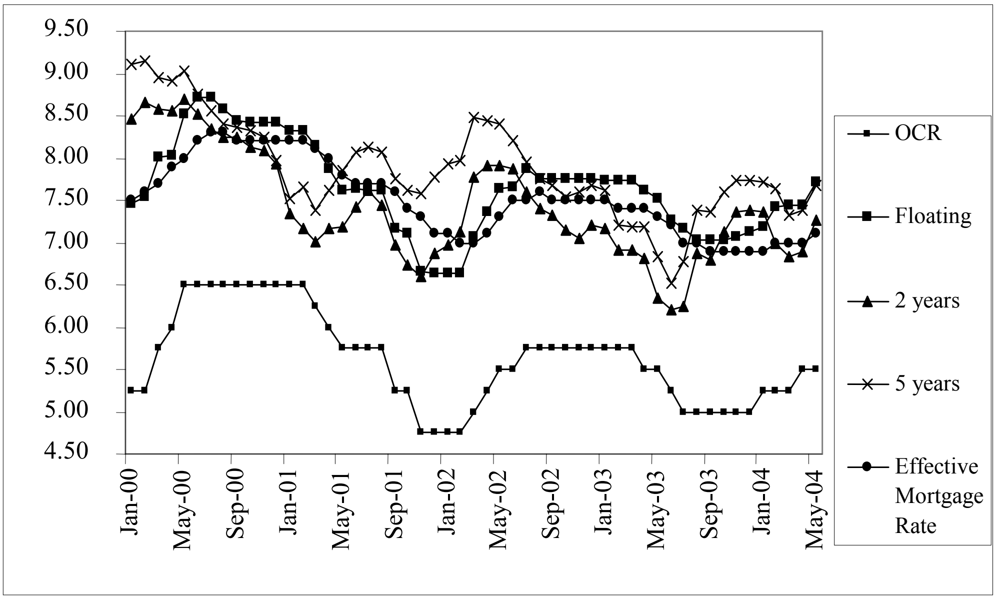

Fig. 5. OCR versus average mortgage rate (floating, 2 year fixed and 5 year fixed) and effective mortgage rate

Table 2

VAR-Floating rates and OCR

Error Correction Model for weekly variable mortgage rates of each financial institution and the OCR (the OLS estimates of each equation are based on White's Heteroskedasticity adjusted Standard Errors)
Dependent Variable is DMORT
P-values are in parentheses; * indicates significance at 90%; ** indicates significance at 95%.

	AMPBANK	ANZ	ASB	BD	BNZ	NB	WP
WPDMORT1	-0.2619*(0.04)	-0.2949**(0.00)	-0.3725**(0.00)	-0.2630**(0.01)	-0.2435**(0.02)	-0.2693**(0.01)	-0.4436**(0.00)
DOCR1	0.4663**(0.00)	0.7944**(0.00)	0.5957**(0.00)	0.4634**(0.04)	0.5876**(0.00)	0.5598**(0.00)	0.5084**(0.00)
DMORT2	-0.4704**(0.00)	-0.3484**(0.00)	-0.3867**(0.00)		-0.3113**(0.00)	-0.2897**(0/00)	-0.3066**(0.00)
DOCR2	0.2770*(0.08)	0.3224**(0.00)	0.4402**(0.00)		0.3267**(0.00)	0.3480**(0.00)	0.3462**(0.00)
DMORT3	-0.2887**(0.01)	-0.1380 (0.18)	-0.1800 (0.12)		-0.0814 (0.359)	-0.1335(0.267)	-0.0695 (0.534)
DOCR3	0.3176*(0.10)	0.3931**(0.00)	0.4318**(0.00)		0.3277**(0.00)	0.3541**(0.00)	0.2393**(0.04)
DMORT4	-0.1907*(0.08)	0.0088 (0.88)	-0.0847 (0.26)		-0.1197(1.109)	-0.0842 (0.370)	-0.09581 (0.347)
DOCR4	0.2504**(0.03)	0.2523*(0.058)	0.3272**(0.02)		0.2522**(0.01)	0.2578**(0.00)	0.3162**(0.01)
DMORT5	-0.2120*(0.06)		0.0281 (0.00)		0.03215 (0.582)	0.0891*(0.09)	0.03596 (0.628)
DOCR5	0.4179**(0.00)		0.1562*(0.06)		0.1777**(0.03)	0.0968(0.135)	-0.1278 (0.159)
DMORT6	-0.1930*(006)						
DOCR6	0.2740**(0.03)						
DMORT7	-0.1583 (0.12)						
DOCR7	0.2415*(0.06)						
DMORT8	-0.1150 (0.23)						
DOCR8	0.3302**(0.01)						
DMORT9	-0.0094 (0.91)						
DOCR9	0.2190*(0.06)						
DMORT10	-0.0219 (0.73)						
DOCR10	0.2376*(0.053)						
DMORT11	0.1113*(0.09)						
DOCR11	0.1373 (0.16)						
ecm1(-1)	**-0.1135**(0.00)**	**-0.1265**(0.05)**	**-0.1487*(0.056)**	**-0.1366**(0.04)**	**-0.1376*(0.09)**	**-0.1561 (0.11)**	**-0.1278 (0.141)**
order of VAR	Var (12)	Var (5)	Var (6)	Var (2)	Var (6)	Var (6)	Var (6)
Number of observations	205	221	220	224	220	220	220
R-Bar Squared	28%	37%	28%	15%	23%	24%	22%
Serial Correlation (F version)	1.43 (0.232)	1.61 (0.205)	0.0071 (0.97)	0.33 (0.564)	1.0040 (0.98)	0.022 (0.882)	0.021 (0.883)

Table 3

Cointegrating Vectors and Short Run Speed of Adjustment – Floating rates and OCR

Average – 13.53%
St. dev – 1.43%
Median – 13.66%
* indicates significance at 90%
** indicates significance at 95%

Fin institution	Short-run speed of adjustment	Long-run relationship $Mort_{it}=A_{it}+B_{it}*OCR_t$
AMPBANK	11.35%	AMPBANK=5.25**+0.396*OCR
ANZ	12.65%	ANZ=2.69**+0.881**OCR
ASB	14.87%	ASB=2.75**+0.869**OCR
BD	13.66%	BD=2.23**+0.904**OCR
BNZ	13.76%	BNZ=2.74**+0.876**OCR
WPNB	15.61%	NB=2.39**+0.973**OCR
WP	12.78%	WP=2.52**+0.919**OCR

Table 4

VAR – Floating rates and the 90-days Bill Rate

Error Correction Model for weekly variable mortgage rates of each financial institution and the 90-days bill rate (the OLS estimates of each equation are based on White's Heteroskedasticity adjusted Standard Errors)
Dependent Variable is DMORT
p-values are in parentheses
* indicates significance at 90%
** indicates significance at 95%

	AMPBANK	ANZ	ASB	BD	BNZ	NB	WP	TSB
DMORT1	-0.0558 (0.51)	-0.666 (0.32)	-0.1420* (0.07)	-0.2378** (0.00)	-0.0864 (0.30)	-0/0408 (0.45)	-0.2347** (0/01)	-0/4247** (0.00)
D90days1	0.2579 (0.15)	0.1090 (0.43)	0.2039 (0.238)	0.5573** (0.00)	0.1122 (0.49)	0.0645 (0.61)	0.2849 (0.18)	-0.1696 (0.47)
DMORT2	-0.2240* (0.01)		-0.1742** (0.00)	-0.0687 (0.310	-0.1533** (0.01)		-0.1489** (0.01)	-0.1974** (0.01)
D90days2	-0.2619 (0.15)		-0.0664 (0.57)	-0.2296 (0.24)	-0.0777 (0.49)		-0.0443 (0.73)	-0.2111 (0.44)
DMORT3			-0.0158 (0.763)		0.0011 (0.98)			-0.0929 (0.14)
D90days3			0.2025 (0.20)		0.3446** (0.01)			0.4211* (0.10)
ecm1(-1)	**-0.2439** (0.00)**	**-0.2485** (0.00)**	**-0.2284** (0.00)**	**-0.2945** (0.00)**	**-0.2359** (0.00)**	**-0/3338** (0/00)**	**-0.3668** (0.00)**	**-0/3651** (0.00)**
order of VAR	Var(3)	Var(2)	Var(4)	Var(3)	Var(4)	Var(2)	Var(3)	Var(4)
number of observations	214	224	222	223	222	224	223	222
R-Bar squared	24%	21%	23%	25%	23%	29%	36%	42%
Serial Correlation on (F version)	0.17 (0.672)	214 (0.120)	245 (0.117)	0.0007 (0.00)	0.0040 (0.98)	0.375 (0.540)	1.388 (0.239)	0.461 (0.497)

Table 5

Cointegrating Vectors and Short Run Speed of Adjustment – Floating rates and the 90-Day Bill Rate

Average – 28.93%
St. dev – 5.89%
Median – 27.01%
* indicates significance at 90%
** indicates significance at 95%

Fin institution	Short-run speed of adjustment	Long-run relationship $Mort_{it}=A_{it}+B_{it}NINETYD_t$
AMPBANK	24.40%	AMPBANK=2.24**+0.899**NINETYD
ANZ	24.58%	ANZ=2.37**+0.909** NINETYD
ASB	22.84%	ASB=2.28**+0.923** NINETYD
BD	29.44%	BD=1.97**+0.922** NINETYD
BNZ	23.59%	BNZ=2.24**+0.935** NINETYD
NB	33.38%	NB=2.24**+0.934** NINETYD
WP	36.68%	WP=2.35**+0.921** NINETYD
TSB	36.51%	TSB=2.04**+0.944** NINETYD

Table 6

VAR – 5 year fixed rates and the 5-year swap

Error Correction Model for weekly five year mortgage rates of each financial institution and the five year swap rate (the OLS estimates of each equation are based on White's Heteroskedasticity adjusted Standard Errors)
Dependent Variable is DMORT
p-values are in parentheses
* indicates significance at 90%
** indicates significance at 95%

	AMPBANK	ANZ	ASB	BD	BNZ	KIW	WP	HSBC
DMORT1					0.1052 (0.267)	0.0158 (0.825)	0.080 (0.209)	-0.0163 (0.661)
DFIVESWAP1					-0.0971 (0.560)	-0.16038 (0.03)	-0.3561** (0.01)	-0.2993** (0.01)
ecm1(-1)	**-0.037** (0.00)**	**-0.2913** (0.00)**	**-0.4241** (0.00)**	**-0.3151** (0.00)**	**-0.2583** (0.00)**	**-0.2448488 (0.00)**	**-0.4681** (0.00)**	**-0.271288 (0.00)**
order of VAR	1	1	1	1	2	2	2	2
number of observations	75	85	85	85	84	84	84	84
R-Bar squared	13%	32%	42%	39%	22%	30%	43%	30%
Serial Correlation on (F version)	1.329 (0.253)	0.0047 (0.945)	0.0683 (0.794)	0.0904 (0.344)	0.624 (0.432)	-.0583 (0.810)	0.249 (0.619)	0.700 (0.405)

Table 7

Cointegrating Vectors and Short Run Speed of Adjustment – 5 year fixed rates and the 5 year swap

Average – 28.92%
St. dev – 12.95%
Median – 28.13%
* indicates significance at 90%
** indicates significance at 95%

Fin institution	Short-run speed of adjustment	Long-run relationship $Mort_{it}=A_{it}+B_{it}FIVESWAP_t$
AMPBANK	3.70%	AMPBANK=-2.790+1.535**FIVESWAP
ANZ	29.13%	ANZ=0.5866+1.0990**FIVESWAP
ASB	42.41%	ASB=1.237**+1.001** FIVESWAP
BD	31.51%	BD=0.9888*+1.013** FIVESWAP
BNZ	25.83%	BNZ=1.132+1.0013** FIVESWAP
NB	24.84%	KIWI=0.5735+1.083** FIVESWAP
WP	46.80%	WP=0.7314*+1.0829** FIVESWAP
HSBC	27.12%	HSBC=0.04830+1.1012** FIVESWAP

Table 8

Summary of the percentage error corrected each month for each market rate change

% error corrected in 1 week

OCR Fin Institution		90 day Fin Institution		5-year-swap Fin Institution	
		AMPBANK	8.1%	AMPBANK	3.7%
AMPBANK	0.9%	ANZ	12.3%	ANZ	29.1%
ANZ	2.5%	ASB	5.7%	ASB	42.4%
ASB	2.5%	BD	9.8%	BD	31.5%
BD	2.3%	BNZ	5.9%	BNZ	12.9%
BNZ	2.3%	NB	16.7%	NB	12.4%
NB	2.6%	WP	12.2%	WP	23.4%
WP	2.1%	TSB	9.1%	HSBC	13.6%