The link between the Official Cash Rate (OCR) and market interest rates - A New Zealand perspective

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Abstract

On 17 March 1999, The Reserve Bank of New Zealand (RBNZ) implemented an Official Cash Rate (OCR) mechanism as its basic tool for monetary policy implementation. This brought with it a paradigm shift in local debt markets where volatility has reduced sharply since the OCR's introduction.

This paper explores the relationship between the OCR, money market interest rates and financial intermediaries' lending margins. The paper looks at the difference in the degree of pass-through before and after OCR implementation and the extent to which a change in money market rates is passed through to banks' housing lending rates.

The paper argues that under the new regime, the market has become more transparent, with the OCR remaining constant for longer periods of time. The degree of pass-through is now greater for floating interest rate loans, although mitigating factors such as the degree of competition, the structure of banks' balance sheets and credit risk continue to affect the margin.

I. Introduction

Since 1984, the monetary policy regime in New Zealand has, in a number of stages, been turned on its head. This has entailed a switch from a highly regulated approach, in which monetary policy was operated within a structure of government controls, to the market based approach now used. The most recent change was on 17 March 1999, when the Reserve Bank of New Zealand (RBNZ) switched to use of an Official Cash Rate (OCR) as its basic monetary policy instrument. This sets the basic rates at which banks can borrow and lend overnight from the RBNZ, with actual rates 25 basis points above and below the OCR.[1]

This latest change in monetary policy has given us an opportunity to review the way monetary policy operates in New Zealand, and more particularly to understand something about the pass-through from the policy rate to both short and longer-term interest rates in the New Zealand economy.

The OCR is set eight times a year (although the RBNZ has power to intervene intra-meeting) and can remain unchanged for long periods of time (it was held steady at 6.50 percent for 10 months during 2000). As with official interest rates in other countries, a change in the OCR is well publicised, and even though it is only an overnight rate, it potentially influences interest rates all along the yield curve, although effects are stronger for shorter maturities, where the arbitrage effects of an official rate change are strongest. The OCR's effects are weaker at longer maturities, which are more influenced by interest rate and inflation expectations. Any movements of longer term rates might be expected to be more important for monetary policy, as they would be more likely to influence firms' and households' spending decisions.

Brookes and Hampton (2000) reviewed the new OCR regime one-year into its existence. They concluded that the new system was working well and that it appeared to be effective, simple, transparent and efficient. Their main focus was on the effects on short-term interest and exchange rate volatility, transaction volumes and market behaviour.

[1] Details of the OCR and the background to it are provided in Archer, Brookes and Reddell (1999).

International comparisons showed that, since the OCR's inception, the average daily change in overnight interest rates had reduced significantly, and that New Zealand rates were less volatile than those of Australia, Canada, the USA and the UK.

The reduction in cash rate volatility since the OCR has been implemented is highlighted in Graph 1.0. Volatility as measured by the standard deviation of daily changes in yield was 1.53 prior to 17 March 1999 compared to 0.79 since. Under the previous regime, the cash rate was market determined and fluctuated frequently. Banks sought to influence the cash rate to benefit trading positions by shifting other parts of the yield curve as well as influencing the cash rate at which they could borrow or lend overnight, with this reflected in high volatility in New Zealand interest rate markets.

The reduced volatility of the cash rate in New Zealand has coincided with reduced volatility in longer term money market rates including the ninety-day bank bill rate and the one to three-year swap rates. Brookes and Hampton (2000) also suggested that the reduced volatility of short-term interest rates since the OCR's introduction might have enabled banks to reduce margins on floating rate mortgages, but they provided no evidence to support this.

This paper investigates this relationship between the cash rate, money market interest rates and interest rates charged by financial institutions in New Zealand. The interest rates examined are the standard floating and one, two and three year fixed residential mortgage rates, over the period from July 1994 to August 2001. These are the lending rates most widely publicised and discussed in the New Zealand market, which reflects the significance of residential mortgage lending in New Zealand banks' assets. Moreover, the rates advertised are the rates charged, rather than being a base or prime rate subject to an additional margin.

Because we are looking at pass-throughs, we would expect to generate some insights into the operation of monetary policy in New Zealand, and in particular, on the effects that arise from a change in the instruments used for implementation of monetary policy.

This paper is organised as follows: Section II summarises previous research. Section III summarises the main findings and contains the statistical results, looking at which products show a greater or lesser degree of pass-through, and whether the degree of pass-through has changed since the OCR has been in place. Section IV discusses the results and Section V concludes. An appendix describes the source of and possible weaknesses in the data used.

II. Previous research

The reason that central banks undertake monetary policy is that they believe that, by doing so, they can have an impact on some combination of inflation and output levels in the economy. As Bernanke and Gertler (1995) have noted, however, there is less than full agreement as to exactly how monetary policy exerts its influence on the real economy (p 27). Cottarelli and Kourelis (1994) have argued that the effectiveness of monetary policy hinges on a set of structural parameters, not directly controlled by central banks (p 587), and it is thus reasonable to expect that differences in financial system structure between countries may in turn lead to differences in the way in which monetary policy has its effect.

There are a number of issues that may impact on the way monetary policy changes the interest rates actually charged by banks. These include the competitive structure of the market (including the effect of switching costs), individual bank policies in relation to market share, deposit structure, the state of the economic cycle, credit risk and interest rate volatility (which generates uncertainty about future interest rate changes). Another important issue is interest rate rigidity or stickiness, which, in terms of the definition provided by Cottarelli and Kourelis (1994), refers to a situation where "in the presence of a change in money market rates, bank rates change by a smaller amount in the short run (short-run stickiness), and possibly also in the long run (long-run stickiness)" (pp 589-590).

The issue of interest rate rigidity or stickiness has been investigated by, among others, Hannan and Berger (1991), Lowe and Rohling (1992), Hannan (1994) and Dueker (2000). Major findings have been that interest rate rigidity may not be symmetric in terms of upward and downward movements, that concentrated markets may be associated with greater rigidity, and that rigidity or stickiness will relate to switching costs faced by financial services consumers. Moreover, as both Cottarelli and Kourelis (1994) and Mester and Saunders (1995) have noted, loan rates will also be sticky because of the costs of changing them.

Another strand of research on the effect of monetary policy has looked at the response of market rates to changes in official (central bank) interest rates. Contributors to this have included Dale (1993), Lowe (1995), Borio and Fritz (1995), Thornton (1998) and Bowden and Frost (1999). Dale found that changes in the policy rate induced statistically significant interest rate reactions across maturities up to five years, while Lowe concluded that the pass-through to short term rates was rapid, but that outcomes were less clear for long-term rates. Expectations of future inflation tended to be factored into long-term rates, so that these did not always move in the same direction as the cash rate.

Borio and Fritz (1995) found potentially relevant factors to include the degree of monopoly power within the market, customers' aversion to variable interest rate payments, the degree of stickiness of the overall cost of funds and the volatility of market and policy interest rates. Thornton (1998) found that longer-term rates had a statistically insignificant response to changes in the Federal Funds rate.

Bowden and Frost (1999) used an asymmetry generator to test for asymmetric pricing behaviour in the New Zealand home mortgage market, using ten years of monthly New Zealand mortgage rate data. They found that adjustment rates over the period did exhibit asymmetries, although it is arguable that their vision of the market no longer applies in practice, with there being a much greater emphasis on fixed rate lending since the mid 1990s.

A further strand of research looks at interest margins, based on the dealership model of Ho and Saunders (1981) and subsequent follow-up work. The application of this in the New Zealand market is explored further in Tripe (2002), although the relevance of that research to the present study is limited, in that the dealership model looks at overall interest margins, ex post, whereas this study is concerned with ex ante margins over market rates.[2]

Saunders and Schumacher (2000) used the Ho and Saunders (1981) model on a sample of banks in seven major countries of the OECD over the period from 1988-95. They found that the higher the volatility of interest rates, the higher was pure spread, with spreads equally sensitive to both the short (3 month) rate and long (1 year) rate volatility.

A further body of work brings several of these prior strands together to look at issues in the transmission mechanism for monetary policy. Major contributions to this include the work of Cottarelli and Kourelis (1994), Mester and Saunders (1995), Cottarelli, Ferri and Generale (1995), and Mojon (2000). One particular point made by Cottarelli and Kourelis, which may impact on this research, is that

> "… in oligopolistic markets, the [loan rate] stickiness can be reduced if the central bank acts as a market leader by signalling changes in the stance of monetary policy through changes in an administered rate, as the latter reduces the uncertainty about competitors' responses." (p 592).

Weth (2002) provides a summary of a number of relevant issues. He identified loan rate stickiness as arising from banks' uncertainty about future market rates and adjustment costs, while these adjustment costs can mean that changes to managed rates are inclined to be by larger amounts but less frequently. He also noted that shifts in credit demand and changes in banks' competitive positions can affect the pass-through, with this often reflected in unequal rates of adjustment for deposit and loan interest rates (p 3). He also noted that banks that depend on money markets for their funding will usually have to adjust lending rates more promptly than banks whose liabilities are less sensitive to market conditions (p 4): this generally impacts more on larger institutions (p 22).

[2] This distinction between ex ante and ex post margins can be attributed to Demirgüç-Kunt and Huizinga (1999).

This prior research gives us a set of expectations for what we might expect to have happened in New Zealand with the change in monetary policy instrument. The greater certainty (associated with reduced volatility) and clearer signalling applying under the OCR regime should have reduced stickiness. We also expect that longer-term rates will be less responsive to shifts at the short end of the market than will be the floating rates. The next section of the paper outlines the investigation of this for the New Zealand market.

III. Empirical Results

Our data set consists of daily observations of money market and retail lending interest rates. The data span August 1994 to July 2001 offering a total of 1709 observations. A full listing of data source and methods is given in the Appendix.

Our sample provides a rich body of data for studying the link between wholesale and retail interest rates since the monetary policy implementation regime was altered considerably during this timeframe. This offers a unique nature experiment for us to examine the behaviour of banks under different regimes.

Our aim is to test whether there has been a shift in the (long-run) relationship between lending rates and money market interest rates after the introduction of the OCR regime. The OCR regime has clearly reduced the volatility of money market rates. Standard deviation of the money market rates all exceed one in our pre-OCR sample (ranging between 1.04 and 1.53) and are less than one in our post-OCR sample (ranging between 0.59 and 0.87). While the new regime will have altered the time-series properties of money market rates in some respects our central concern is with the longer-run properties, specifically whether the degree of pass-through from wholesale to retail market has changed.

First, we need to establish the time series properties of the interest rate data to see if the possibility of a (long-run) or cointegrated relationship exists. We do that by employing unit root statistics to test the null hypothesis that interest rates follow a unit root process.

Unit roots in individual rates would imply nonstationarity in the rates but if the spreads between the rates are stationary then there must be (long-run) or cointegrating relationships between the rates. Second, we test for cointegration using a residual-based test. A useful by-product of this test is that average pass-through is estimated. Finally, we will use a Wald test to determine whether there is any change in the long-run relationships.

Unit root tests

We applied two sets of unit root tests to the data, both the augmented Dickey-Fuller (ADF) tests and the seminonparametric Phillips-Perron (PP) modifications of those tests. To control for the presence of serial correlation, lags of the first difference are included in the ADF regression while nonparametric adjustments are made to the PP regression. The number of lags in the ADF regression was determined using the general-to-specific lag selection procedure of Ng and Perron (1995) and Hall (1994), with the maximum lag set to 10. Results from the PP unit root test were computed using the Bartlet kernel and with lag lengths determined by the data-dependent method of Andrews (1991). Both testing procedures indicate that all the interest rates examined in this paper are integrated of order one and so the possibility of cointegration between lending rates and money market rates exists (Table 1).

Cointegration Tests

We commence with the standard model for cointegration, which in the context of this paper is

$$L_t = \alpha + \beta M_t + \varepsilon_t, \tag{1}$$

where L_t is the lending rate at time t, M_t is the money market rate at time t and ε_t is a stationary error term that may be serially correlated and heterogeneously distributed. The error term may even be correlated to differences of the regressor introducing an endogeneity problem when estimating the cointegrating relationship. Using an asymptotically efficient estimator that makes an explicit correction for endogeneity can circumvent this problem. In particular, the cointegrating regression can be estimated using Phillips and Hansen's (1990) fully modified estimator, Park's (1992) canonical cointegrating regression, or Stock and Watson's (1993) dynamic OLS estimator, which are all asymptotically efficient in the presence of serial correlation and endogenity.[3]

We use Stock and Watson's dynamic OLS estimator, which was independently proposed by Saikkonen (1991), and found to be asymptotically efficient under very general conditions. To implement the dynamic OLS estimator, one simply regresses the lending rate onto contemporaneous levels of the money market rate, leads and lags of the their first difference, and a constant.

The results of the Phillips-Ouliaris (1990) *Z(t)* residual-based tests for cointegration, computed using the residuals from the Stock and Watson dynamic OLS cointegrating regression of equation(1), reject the null hypothesis of no cointegration between lending rates and money market rates at the 5 percent significance level for all time horizons and all subperiods (Table 2). There is a long-run link between money market and lending rates over the whole sample period despite the diverse monetary policy implementation regimes being in place.

We also report the estimated coefficients of the cointegrating regression for both pre- and post-OCR periods together with the full sample period. The estimated slope coefficients in the fixed interest markets are all close to unity indicating a high degree of passthrough from wholesale to retail rates. However, for floating interest rates there seems to a marked difference in this slope coefficient. In the pre-OCR regime the coefficient is much less than unity, while in the post-OCR regime it is exactly one. This suggests the degree of passthrough in floating interest rates rose shapely following the introduction on the OCR regime. We will formally test this proposition below.

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[3] Ordinary least squares (OLS) estimation could be used to yield a super-consistent estimate of the cointegrating vector, where the endogeneity problem vanishes asymptotically. However, OLS estimation has rather poor small sample properties, is not asymptotically efficient, yields non-standard distributions of the estimators. Consequently, standard test of linear restriction cannot be used in the OLS framework, a severe disadvantage given we wish to use a Wald test to examine if the degree of pass-through has varied over regimes.

Regime Change Test

The final task is to test whether the slope coefficients from the pre-OCR sample are less than the slope coefficients from the post-OCR sample. To do this we use a Wald test that has been suitably corrected for the error term being serially correlated and heterogeneously distributed and correlated with first differences of the regressor (see Stock and Watson (1993) for details). This test has the usual Chi-square asymptotic distribution.

We do not need to conduct any test at the one-year horizon since the point estimate in the pre-OCR sample is larger than the point estimate in the post-OCR sample. At the two- and three-year horizons the Wald statistics are 2.06 and 2.70 respectively. Both results are less than the 5 percent critical value of 3.84 suggesting there have been no significant change in how the fixed markets operate following the introduction of the OCR regime. In contrast, the Wald Statistic for floating rates was 433.87, clearly in excess of the 5 percent critical value, thus suggesting there has been a significant change in how retail floating mortgages price off the wholesale market.

IV. Discussion

The previous section has shown us that the pass-through from money market rates to loan rates has been stronger for floating interest rate loans since the OCR has been in place, and that volatility in both money market and loan rates has been reduced. This section tries to relate those findings to the relevant theories, with a particular emphasis on the impact on margins. Factors considered likely to be relevant to margins include the competitive structure of the market (including the effect of switching costs), bank policy in relation to market share, deposit structure, the state of the economic cycle, credit risk and rate volatility.

With respect to competition, a relevant theoretical precept is the structure-conduct-performance hypothesis, which generally argues that margins would be higher the smaller the number of competitors in the market. This has been subject to extensive previous research, with the balance of this finding in its favour relative to the alternative efficient-structure hypothesis. The number of banks in the New Zealand market did not change significantly over the period of the study, although there may have been some growth in the number of non-bank providers of home mortgage finance. This would tend to mitigate the effect of an apparent increase in the Herfindahl-Hirschman Index for bank residential mortgage market share over the period studied. In any case, other investigations reported in Smith and Tripe (2001) would not suggest any particular change in competitive conditions, with no indication of the existence of monopoly power over the period.

Switching costs also mitigate the effects of competition by reducing the elasticity of demand. These costs have normally been passed onto the customer as a fixed up front fee to compensate the bank for administration costs and information acquisition about the borrower. The customer also has to bear search costs, including filling out application forms, obtaining documentation (e.g. property valuations) and attending interviews. The higher are switching costs, the fewer customers will react to more attractive lending rates offered by competitors. Fewer banks will therefore initiate rate changes and the level of pass-through declines. The willingness of customers to switch banks is likely to put downward pressure of lending spreads.

Bank policy plays an important role in the level of pass through to lending rates. This includes loss-leading campaigns to build market share, the structure of balance sheets and regulatory capital requirements. Market share is sometimes chosen by banks as a policy over profitability and margins are reduced as a result. Regardless of fluctuations in money market rates, banks forego profit in attempt to gain new customers. These campaigns tend, however, to be temporary and the lending rates often return to 'market' levels once specific targets have been reached.

A change in a bank's deposit structure also affects the degree of pass-through to lending rates. The portion of bank liabilities held in low interest rate accounts obviously changes over time. The transfer of these funds to on call accounts that pay market rates (nearer the cash rate) affects banks' spreads. An increase in the cash rate is more completely passed through to these on-call accounts whereas low interest rate accounts tend to be sticky. In a high interest rate environment, the spread between the cash rate and the average rate paid on low interest rate accounts is wide. In a high interest rate environment these accounts are highly profitable for banks but they are of reduced benefit in times when interest rates are low. Other research (Tripe, 2002) would suggest, however, that banks' interest margins are independent of the general level of interest rates, which may allow us to reject this as a cause of margin shrinkage.

Both the economic cycle and credit risk contribute to the level of pass-through, often simultaneously. An increase in the general level of interest rates increases the probability of default, forcing banks to widen their risk margins. Higher interest rates levels may generate moral hazard problems: loan rate increases could attract higher risk borrowers (who are less affected by the higher rates than more creditworthy borrowers), thus increasing the probability of default. The behaviour of borrowers may also change if there is a general increase in loan rates, as borrowers undertake projects with higher returns but lower probability of success. These all imply increased credit risk as loan rates increase (with wider margins and a lower degree of pass-through as a result).

Lowe (1995) points out that lending spreads in Australia appear to behave counter cyclically - periods of slow economic activity are associated with wider lending spreads. Once again, the likelihood of default increases in a recessionary environment - spreads narrowing in upswings and widening in downswings.

Lowe also found a lag in the time for banks to widen their spreads. Only after a series of defaults had occurred did the banks react and widen their spreads. This was particularly evident in the late 1980s and early 1990s. From our observations, there was a noticeable widening of the floating rate spread in 1998, coinciding with the Asian crisis, which nearly sent New Zealand into recession.

The final topic is the issue of volatility reduction and its effect on the degree of pass-through and the margin. The New Zealand wholesale interest rate market is a lot more transparent since the OCR has been in place, with any changes in the OCR publicised as soon as they occur, and with these changes filtering through to residential mortgage rates, particularly the floating rate. The changes normally take effect immediately for new borrowers but with a time lag of approximately a month for existing borrowers. As outlined in the previous section, changes are not as rapid further out along the yield curve.

Under the previous cash rate regime, a cash rate movement did not always lead to a change in lending rates. The likelihood of the cash rate being at a different level over the next few days was high given the volatile nature in which the market behaved. The rate setting procedure used to be a less formal process, with banks' Asset and Liability committees meeting regularly to discuss wholesale interest rates and economic conditions more generally. The bank's margins and the level of the banks assets and liabilities would be the main focus and deposit / lending rates adjusted accordingly.

If a bank were to change lending rates, especially the floating rate, whenever the cash rate changed, they would be doing so frequently, with a consequent increase in administration costs. These costs include customer notification, system alteration costs and re-training/educating staff. As a result banks would charge a higher margin to smooth revenue and compensate themselves for the volatile nature of their cost of funds. This is also evident in the volatility of the spread, which has reduced since the OCR has been in place.

The degree of pass-through is now greater for floating rate loans (see Wald test in the previous section). Banks are able to budget for their cost of funds in the knowledge that the lending rates and money market rates will have a stronger relationship to the OCR, which has become a benchmark for lending rates.

Volatility also affects the cost of funds via the banks' deposit base. For example, if there is a timing difference between when a new deposit arrives and when a new loan is demanded, the bank will have to temporarily invest these funds in the money market.

This rate is the short-term risk free rate (In New Zealand this is the cash rate at which banks deposit their inter-bank funds with the RBNZ). In so doing the bank faces reinvestment risk should the short-term rate fall in the interim. Similarly, if a loan is drawn down by a customer without a contemporaneous inflow of deposit funds, the bank would have to borrow in the money market to fund the loan, exposing it to re-financing risk if the short-term rate goes up.

If the cash rate was as volatile as it was pre-OCR, the risks are exacerbated and the effects on volatility of revenue would have to be compensated for through wider margins. This is now not the case, with banks' exposure to such risk significantly reduced as the OCR stays static for lengthy periods of time.

V. Conclusion

The impact of monetary policy on the real economy depends on the pass-through of policy levers like the OCR being rapid and complete. Certain factors such as competition will prevent pass through being one for one but the implementation of the OCR has given the Reserve Bank more control over the economy, as money markets now have a closer relationship with the corresponding lending rates.

This paper examines the effects of the OCR implementation on residential lending rates in New Zealand. We find that since 17 March 1999 there has been a significant decline in the volatility of both underlying money market rates and margins. There has also been a significant structural change in the relationship between the money market and relevant lending rates, with margins relative to floating rates having widened, whereas those relative to the 1 to 3 year fixed rates having narrowed.

A number of explanations can be identified as to why the level of pass-through is not one for one between money market and lending rates. These include the competitive structure of the banking industry, the stage of the economic cycle, regulatory controls on the market and interest rate volatility. The reduction in interest rate volatility is likely to be the main cause of the structural change in the relationship between money market and lending rates. There has been no obvious change in the level of competition, switching costs have only varied slightly over the period of the study and the credit risk has not altered sufficiently to have a significant effect.

Data Appendix

Lending rate data for this research was obtained from the National Bank of New Zealand (NBNZ), while Fixed Interest Securities (FIS) provided money market and cash rate data. The cash rate data utilised was the RBNZ's inter-bank rate for New Zealand settlement banks to square up cash positions at the end of each business day. The bank bill rate used is the mid rate as at 10:30 am each business day, with this derived from rate-setting activity by participating banks, and which is also used as the benchmark for daily derivative settlements. The swap rates are the semi annual rates at the close of business (4:30pm) each day. The lending rates used are the floating and 1 to 3-year fixed rate mortgages for residential borrowers. The sample period was 30 August 1994 to 5 July 2001.

One weakness identified is that the lending rate data has been obtained from only one source. The loan market is far from homogenous and there are a number of factors which banks consider when they set lending rates, including cost of funds, contract terms of the loan including maturity, repayment clauses, collateral and fee structures. We have, however, assumed that a bank would receive negative publicity for not conforming with the rest of the market and would lose market share over time. Any differences in rates between the main mortgage providers are likely to be negligible, with a difference of 5-10bp the norm. Obviously some banks will have cheaper access to funding or offer 'special' rates to entice new clientele but we also assume that over time that this has a minimal effect on the general movements in interest rates.

Another weakness relates to the source of data for swap rates. The rates used in this research are termed as semi annual i.e. the floating leg of the swap is paid / reset at semi annual intervals. The swap rates used to hedge the fixed rate loans are predominantly priced on a quarterly basis, i.e. the floating leg of the swap is reset / paid a quarterly intervals. Whilst this will affect the spread (the current difference between a 2 year semi-annual and a 2 year quarterly rate is 4bp), the difference between semi-annual and quarterly rate will remain relatively constant over time.

There will also be a lag in the lending rate changes. In some instances rates charged to customers will not be altered for up a month, to allow for systems changes and customer notification. Banks may participate in asymmetric price setting behaviour depending on whether the change in money market rates is a decrease or an increase. The actual cost of providing these funds will also not be entirely accurate. Banks use derivative instruments such as Forward Rate Agreements (FRAs), options and forward starting swaps to mitigate potential losses as a result of adverse interest rate movements. The spread is therefore a snapshot in time, valid for the observed day only.

The way the data have been recorded assumes that all loans made on that day are funded at the actual rate for the money market instrument on that day. This is not the case: derivative instruments may have been used, and loans will therefore often be placed in time series buckets and hedged as a group rather than individually.

Graph 1.0 The New Zealand Cash Rate

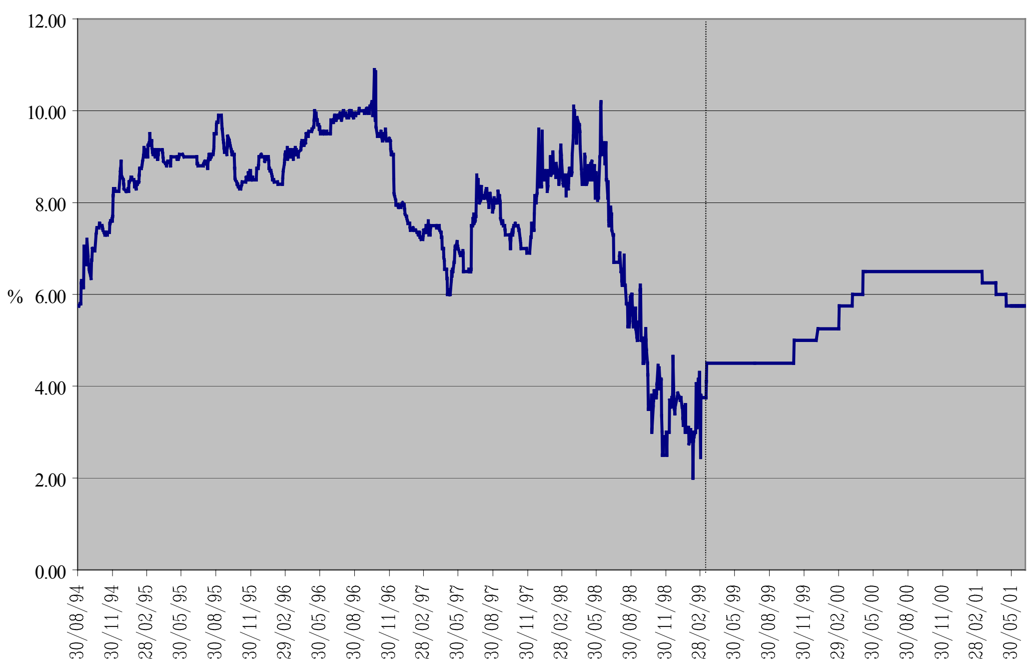

Table 1. Unit Root Test for Interest Rates

Interest rate	ADF Test	PP Test
Money market rates		
90 day bank bill	-1.17	-1.05
1 year swap	-1.02	-1.04
2 year swap	-1.55	-1.50
3 year swap	-2.08	-1.88
Lending rates		
Floating	-0.42	-0.44
1 year fixed	-0.51	-0.57
2 year fixed	-1.31	0.23
3 year fixed	-0.05	-0.06

Notes: The results of this table allow for serial correlation by including lagged first difference in the case of the ADF test or using a lag window in the case of the PP test. The number of lags in the ADF test was determined using the general-to-specific lag selection procedure of Ng and Perron (1995) and Hall (1994), with the maximum lag set to 10. Lagged first differences of the interest rates were sequentially removed from the ADF regression until the last lag was statistically significant. Results from the PP unit root test were computed using the Bartlett kernel and with lag lengths determined by the data-dependent method of Andrews (1991). The five percent critical values is –2.86 (Hamilton (1994, pp. 763).

Table 2. Cointegration Tests between Lending and Money Market Rates

Time horizon	**Pre-OCR**			**Post-OCR**			**Full Sample**		
	α	β	*Z(t)*	α	β	*Z(t)*	α	β	*Z(t)*
Floating	3.65	0.76	-4.56	1.81	1.00	-6.99	2.78	0.85	-5.94
1 year	1.11	1.01	-7.02	1.32	0.96	-6.93	0.98	1.02	-8.68
2 year	1.92	0.93	-5.20	1.36	0.96	-8.04	1.12	1.02	-6.68
3 year	2.12	0.91	-5.27	1.51	0.94	-8.85	1.35	0.99	-6.72

Note: Parameter estimates have been obtained from Stock and Watson (1993) dynamic OLS estimation of the cointegrating regression equation (1). The lags and leads were determined using the general-to-specific approach. Starting from a maximum of 10 leads and lags and sequential reducing them until the longest lag or lead is significant. The coefficient estimates on the lead and lagged first differences are omitted for reasons of space. *Z(t)* is the Phillips-Ouliaris (1990) residual-based cointegration test – the 5 percent critical value for this test is –3.37; an asterisk (*) indicates that the null hypothesis of a cointegration can be rejected at the 5 percent level of significance. The Phillips-Ouliaris (1990) cointegration test was computed using the residuals from the Stock and Watson (1993) dynamic OLS cointegrating regression of equation (1), the Bartlett kernel, and lag lengths were determined by the data-dependent method of Andrews (1991).

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