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Retail Interest Rate Pass-Through: The Irish Experience*

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Abstract: In this paper, we examine the extent to which changes in the money market interest rate are passed through to a number of retail lending rates between 1980 and 2001. In addition, we analyse the speed of adjustment of these lending rates with respect to such changes in the money market rate. Our main findings are: (1) pass-through from the money market rate to lending rates is not complete (2) the speed of adjustment varies quite considerably across alternative lending rates and (3) there has been significant structural change in the relationship between the money market rate and lending rates both in terms of pass-through and speed of adjustment during this period.

I INTRODUCTION

Most central banks use a short-term interest rate such as the one-month money market interest rate as their main instrument of monetary policy.[1] Changes to this short-term interest rate are the first important step in the transmission of monetary policy.[2] Consumption and investment decisions

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[1] See Goodfriend (1991) and Borio (1997).

[2] The operational framework and the monetary policy strategy of the euro area are discussed in Manna *et al.* (2001).

made by households and firms will be affected by the rate of interest charged to them by banks and other financial intermediaries. A critical element in the transmission of monetary policy is the degree and speed at which changes in the short-term policy rate are transmitted to retail rates faced by firms and households.

A number of studies have investigated possible differences in the monetary transmission mechanism across countries in the euro area (see for example, Gerlach and Smets, 1995; Ramaswamy and Sloek, 1997; Ehrmann, 2000 and Mojon and Peersman, 2001). One possible source of asymmetries across countries is differences in the speed and degree of interest rate pass-through. In a European context, Mojon (2000) has examined this subject for six of the largest euro area countries. While he finds differences in the speed of pass-through across countries, the author suggests that "country asymmetries" should decrease over time as a result of EMU.[3]

This paper aims at increasing our understanding of this particular aspect of the monetary transmission mechanism in an Irish context. To date, this topic has not been addressed for Ireland. In this paper, we seek to answer two questions. (1) To what extent are changes in the one-month money-market rate passed through to various retail lending rates? (2) What is the speed at which changes in this money market rate transmitted to these lending rates? Understanding this process is important since it will determine in part how sensitive the domestic economy is to monetary policy changes as well as determining the speed at which the real economy responds to such policy rate changes.

In addition, we document a number of the more substantial changes in the financial environment over the sample period, namely, changes in institutional arrangements regarding the setting of retail rates, changes in competition and regulatory regimes in financial markets and changes in the conduct and operation of monetary policy. We assess the stability of the relationship between the money market rate and retail lending rates during this period in the light of these changes.

In this paper, the term *pass-through* refers to the extent to which changes in money market rates are reflected in changes in retail rates both in the short and long run. Complete pass-through occurs when a movement in the money market rate leads to a *one for one* change in retail rates. Retail rates are said to be "sticky" when there is a slow response of these rates to movements in the money market rate.

[3] Mojon (2000) also points out that national differences in financial structure are likely to persist in the euro area for some time. This would lead to persistence in the country asymmetries with regard to interest rate pass-through.

The format of the paper is as follows. In Section II, we review some of the related theoretical and empirical literature. Section III provides some background regarding the changing institutional arrangements with respect to the setting of interest rates in Ireland while the following section describes our econometric methodology. Section V describes the data used and then reports and discusses the results as well as outlining the possible effects of structural change during the sample period. Finally, we conclude and indicate some future avenues of research.

II LITERATURE

Conceptually one can think of the rate of interest charged by a financial institution as a function of the marginal cost of funds to that institution. One useful proxy of this cost is the wholesale money market rate, i.e., the cost to a bank of borrowing from other banks.[4] Changes in this rate are likely to feed into changes in the rates charged to customers since this represents a change in the financial institutions' marginal cost. Several factors are likely to explain the spread between the retail rate and the marginal cost of funds. For example, the lesser the degree of competition, the higher this spread is likely to be. Lack of competition could be due to regulation, collusion on the part of financial institutions or fixed costs of entering the market. Differences in rates charged to particular customers may reflect variations in credit worthiness or riskiness of individual borrowers. In addition, asymmetric information between borrowers and lenders may cause this premium to vary depending on the market or the state of the economy.

These same factors are likely to influence the degree to which changes in the money market rate are passed through to retail rates as well as the speed at which such pass-through occurs.[5] These factors can be broadly classified into: (1) monetary policy (2) degree of competition in lending and deposit markets, and (3) other factors.

Monetary policy factors: Lags in the adjustment of retail rates are likely to occur due to the difficulty of deciphering whether changes in policy rates are permanent or temporary or whether changes in policy rates are expected or unexpected.[6] For example, the banking sector may be slow to respond to

[4] Other possible proxies of the opportunity cost of funds are the short-term lending facility provided by the monetary authority to banks or the deposit rate offered by financial intermediaries to their customers.

[5] There is also an overlap between the factors that influence the degree and speed of pass-through.

[6] Expected monetary policy changes may have already been factored into retail rates prior to changes in policy rates. Moreover, empirical estimates may be biased if this is not taken into account.

temporary changes in the policy rate but quicker to respond to more permanent changes in interest rates. Stickiness of retail rates may be compounded due to the presence of adjustment costs associated with changing retail rates to customers and this may lead to the smoothing of retail interest rate changes with respect to changes in money market rates.

Another consideration is the relationship between short-term and long-term interest rates, i.e., the term structure of interest rates and how this relationship affects retail rates. This is important for a number of reasons. First, the proportion of retail rates which are fixed or variable will determine the relative importance of movements in short-term or long-term interest rates and will influence the degree of pass-through from money market rates to retail rates. Second, is the main source of funds for financial intermediaries derived from short-term or long-term capital markets?[7] If the main source of financing is from the former then changes in short-term rates are likely to feed into retail rates. Alternatively, if the main source is from long-term capital markets, then there will be a weaker link between changes in policy rates and retail rates. In Ireland, until recently variable interest rates were the norm and the main source of funds are from wholesale money markets or deposits that are closely connected to short-term money market rates.[8] Finally, it may be that there is not one way causation running from money market rates to retail rates (Sarno and Thornton, 2000).

Competition in the banking sector: The relative elasticities of the supply and demand for loans are important determinants of the degree to which interest rate movements are passed through to customers.[9] If one thinks of a change in the money market rate as an exogenous change in the marginal cost of funds for financial institutions, then the elasticity of supply and demand, in a particular retail market, will determine how much of such a change in cost is passed on to the consumer or absorbed by the financial institution.[10] In monopolistic or oligopolistic settings there generally will not be a one for one movement in retail rates in response to changes in money market rates.

Other factors that may be important in the speed and degree of pass-through are the characteristics of the borrower (saver) and cyclical elements

[7] A crucial issue here is the degree of substitutability between funds raised on both short-term and long-term capital markets.

[8] Recently, in the mortgage market, fixed rate mortgages have become more popular but are still generally less than five years in term. In addition, with the advent of EMU, access to longer-term capital markets has become easier.

[9] See Bank of England (2001) for a discussion on the impact of increased competition in the retail credit market on the degree of pass-through.

[10] For example, in a perfectly competitive loan market, the more elastic the supply of loans and the more inelastic the demand for loans the greater the degree of pass-through from money market rates to retail rates.

in the degree of pass-through. In addition, there may be asymmetries in the speed of adjustment and the degree of pass-through depending on whether money market rates increase or decrease. Thus, there are a number of factors that may influence the degree and speed of pass-through.

2.1 Empirical Evidence

BIS (1994); Borio and Fritz (1994); Cottarelli and Kourelis (1994); Lowe (1994); Mozzami (1999) and Mojon (2000) have attempted to quantify the degree and speed of pass-through from money market rates to retail rates for a number of countries. These studies have adopted a single equation error correction approach in order to quantify the dynamics of retail rate adjustment following a change to market interest rates. In general, these studies have found that the degree of pass-through varies across particular retail rates and there are also significant differences across countries.

For example, Borio and Fritz (1994) find the point estimates of the long run response of loan rates to money market rate changes ranged between 0.8 and 1.1 across a number of countries. While Cottarelli and Kourelis (1994) find a long run pass-through coefficient on average of 0.97, with a range of 0.75 to 1.25 approximately using one lending rate. The speed at which changes in money market rates are completely transmitted to retail rates varies between three months and two years.

Mojon (2000) examines how a permanent change in the money market rate is transmitted to a number of retail rates for six countries in the euro area between 1979 and 1998.[11] He finds that, on average, 80 per cent of the adjustment of the lending rate with respect to a change in the money market rate takes place within the first three months for France. While only 15 per cent of the adjustment takes place within the same time period in the case of Spain. The mean adjustment for the six countries is a little over 40 per cent within one-quarter for the entire sample period. He suggests that this heterogeneity has declined over time.

Both Cottarelli and Kourelis (1994) and Mojon (2000) have also tried to relate country specific characteristics to the degree of pass-through in the short run. Both studies use a panel data approach to relate estimates of the degree of short run pass-through to variables such as banking competition, money market factors, financial structure, and bank costs. In summary, the main findings are that inflation, a volatile money market rate, and a lack of competition are the main factors positively related to stickiness.

[11] The countries included in the Mojon (2000) study are Belgium, Germany, Spain, France, Italy, and the Netherlands.

III RETAIL INTEREST RATES IN IRELAND 1980-2001

Due to the fact that the environment in which banks operated changed substantially during the sample period, it is helpful to consider some of the more important forces that have shaped the current environment, namely, institutional arrangements for monetary policy and the financial sector environment.

3.1 Monetary Policy in Ireland: Some Background

Between 1979 and 1999, the Central Bank of Ireland had direct control over monetary policy in Ireland, albeit with the constraint of being a member of the European Monetary System. The Bank could in principle influence economic activity by determining the rate of interest charged to banks and influencing the amount of money in circulation. With the advent of EMU, control of monetary policy is now the responsibility of the European Central Bank (ECB).

In the past, the Central Bank of Ireland never directly controlled retail interest rates in Ireland. However, the Bank entered into a voluntary arrangement with the Associated Banks in 1972.[12] This arrangement consisted of a range of interest rates categorised by the level of risk associated with the borrower and maturity. This arrangement was referred to as the *matrix*. Under the matrix, rates were agreed collectively between the Associated Banks, in consultation with the Central Bank.

In 1986, the Bank announced changes to the operation of the matrix. This was to increase competition and reflect the development of financial markets, and it can essentially be seen as a first step in dismantling the matrix system. The main innovation was that changes in retail rates would be directly linked to changes in wholesale or market interest rates. A change in a reference rate (the one-month inter-bank rate) would trigger a response in matrix interest rates. From 1987, increased competition for deposits meant that these rates were excluded from the matrix. In that year, another major change concerned the abolition of the formal mechanism linking changes in the representative rate to changes in the matrix rates. From 1998 onwards, only the A rate remained in the matrix. This rate must not exceed the representative rate by more than 5.5 percentage points at the time of a generalised change in clearing bank retail rates.

[12] The Associated Banks are AIB, Bank of Ireland, Ulster Bank and National Irish Bank. The term associated derives from the Central Bank Act, 1942.

3.2 The Financial Sector Environment

The Irish banking sector has changed considerably over the past twenty-one years. The changes considered here pertain to deposit-taking institutions only.[13] Among the relevant changes were the decline of the building society sector, the extension of mortgage lending activities by the Associated Banks, and the increased contestability of the domestic market place arising from new entrants and EMU. For example, at the beginning of the 1980s, the 16 building societies were the main mortgage lenders. However, at the end of the sample period, there were only three. This was due to a number of mergers and demutualisations.[14] Moreover, the Associated Banks began to widen the scope of their activities to include mortgage lending to compete with building societies and new entrants to the domestic market.

IV METHODOLOGY

An important consideration in dealing with any time series variable is whether it is stationary or nonstationary.[15] If a group of variables are individually integrated of order one and there exists at least one linear combination of these variables that is stationary, then the variables are said to be cointegrated. Cointegrated variables will never move too far apart and will revert to their long-run relationship. For this reason, the knowledge that some variables are cointegrated can have a significant impact on the analysis of the short and long run dynamics of the economic variables.

Thus, if we can estimate a cointegrating relationship this will tell us in the long run how changes in the money market rate are passed on to retail rates. Three general approaches are widely used for testing whether non-stationary economic time series are cointegrated. These are:

1. Single equation static regressions due to Engle and Granger (1987),
2. Vector autoregressions formulated by Johansen (1988, 1991 and 1995),
3. Single equation error correction models.

[13] A comprehensive account of the forces shaping the Irish financial sector in general can be found in McBride (2000).

[14] Demutualisation is the process of converting from a building society to a bank in order to circumvent restrictions building societies have on the development of their of capital base.

[15] Issues of stationarity are of importance to the modeller as they deal with the behaviour of a particular time series of data. Shocks to a stationary time series will have a temporary effect. On the other hand, shocks to a non-stationary series will have permanent effect and the mean (and/or the variance) will be dependent on time.

Currently there is no consensus regarding the most appropriate test for cointegration and the general empirical approach is to report results for a variety of tests.[16]

The latter two approaches are adopted in the study. We first use the now standard Johansen procedure to test for a long-run relationship. Having established cointegration, the Johansen approach is used to test for weak exogeneity for the system containing the lending and wholesale rates (Ericsson, 1992 and Ericsson and Irons, 1994). Wholesale rates might be expected to be weakly exogenous in the wholesale-lending system, as they are determined in the wholesale money market, with no reference to lending rates. In order to test that the retail rates are in fact weakly exogenous, the speed of adjustment parameter denoted by α should not be significantly different from zero in the wholesale rate equation. Hence, past disequilibria between the two rates do not significantly affect the wholesale rate. On the other hand, the α on the lending rate equation should be significantly different from zero, indicating that past disequilibria do affect the retail rate.

If weak exogeneity holds, and in common with the previous studies already mentioned, we concentrate on a single equation error correction model (ECM) approach. Using the single equation ECM it is possible to model both the long-run relationship and the short-run dynamics. In addition, an important consideration in our analysis is whether structural change has influenced the relationship between the money market rate and various lending rates. The single equation ECM allows us to easily analyse the impact of such structural change. In contrast the Johansen approach has not yet been fully articulated in terms of modelling structural change within the cointegrating relationship.

The ECM can be written as;

$$\Delta i_t = \sum_{i=1}^{n} \beta_i \, \Delta i_{t-i} + \sum_{i=0}^{n} \gamma_i \, \Delta r_{t-i} + \alpha(i_{t-1} - \lambda - \beta \, r_{t-1})$$

where

i_t is the lending interest rate in question

r_t is the money market rate of interest

Δ_t is the change in the variable between t and $t - 1$

[16] For example, Gonzalo (1994) reports a Monte Carlo study which lends support to the superior properties of Johansen procedure relative to several other methods. Haug (1996) finds that single equation tests have smaller size distortions but also have lower power than system based rules. He could not find a consistent ranking of tests so he recommended the application of a number of sets of tests. Pesavento (2000) suggests that using a single equation approach or systems approach for cointegration depends on the degree of simultaneity i.e., the correlation between the independent variable and the errors of the cointegration regression.

The degree of pass-through is represented by β, while the speed of pass-through is represented by α (ECT).

V DATA DESCRIPTION AND EMPIRICAL RESULTS

5.1 Data Description

Our data set consists of monthly data, covering the period January 1980 to March 2001. The data are taken from the Central Bank of Ireland database. The rates are those offered on new business at months' end. Each series is constructed by taking an un-weighted average of the lowest and highest values of the range of rates offered by the institutions in question.[17] Rates will also vary depending on borrower type and maturity of loan. While we attempt to differentiate among borrowers by using differing rates, we have not been able to take maturity of the loan contracts into account in the present paper.[18]

A time series of variable mortgage rates was constructed labelled MORT which includes differing types of financial institutions such as building societies, Associated Banks and other clearing banks. This wider series avoids numerous breaks in the series due to demutualisations, as building societies became banks over the sample. We use a combined series that covers a range of potentially different mortgage lending activities.[19] The A rate on overdraft facilities granted by the Associated Banks is our proxy for a consumer lending rate and is labelled CONSL. The AA rate with a maturity of 1-3 years is our proxy for firm lending to small and medium sized enterprises and is labelled FIRML. The prime rate is the rate offered by clearing banks on prime lending.[20]

Finally, our index of the policy rate is the one-month wholesale money market rate and is labelled MMR. We could alternatively have used the short-term lending facility (STF) of the Central Bank as our index of changes in monetary policy. However, we choose not to use the STF since it was not the only instrument of monetary policy used by the Central Bank.[21] Second, there were restrictions on the use of the short-term lending facility particularly during the currency crisis when it was actually suspended.

[17] A better measure would be an average of each institutions rate weighted by market share. However, data limitations prevent us from calculating this at present.

[18] This is due to a lack of appropriate data.

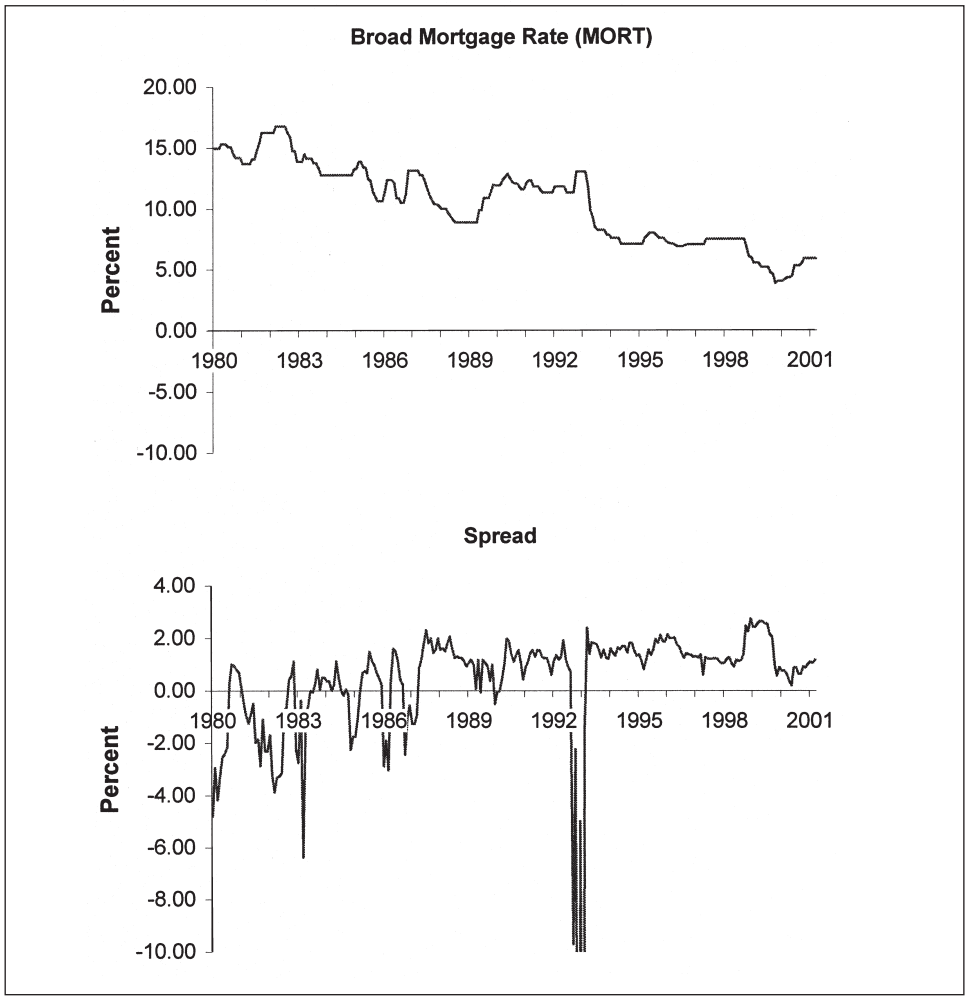
[19] However, the aim in the present paper is to determine the overall degree of pass-through for lending, so we think it is a justifiable assumption.

[20] Clearing banks are the Associated Banks plus TSB.

[21] The Central Bank could influence monetary conditions through the conduct of open market operations in terms of buying or selling government securities or foreign exchange rate swaps (McGowan, 1993).

Figures 1 to 4 plot the various retail lending rates used in this study as well as the spread between each lending rate and the money market rate, while Tables 1a and 1b provide corresponding descriptive statistics for each series. Each lending series shows a decline in value over the sample period. This decline is more than likely attributed to the increased credibility of Ireland's membership of the European Exchange Rate Mechanism.[22]

Figure 1: *Broad Mortgage Lending Rate (MORT) and Spread*



[22] The spike in rates is attributed to the exchange rate crisis of 1992-3.

Figure 2: *Prime Lending Rate (PRIME) and Spread*

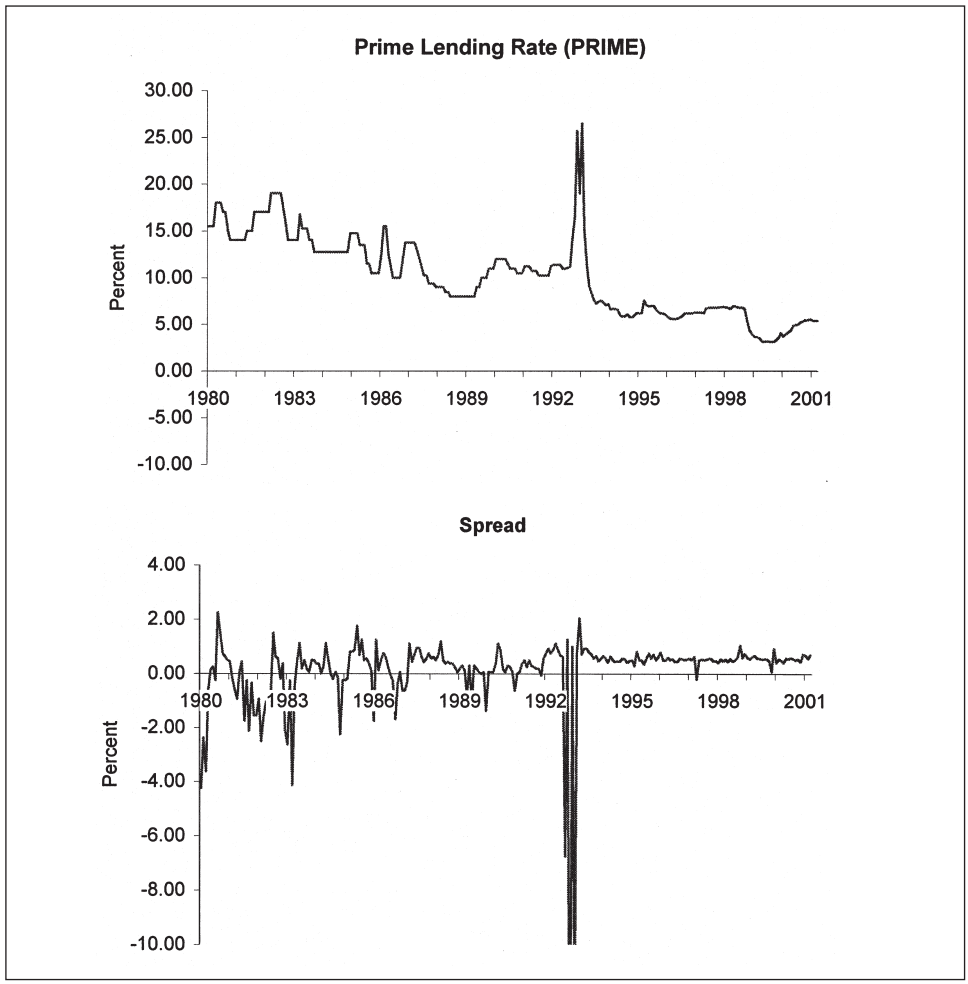


Figure 3: *Consumer Lending Rate (CONSL) and Spread*

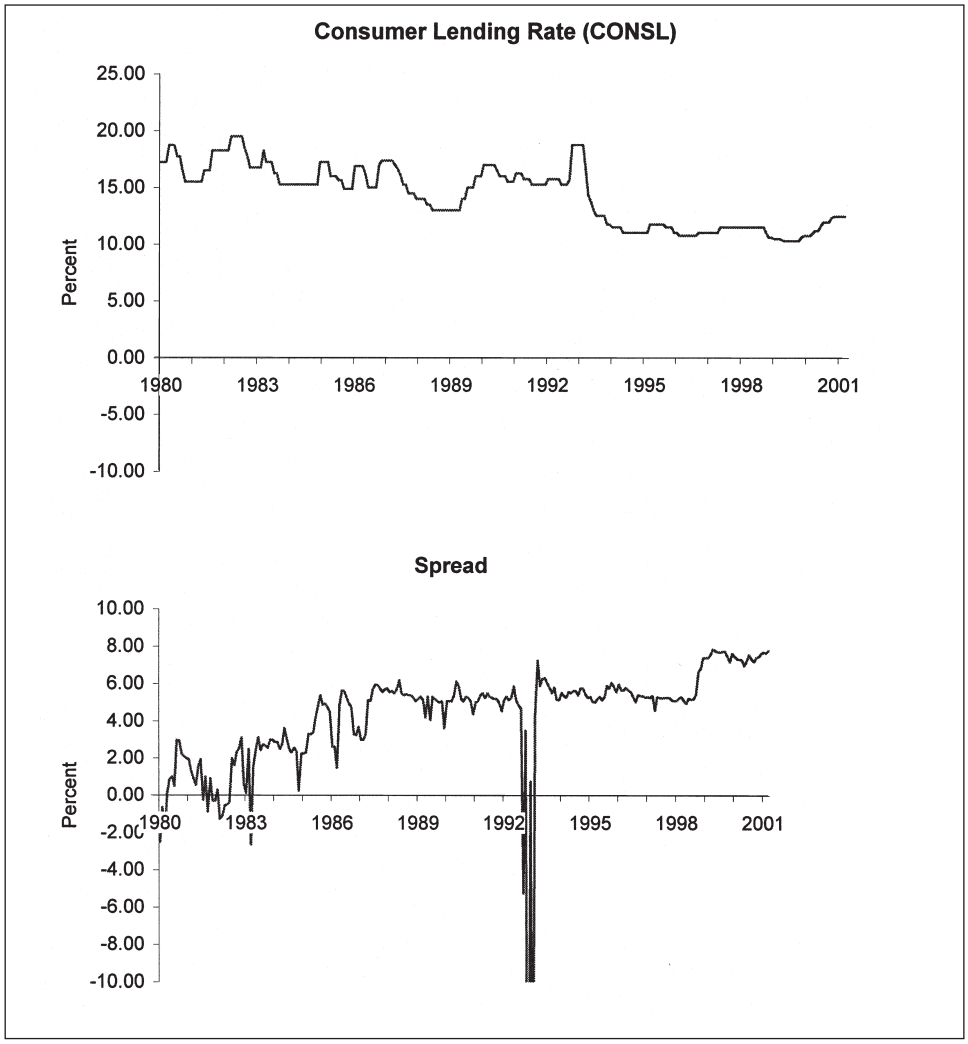


Figure 4: *Firm Lending Rate (FIRML) and Spread*

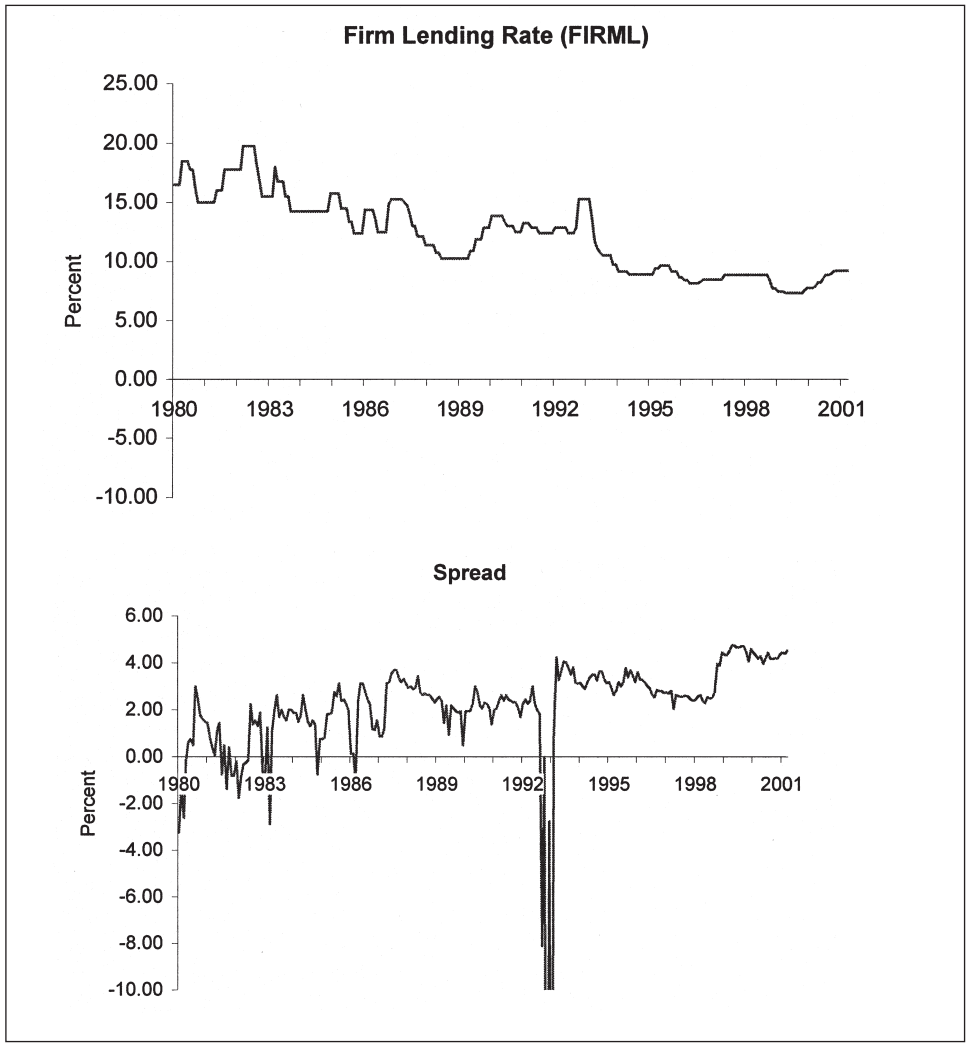


Table 1a: *Retail Interest Rates 1980:1 2001:3*

Series	*Mean*	*Std Dev*	*Min*	*Max*
MORT	10.69	3.12	3.84	16.75
PRIME	10.50	4.21	3.11	26.50
FIRML	12.33	3.20	7.28	19.75
CONSL	14.45	2.64	10.30	19.50
MMR	10.44	5.26	2.54	44.00

Table 1b: *Spread over Money Market Rate*

Series	*Mean*	*Std Error*	*Min*	*Max*
MORT	0.25	3.16	–30.98	2.75
PRIME	0.06	1.75	–18.25	2.25
FIRML	1.89	3.05	–28.75	4.74
CONSL	4.01	3.30	–25.25	7.84

Visual inspection of the spread between each lending rate and the money market rate, suggests that the spread is mean reverting for most of the series and this may indicate the existence of a long-run relationship between each retail rate and the market rate. We will test this more formally below using cointegration tests. However, despite the relative constancy of the spreads, there appears to be some degree of regime change across series. Prior to the mid-1980s, the spread for most series is highly variable but settles down afterwards. In addition, there appears to be a change in the spread for most series with the onset of EMU.[23]

Descriptive statistics show that the spread between the prime rate and the money market rate is the smallest of all lending rates considered, followed by the mortgage rate. Lending to consumers has the highest spread of all lending retail rates. This could reflect the generally higher credit risk inherent in consumer lending than in lending to businesses or for mortgage purposes. It could also reflect less competition in this area.

Tests of stationarity were carried out for each of the lending series using both the Augmented Dickey-Fuller and the Phillips-Perron unit root tests. All rates were found to be integrated of order one, I(1). We formally test for cointegration between each individual lending rate and the money market rate using the Engle-Granger, Johansen and single equation ECM

[23] The change in the spread for the mortgage rate could also be attributed to the entry of the Bank of Scotland into the market.

approaches.[24] For all series and for all test procedures we find evidence in support of the presence of a cointegrating relationship between each individual lending rate and the money market rate. For example, in Table 2a we report the trace and maximum eigen-value tests of cointegration associated with the Johansen procedure.[25] In all cases we find support for the presence of one cointegrating vector between each lending series and the money market rate. Our results are consistent with those of other studies such as Diebold and Sharpe (1990) for the US and Mojon (2000) for some euro area countries.

Table 2a: *Johansen Procedure: Testing the Number of Cointegrating Vectors*

Rates	*Lags*	*Maximum Eigenvalue Test*		*Trace Test*	
		r = 0	r ≤ 1	r = 0	r ≤ 1
MORT	2	44.84*	2.21	47.05*	2.21
CONSL	4	17.40*	2.90	20.31*	2.90
FIRML	2	56.22*	3.25	59.47*	3.25
PRIME	1	163.52*	2.50	166.02*	2.50

Notes: All models estimated include a constant restricted to the cointegration space. All include impulse dummies for the exchange rate crisis 1992-3.
VAR length based on standard selection criteria.
*Significant at the 5 per cent level from Osterwald Lenum (1992) critical values for cointegration tests with constant restricted to cointegration space.

Having established cointegration, we can now move to estimating the degree and speed of pass-through between each lending series and the money market rate. The validity of concentrating on a single equation approach such as the single equation ECM framework as opposed to a systems approach such as Johansen depends on whether the money market rate is weakly exogenous. In Table 2b we report tests of weak exogeneity of the money market rate with respect to each lending series. In general our results suggest that the money market rate is in fact weakly exogenous. Thus, it is legitimate to move to estimation using a single equation ECM approach.

[24] We only report statistics associated with the Johansen and single equation ECM approaches.
[25] This is based on a vector autoregression between each series and the money market rate.

Table 2b: *Estimated Degree of Pass-Through (β) and Speed of Pass-Through (α) using Johansen*

Retail Rates	*Cointegrating Vector* β	α	χ^2	*Cointegrating Vector* α	χ^2
	(normalised)	*(retail)*	*(H_0: a = 0)*	*(wholesale)*	*(H_0: a = 0)*
MORT	0.80	–0.09	19.93 [0.00]	0.11	3.31 [0.07]
CONSL	0.64	–0.06	3.47 [0.06]	0.10	2.35 [0.13]
FIRML	0.75	–0.35	32.58 [0.00]	0.08	0.43 [0.51]
PRIME	0.92	–0.53	67.84 [0.00]	0.14	1.87 [0.17]

Notes: Normalised β is from the estimated cointegrating vector of the money market rate on the relevant lending rate. Factor loading coefficients α are from each of the lending and wholesale equations in the cointegrating system taken from the α matrix estimated by the Johansen procedure.

Tests for weak exogeneity: If α (lending) is significantly different from 0 and α (wholesale) is not significantly different from 0, then we cannot reject the hypothesis that the wholesale rate is weakly exogenous.

5.2 ECM Results

Based on Equation (1) and using the general to specific methodology for testing down, we arrive at a model that captures both the long-run relationship and the short-run interaction between each retail series and the money market rate. We also include impulse dummies to account for the exchange crisis of 1992-3. Table 3 provides the long-run coefficients λ and β as well as the speed of adjustment coefficient α for each of the series. Given the existence of a long-run relationship between each lending rate and the money market rate we next turn to answering the two questions posed in the introduction. First, what is the degree of pass-through from the money market rate to each lending rate? Second, what is the speed of this process?

The coefficient β gives the long run response of each particular retail rate with respect to a change in the money market rate. Thus, it summarises the degree of long run pass-through. For example, if β =1, this implies there is complete pass-through from changes in the money market rate to the retail rate in question. We find the long-run response as summarised by β varies from a high of 0.92 (PRIME) to a low of 0.54 (CONSL). The high value for PRIME may be rationalised by the fact that large corporations have alternative avenues for external financing.[26] This alternative may not be

[26] This is consistent with evidence for the US, see Sellon (2002).

available for consumers. However, the most notable feature is that all the series have a pass-through coefficient of less than unity. Formal statistical tests (Wald test) also reject the hypothesis that $\beta=1$ for all the lending series.[27] This suggests that all retail series respond less than one for one to changes in money market rates. Moreover, these results suggest a lower degree of pass-through than observed in other countries, see for example, Cottarelli and Kourelis (1994) and Mozzami (1999).

Table 3: *Single Equation ECM*

	Coeff.	*MORT*	*PRIME*	*CONSL*	*FIRML*
Speed of Adjustment	α	– 0.13	–0.56	–0.06	–0.23
		(0.02)	(0.04)	(0.03)	(0.04)
Intercept	λ	2.79	1.02	9.26	4.90
		(0.33)	(0.11)	(0.85)	(0.21)
Long-Run pass-through	β	0.77	0.92	0.54	0.74
		(0.03)	(0.01)	(0.08)	(0.02)
Note: All coefficients have standard errors in brackets					
Diagnostic Tests	Adjusted R^2	0.59	0.91	0.68	0.67
	SE	0.24	0.40	0.29	0.30
	SC	8.66	11.77	12.94	1.73
		[0.07]	[0.02]	[0.01]	[0.78]
	HET	0.82	0.78	3.66	3.50
		[0.36]	[0.37]	[0.05]	[0.07]
	Wald Test $\beta = 1$	55.13	59.23	35.05	159.95
		[0.00]	[0.00]	[0.00]	[0.00]

Note: Terms in brackets refer to significance levels. SC is the Breusch-Godfrey test for serial correlation, HET is the Breusch-Pagan test for heteroscedasticity.

The second question posed in the Introduction regards the speed at which money market rate changes are transmitted to lending rates. The coefficient α describes the speed at which any disequilibrium in the long-run relationship

[27] A referee has suggested that another test of complete pass-through would be a joint test of whether β is equal to unity and λ is equal to the spread. In all cases this was rejected.

between the money market and retail rate dissipates. For example, the coefficient associated with the ECT for MORT is 0.13. This implies that 13 per cent of any money market rate change is passed through to the mortgage rate within a one-month period. Overall, the coefficient on the ECT varies between a high of 0.56 (PRIME), to a low of 0.06 (CONSL).

Our results here are not directly comparable to recent studies on the euro area such as Mojon (2000). First, Mojon (2000) imposes complete pass-through in his estimation, i.e., he sets $\beta=1$. Second, he does not report actual estimates for the speed of adjustment, α, but only reports what fraction of adjustment takes place over different time horizons.

While each of the ECM's pass the standard diagnostic tests and appear to give intuitive results, our priors would tend to cast doubt on the validity of a fixed coefficient model over the whole sample period. This is based on the degree of structural change that took place over the period. In particular, there were significant changes in: (1) the institutional structure with respect to the setting of interest rates, i.e., the decline of the role of the matrix, (2) the change in competition and regulatory regimes in financial markets and (3) changes in the conduct, credibility and operation of monetary policy during this period.

5.2.1 Structural Change

We include dummy variables to take account for a number of the institutional changes as well as the exchange rate regime changes witnessed during this period.[28] In particular, we control for three specific periods. First, we include a dummy from 1980-86 in order to control for the period prior to the relaxation of the *matrix*. Second, we take into consideration the broadening of the exchange rate bands in the ERM from 1993 to the start of EMU. Finally, a dummy variable is included for the period since the onset of EMU. In our study these periods are considered important in terms of both λ, the intercept, and also in terms of β, the degree of pass-through. Intercept dummies for the three periods are referred to as *dum86*, *dum93*, and *dum99 respectively*, while the corresponding slope dummies are referred to as *sdum86*, *sdum93*, and *sdum99*.[29] Thus, the introduction of these dummy variables allows for the possibility of changes in the value of the intercept

[28] The dates for controlling possible structural change are determined a priori and are based on our reading of developments over the sample period. An alterative approach would have been to allow the data to determine possible break points.

[29] We also included a dummy variable to allow for anticipation effects of the introduction of EMU to account for the forward looking behaviour of the banking sector to expected declines in Irish policy rates to European levels, but found it insignificant in all cases.

Table 4: *Single Equation ECM Permitting Structural Break*

	Coeff.	*MORT*	*PRIME*	*CONSL*	*FIRML*
Speed of Adjustment	α	– 0.25 (0.03)	–0.72 (0.04)	–0.28 (0.04)	–0.50 (0.03)
Intercept	λ	3.92 (0.48)	1.48 (0.25)	8.80 (0.50)	4.32 (0.24)
Long-Run pass-through	β	0.71 (0.05)	0.88 (0.02)	0.64 (0.05)	0.80 (0.02)
Intercept Dummies	Dum86				
	Dum93	–0.81 (0.23)	1.03 (0.40)	–1.14 (0.25)	
	Dum99	–0.66 (0.23)	–0.79 (0.31)	1.34 (0.26)	
Slope Dummies	Sdum86	–0.04 (0.02)	–0.06 (0.03)	–0.09 (0.02)	–0.04 (0.01)
	Sdum93		0.09 (0.04)		–0.04 (0.02)
	Sdum99				0.28 (0.04)
Note: All coefficients have standard errors in brackets.					
Diagnostic Tests	Adjusted R^2	0.64	0.93	0.70	0.70
	SE	0.23	0.35	0.28	0.28
	SC	1.99 [0.74]	5.21 [0.27]	5.20 [0.27]	3.02 [0.55]
	HET	0.24 [0.60]	3.60 [0.05]	3.46 [0.06]	3.40 [0.06]
	Wald Test $\beta = 1$	38.34 [0.00]	20.03 [0.00]	50.10 [0.00]	67.35 [0.00]

Note: Terms in brackets refer to significance levels. SC is the Breusch-Godfrey test for serial correlation, HET is the Breusch-Pagan test for heteroscedasticity.

term, λ, and the slope term, β, in the cointegrating relationship during the sample period. That is to say we allow for possible changes in the spread between retail rates and money market rate as well as changes in the degree of pass-through from money market rates to retail rates. The results are reported in Table 4.

It is evident from Table 4 that the inclusion of the dummy variables accounting for structural change lead to significantly different results than previously reported in Table 3. Probably the most significant change is with respect to the speed of adjustment coefficient, α. In particular, one observes a rise in the speed of adjustment across all series when we control for the possibility of structural change. For example, the speed of adjustment for PRIME rises from 0.56 to 0.72 while it increases from 0.13 to 0.25 for MORT. To check the robustness of these estimates of the coefficient for speed of adjustment we also graph the recursive estimates of α for each retail series in Figure 5.[30] For each series, apart from the initial period, the speed of adjustment is relatively constant over the sample period. Thus, not controlling for structural change leads to an underestimation of the speed of adjustment from money market changes to retail rate changes.

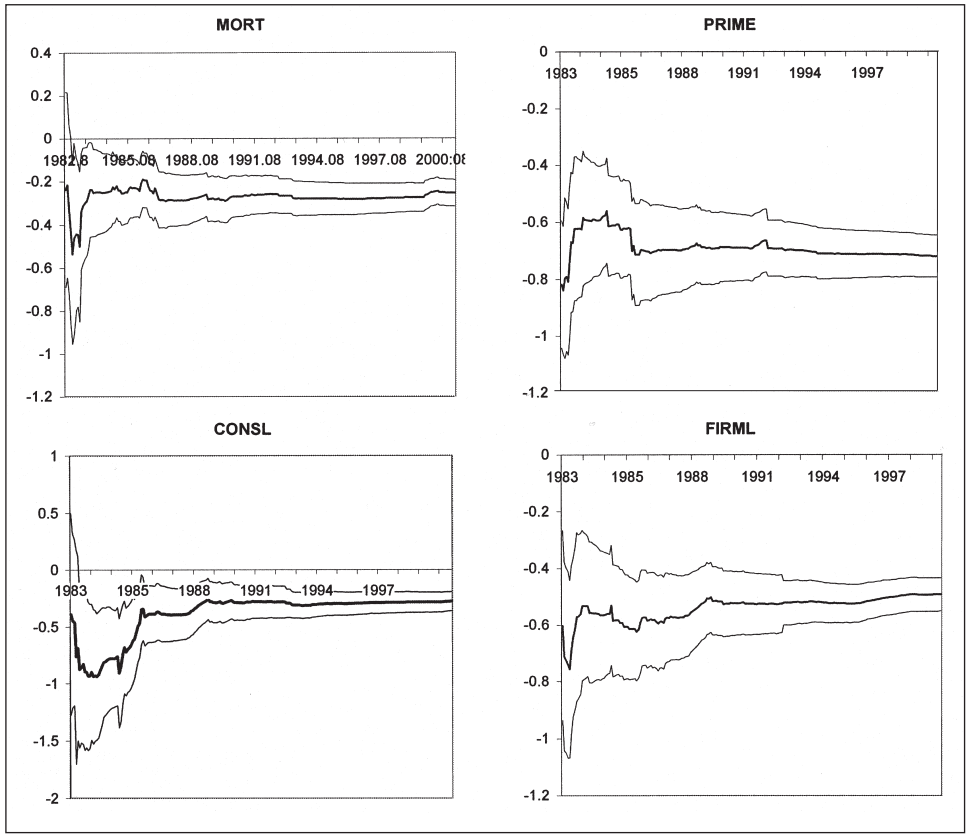
With regard to the effect of structural change influencing the degree of pass-through, β we find evidence that the dismantling of the matrix had a significant effect. In particular, the slope dummy *sdum86* is significant for the four lending series with long run pass-through being less during this period than in the rest of the sample period. For example, in terms of CONSL, the point estimate of degree of pass-through is 0.09 higher post 1986. As highlighted previously, one likely reason for this was the operation of the *matrix*. With retail rates not set strictly based on competitive forces this is likely to have led to a decline in the degree of pass-through. Regarding the advent of EMU, the only lending rate to witness a significant change in the degree of pass-through is FIRML with a large increase in the degree of pass-through.

Next we discuss the intercept term λ and the impact of structural change on this coefficient. One can think of the value of the intercept as a proxy of the margin of financial institutions.[31] A number of lending rates show a decline in their intercept value after 1993. For example, the intercept value for MORT

[30] The dashed lines are the corresponding 95 per cent confidence intervals.

[31] For example, suppose there was complete pass-through i.e. $\beta=1$, then the intercept term could be thought of as a measure of the margin for the financial institution, i.e., the difference between the price and the marginal cost. In this case, the intercept would correspond with the spread shown in Table 1. However, for all our retail rates, with $\beta<1$, pass-through is less than complete suggesting that if the intercept term remains constant, the margin increases (decreases) when money market rates decreases (increase). Overall, it is possible to think of a decline in the intercept as a reduction in the mark-up over the marginal cost of funds *ceteris paribus*.

Figure 5: *Recursive Estimation of ECM Term for Each Lending Equation*



declines post 1993 and post EMU. The decrease in the intercept on MORT and the increase in the degree of pass-through post 1986 is consistent with the increase in competition in the mortgage market brought about through increased participation of the Associated Banks into this sector of the market and the entry in recent years of Bank of Scotland. Although the intercept on CONSL falls post 1993, it has risen post EMU, and this may suggest that competitive forces were less in force in this segment of the market. The results regarding PRIME are somewhat ambiguous, particularly post 1993 to the onset of EMU. During this period the degree of pass-through rises but there is also a rise in the intercept or margin.

Overall, the impact of structural change would appear to be significant in our study. In particular, we find that both degree and speed of pass-through has been affected by such change for all lending rates considered. Further work in this area might involve construction of more sophisticated models to

analyse the impact of regime and structural change and possible asymmetric rate changes in the Irish financial system.

VI CONCLUSIONS

In this paper we have quantified the degree of pass-through between the money market rate and various retail lending rates, in addition to estimating the speed at which such pass-through occurs. As has been discussed, this process is important since it will determine in part how sensitive the domestic economy is to monetary policy changes as well as determining the speed at which the real economy responds to such policy rate changes. For the vast majority of retail lending rates pass-through is less than complete, while the speed of adjustment varies across series. The empirical results are consistent with previous studies, although the degree of pass-through found here is relatively lower. An important issue dealt with in the paper is structural change that occurred in the financial sector during the period in question. Further work in this area might consider issues relating to whether there are asymmetries in the degree of pass-through and the speed of adjustment depending on whether interest rates rise or fall.

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