1/RT/12

Páipéar Taighde Teicniúil
Research Technical Paper

The financial crisis and the pricing of interest rates in the Irish mortgage market: 2003-2011

Jean Goggin, Sarah Holton, Jane Kelly, Reamonn Lydon and Kieran McQuinn

Banc Ceannais na hÉireann
Central Bank of Ireland
Eurosystem

The financial crisis and the pricing of interest rates in the Irish mortgage market: 2003-2011

Jean Goggin, Sarah Holton, Jane Kelly, Reamonn Lydon and Kieran McQuinn

Abstract

This paper examines the changing manner in which Irish financial institutions set their variable interest rates over the period 2003 - 2011. In particular, the onset of the financial crisis clearly results in a break in the pass-through relationship between market rates and variable rates at the end of 2008 in the Irish mortgage market. Until the end of 2008 variable rates for all lenders closely followed changes in the ECB's policy rates, short-term wholesale rates and tracker rate mortgages. Thereafter, the relationship breaks down, in part due to banks' increased market funding costs. It appears that some lenders with higher mortgage arrears rates and a greater proportion of tracker rate loans on their books exhibit higher variable rates. After controlling for these factors and additional funding costs, most of the divergence between banks' variable rates is explained, but there are some exceptions. There is also some evidence of asymmetric adjustment in rate setting behaviour: that is, rates tend to adjust slowly when they are above the long-run predicted level but more quickly when they are below this level. This asymmetric adjustment behaviour appears to increase in the post-2008 period.

Non Technical Summary

Over the period 2003 - 2011 there are two clear regimes indentifiable in the relationship between policy rates and the variable rates offered by Irish financial institutions. Up to 2008, standard variable rates in the Irish mortgage market closely followed policy rates, and consequently tracker rate mortgages. From 2008 onwards and mainly for reasons attributable to the financial crisis, the interest rates on variable and tracker rate mortgages have diverged. This paper seeks to explain movements in Irish variable mortgage interest rates and to examine the factors which affect the changing relationship between market rates and bank lending rates over this period.

We analyse descriptive statistics of variable rate mortgages, which account for around half of outstanding loans and a third of outstanding balances. We then examine the pass-through relationship between variable rate mortgages and banks' funding costs and structure, along with market rates and characteristics, by drawing data from several different sources. While variable rates for all lenders did closely follow changes in policy rates, short-term wholesale rates and tracker rate mortgages, we find a structural break in the relationship towards the end of 2008, which confirms our prior that the relationship has changed. Therefore, we model the relationship both before and after the break. We also examine for asymmetric behaviour in interest rate changes and include alternative measures of funding costs which faced the banks in the post 2008 period.

The results of this analysis show that pass-through varied little across banks before the break in 2008 and that changes in money market and deposit rates are an important determinant for standard variable rates. In the post 2008 period, the breakdown in pass-through between lending rates and monetary policy and money market rates is partly explained by increased market funding costs, captured by direct fees and indirect market spreads. Also, as we expected, some lenders with higher mortgage arrears rates and a greater proportion of tracker rate loans on their books exhibit higher variable rates. Competitive pressures also impact on lenders' variable rates, particularly before the end of 2008. There is also evidence that when variable mortgage rates are below the level suggested by the prevailing environment, that they adjust more quickly than when they are above, particularly after 2008.

1 Introduction

The international financial crisis has had a profound impact on the key determinants of variable interest rates charged in the Irish mortgage market. Up to 2009, standard variable rates in the Irish mortgage market closely followed policy rates. Thereafter, this relationship appears to have broken down. Accordingly, this paper seeks to explain movements in variable rate mortgage interest rates and examine the factors which affect the changing relationship between market rates and bank lending rates over the period 2003 - 2011.

In the run up to the financial crisis, Irish credit institutions built up a heavy reliance on short-term wholesale financing as they rapidly expanded their balance sheets. The resulting gap between loans and deposits (ratio of around 1.8 at end 2010) left these institutions highly susceptible to the general downturn in international market confidence from 2008 onwards. Consequently, the Irish financial system began to experience significant funding outflows, a shortening of maturities and an increased reliance on central bank sources to make up part of the shortfall.[1]

Most of the lending by Irish institutions was heavily concentrated in the residential and commercial property markets. Across the OECD over the period 1995 to 2007, Irish house price increases, at 9 per cent per annum, were the largest. While initially much of the boom in Irish house prices is generally regarded to have been determined by improvements in fundamental economic factors such as increased income levels, lower unemployment and stable interest rates, the availability of wholesale funding post 2003, significantly increased the supply of credit to the residential market. The existing boom in both the residential and commercial property markets at this time resulted in significant demand for this increased source of funding amongst credit institutions. By 2007 a growing body of opinion was of the view that Irish house prices were considerably overvalued[2] - this, compounded by the onset of the financial crisis internationally, left Irish institutions particularly exposed to funding vulnerabilities.

In general the interest rate pricing behaviour of financial institutions can be considered within a marginal cost pricing model, where a mark up is used over money market rates. Market rates are typically viewed as the most accurate reflection of the marginal funding costs faced by banks, and the mark up is used to capture operational costs and risk associated with lending. Perfect pass-through from market rates to retail rates is not expected due to information asymmetries and

[1] Measures are in place to reduce the Irish banking system to a manageable size and to stabilise its funding base - see FMP for details (http://www.centralbank.ie/regulation/industry-sectors/credit-institutions/Documents/The %20Financial%20Measures%20Programme%20Report.pdf).

[2] See Honohan (2007) for more on this.

imperfect competition, however, in a more stable market environment the rates charged by banks tend to closely follow changes in money market rates.

Prior to the crisis, Irish banks accessed short term wholesale funding at levels close to euro area benchmark money market rates and this heavily influenced their marginal cost of funds. With the onset of the crisis, and Irish banks finding it increasingly difficult to raise wholesale funds, particularly term maturities, these institutions had to pay increased premiums relative to euro area benchmarks. Central bank funding offset the cost to some extent but the marginal cost of funds, arguably, was no longer heavily influenced by wholesale rates - corporate and wholesale type funding fell from roughly two-thirds to one-third between end 2008 and 2010. This development is likely to have had a significant impact on variable rate pricing in the Irish market.

Loans in the Irish mortgage market, are issued either on a fixed or variable rate, with the vast majority (85 per cent) on the latter. There are two types of variable rate loans: those that track the ECB base rate at an agreed margin, typically called 'trackers', and those that do not. In the case of the latter, the lender offers no specific link to an underlying market or wholesale rate and can choose to increase or decrease the rate at its discretion. In this paper, when we refer to variable rate mortgages, we mean excluding trackers. The most common variable rate product is the Standard Variable Rate or 'SVR'. Lenders stopped offering tracker rate mortgages in 2009, when the underlying profitability risk inherent in such products was starkly exposed by the divergence of funding costs from the policy rate or interbank lending rates, such as the Euro Interbank Offer Rate, known as Euribor. In the last two years, the majority of new mortgages have been on a variable rates.

This paper, using a panel data approach, seeks to explain movements in Irish variable rates over the period 2003 - 2011. In particular, the paper assesses the implications of the international financial crisis on the funding costs of Irish institutions. The approach also takes into account the implications of the continued deterioration in the performance of the Irish mortgage market - especially, the significant increase in arrears experienced by all lenders from 2007 onwards. In this context, we specifically examine why some Irish lenders increased variable rates more than others. Various policy measures such as the introduction of a government guarantee scheme for deposits as well as the cost of the liquidity funding provided by the ECB and the Irish central bank are also incorporated within the analysis.

The rest of the paper is outlined as follows: Section 2 provides further information on variable rates in the context of the overall Irish mortgage market; section 3 summarises the literature on interest rate pass through; section 4 presents the results from the empirical analysis while a financial section concludes.

2 Variable rates and the Irish Mortgage Market in context

2.1 Share of balances, average balances and interest rates

In Figure 1 the average tracker and variable rate for the Irish mortgage market is plotted in the left-hand side panel. The average difference between variable rates across the Irish market, shown in the right-hand side of Figure 1, is currently 2 per cent. Figure 2 shows the share of current mortgage balances in the Irish market accounted for by variable, tracker and fixed rate loans. In both the owner-occupier and buy-to-let segments, variable rate mortgages account for around one-third of balances. The average balance on variable rate loans is considerably lower than tracker and fixed rate loans. Therefore, the share of loans (and households) that are on variable rates is higher and closer to a half.

Table 1 shows the average mortgage loan balances and interest rate by loan type for the four Financial Measures Programme institutions.[3] The data give a sense of both the prevalence of variable rates in the Irish mortgage market, and the difference in average interest rates when compared with other interest rate types. For owner-occupiers, the average balances at end 2010 for variable, tracker and fixed rate mortgages were around €85,000, €165,000 and €145,000 respectively. The main reason for the difference in balances is that the majority of loans originating during the recent housing boom were tracker loans; whereas older vintage loans, with both smaller originating and current balances, tended to be variable rate loans (see Figure 4). A final point worth noting is that a large number of fixed-rate loans that are shown in the right-hand side of Figure 3, are due to revert to variable rate loans in the next few years.

2.2 Mortgage distress and interest rate type

Falling incomes and rising unemployment in recent years have left many borrowers struggling to service outstanding mortgage debt. Figures from the Central Bank of Ireland (2011) for the end of September 2011 show 8.1 percent of private residential mortgage accounts in arrears for 90 days or more, accounting for €12.4 billion or 10.8 percent of outstanding balances. If we include those loans that have had some form of restructuring plus loans in arrears of less than 90 days, almost one in five mortgage holders are facing, or have faced, some form of difficulty meeting their repayments.

Lydon and McCarthy (2011) use loan-level data to examine the determinants of mortgage arrears. However, the interest rate on the loan in this analysis only enters indirectly via the mortgage payment to income ratio. In this section, we examine whether variable rate customers have fared better or

[3] AIB, Bank of Ireland, EBS and PTSB.

worse than their tracker or fixed rate counterparts, and if so, what is the reason for the difference.

Figure 5 shows the Capital Requirements Directive (CRD) default rate for the four Financial Measures Programme institutions by interest rate type.[4] The arrears rate for variable rate customers is 3 to 4 percentage points higher than the rate for tracker customers. An important question is whether the higher arrears rate we observe for variable rate loans is because they attract significantly higher interest rates, or for other reasons that might make them more likely to be in arrears, e.g. other borrower, lender or loan characteristics. Table 2 shows the results from a probit regression where the dependent variable is equal to one if a loan is 90-plus days past due and zero otherwise. The results indicate that even after controlling for a range of factors, the arrears rate for variable rate loans is significantly higher than both tracker (2 percentage points higher) and fixed rate (4 percentage points higher) loans.

Table 3 summarises the results from another probit regression, including the actual interest rate directly as a control. The first column (model 1) shows the bivariate regression and reaffirms the pattern shown in Figure 5: the arrears rate is 2 percentage points higher for variable rate mortgages, compared with tracker rate mortgages. The second model adds a control for the log of the interest rate, which is positive and highly significant. The inclusion of the interest rate variable reverses the sign on the variable rate dummy variable, which is now negative and signficant. The third and fourth columns add additional controls incrementally, such as income, LTV and other loans. The results from the regression analysis indicate that the higher arrears rate for variable loans is not explained by the observable characteristics of the borrower and indicate that higher interest rates to some extent may explain arrears.

2.3 Bank funding costs and interest margins

This section provides some background on two other potential drivers of variable rates: banks' interest margins and funding costs. The net interest margins for Irish institutions have declined for the last two decades, as shown in the bottom of Figure 6. The average net interest margin for the 2005 to 2008 period is 1.6 per cent. As discussed in the empirical analysis, we obtain similar margins over Euribor for the period up to the end of 2008. According to European Banking Authority (EBA) stress test figures for December 2010, Irish banks' net interest margins were at the lower end of the range (see Figure 6, top panel).

[4]The CRD introduces a supervisory framework for capital measurement and adequacy standards in the financial services industry that reflects the Basel II rules.

Prior to the onset of the banking crisis, Irish banks accessed short term wholesale funding at rates close to European benchmarks such as Euribor. An ECB survey confirmed that variable rate pricing was largely based off the ECB main refinancing rate or 3-month Euribor for Irish lenders in 2007 (ECB Occasional Paper, 2009). This explains why variable rates followed tracker rates so closely up to the end of 2008. Market funding costs have risen substantially since the onset of the crisis. Domestic banks have experienced significant funding outflows of corporate deposits and wholesale debt securities (Figure 7, left panel). Given Irish lenders' high loan to deposit ratios relative to many European peers, there has also been an increased reliance on central bank funding as a means of partially offseting these outflows (Figure 7, right panel).

Borrowing from the Eurosystem peaked at 21.3 per cent of total liabilities in January 2011, before falling back to 17 per cent by end-2011.[5] Remaining liabilities, which include the Emergency Liquidity Assistance (ELA) provided by the Central Bank of Ireland, accounted for just over 10 per cent of total liabilities in July 2010 but rose rapidly from this point. Its contribution peaked in March 2011, at 23 per cent of total liabilities.[6]

Banks also pay a fee to the government for the Eligible Liabilities Guarantee (ELG), which covers deposits, certificates of deposit, commercial paper, senior unsecured bonds and notes and other senior debt.[7] The covered banks have paid fees to date of €1.8 billion for the scheme. The quantity of assets guaranteed by the state has fallen from a peak of €375 billion in Q3 2008 (under the previous broader scope scheme) to €100 billion in Q3 2011, reflecting the funding outflows and shortened maturity profile experienced by the covered institutions. Nonetheless, given the increasing

[5]These shares and the series shown in Figure 7 are based on statistical balance sheet data, which provide details of the liabilities of within-the-state offices or branches of the Irish-owned institutions, including IBRC. The data are unconsolidated, however for the purpose of this analysis they have been adjusted to exclude deposits from resident and foreign affiliated MFIs.

[6]The ECB provides system wide liquidity to euro area eligible credit institutions through standard operations against a clearly defined range of collateral assets. The ECB bears the risk of these loans as opposed to the national central bank (NCB) in the country where the funds are lent. By contrast, ELA is not system wide lending - it should only be provided to a solvent bank experiencing temporary liquidity problems. ELA is at the discretion of the NCB, subject to ECB approval, with the risk lying with the NCB. If there is any doubt as to a bank's solvency, a national government guarantee would be required in relation to the NCB's liquidity support.

[7]The ELG, introduced in December 2009, provides a Government Guarantee on certain liabilities of a number of credit institutions in Ireland and is one of a range of measures designed to stabilise confidence in the domestic banking system. Further details on the ELG are available from the Department of Finance: http://www.finance.gov.ie/viewdoc.asp?DocID=7071.

fee structure imposed by the European Commission over time to incentivise exit, the Department of Finance estimate that the average effective ELG cost has doubled since its introduction from 50bps to 100bps in Q3 of 2011.

There is a lack of time series data on both the price and quantity components of banks' funding costs. However, drawing on a range of sources, we have constructed funding cost estimates for the domestic banks as at December 2011. The calculation uses group level volume data on funds outstanding by instrument, and makes the following assumptions as to the interest rates for each category:

- Retail deposits - we use household share weighted deposit rates (outstanding business rates weighted by volume per maturity category) from the resident statistical returns.
- Corporate and non-bank financial deposits - we use the matching non financial corporations' (NFCs') rates on outstanding business from the resident statistical returns.
- Repo and interbank funding - we use average rates paid drawn from a small sample of recent repo deals, sourced from Central Bank of Ireland, Treasury.
- Debt issuance - we use a sample of at issue yields on bonds issued by domestic banks since the crisis (e.g. on asset covered securities, ELG debt and senior unsecured issues).
- Official borrowing - for ECB and other central bank borrowing we apply the official rates.
- ELG fee estimates - on the basis of the guaranteed liabilities data as at end October 2011.

Table 4 shows an estimate of the price and quantity components of funding costs, as at December 2011 for the FMP institutions. The calculation uses group level volume data on funds outstanding by instrument, and makes a number of simplifying assumptions as to the interest rates for each funding component. For example, we assume the same interest rate applies to domestic and UK deposits; we also assume that the rate on non-bank financial institution (NBFI) deposit rates is equal to the rate on NFC deposits. For debt issuance, we have not adjusted rates for maturity or other features such as options. Furthermore, from a marginal cost perspective, the yields on the bonds selected may be biased downwards if they are drawn from pre-crisis issuance. On the basis of these figures, we estimate average funding costs for these institutions of around 2.6 per cent. This compares with an average standard variable mortgage rate of 3.9 per cent in December 2011. We take account of funding costs using a number of different measures, as discussed in the empirical approach in section 4.

The estimates in Table 4 should be treated as a *guideline* since they are subject to a number of assumptions (see table notes) and also exclude costs relating to credit risk, operating costs, the costs of holding capital and liquidity costs. Nonetheless, the estimate does inform our understanding in a number of ways. First, it suggests that banks' cost of funds are significantly higher than using the December ECB base rate (1 per cent) or 3-month Euribor (1.36 per cent) alone would suggest. Intuitively, therefore, one might expect variable rates to be higher than tracker rates, which incorporate a typical margin of 1 to 1.3 per cent. Second, the range of cost estimates (0.65 per cent between lowest and highest) is narrower than the range of variable mortgage rates set by these institutions (1.95 per cent between lowest and highest). Hence, there may be merit in checking whether other factors, in addition to funding costs, help explain the divergence across institutions. In the empirical section below we incorporate what panel data there is on funding costs (Euribor and ELG fees) to test this relationship more formally.

We can also use the funding cost estimates to get a sense of how overall costs might respond to a hypothetical change in a particular element of funding. For example, suppose we reduce the cost of central bank funding by 0.25 per cent, while holding all other funding costs constant, the weighted average cost of banks funding falls by 0.06 per cent. In practice, the impact might vary depending on the rates banks offer on other elements of funding such as retail and corporate deposits. In other words, whether they also cut deposit rates in response to an ECB rate cut. The quantities of funding from each source are also likely to evolve over time. In particular, reliance on central bank funding is not a sustainable strategy for the future even if it is cheaper at present. Furthermore, the domestic banks are obliged to reduce their loan to deposit (LDR) ratios to 122.5 per cent by end 2013 as part of the Financial Measures Programme to help create a clean, appropriately-sized banking system and make market funding more attainable.

3 Pass through literature

The literature on interest rate pass-through can be categorised into two broad strands. The monetary policy perspective examines the functioning of the monetary transmission mechanism, and analyses the degree and speed at which the policy rates or money market rates (which are often assumed as the closest proxy for bank funding costs) are transmitted into lending and deposit rates. The industrial organisation (IO) perspective looks at banks' pricing of loans and deposits in proportion to their costs of funds. The IO framework incorporates bank characteristics, such as financial structure, and market features, such as competition, in the pass-through framework.

In a perfectly competitive financial system, banks set their retail rates equal to marginal costs

and any change in the marginal cost is passed on in its entirety to retail rates. However, a more likely depiction of marginal cost pricing model is that outlined by Rousseas (1985), whereby retail lending rates (r) are based on the cost of funds (mr) plus a mark-up (α_0), called an "interest rate spread" from which they make a profit:

$$r_t = \alpha_0 + \beta_1 mr_t + \beta_2 \mathbf{X}_t + \epsilon_t. \tag{1}$$

This outlines the long run relationship between market rates and retail rates with β_1 capturing the long run extent of pass-through. The matrix $\mathbf{X}$ captures other factors that may affect the variable interest rate setting behaviour by lenders, such as balance sheet structure and competitive pressures.

The inclusion of additional macro and micro variables in (1) usually motivated by the industrial organisation literature, can identify what factors drive overall pass-through and explain changes and differences in banks' price setting behaviour. For example, pass-through may be incomplete ($\beta_1 \neq 1$ in equation 1) due to a higher or lower interest rate elasticity of demand, depending on the frictions in the system. Switching costs associated with moving banks can reduce the elasticity of borrowers' demand (Klemperer, 1987). This factor may be particularly relevant to Ireland in the post-2008 period, when customers' ability to switch has been, arguably, curtailed by a combination of rapidly rising negative equity (Kennedy and McIndoe-Calder, 2011) and tightening credit standards (Kelly, 2011 and McCarthy and McQuinn, 2011). On the credit supply side, menu costs incurred from interest rate adjustments (Hofmann and Mizen, 2004) and credit rationing (Stiglitz and Weiss, 1981) can obstruct pass-through and interest rate margins are affected by money market volatility and banks' risk aversion (Ho and Saunder, 1981).

Putkuri (Finland, 2010), Cecchin (Switzerland, 2011), Gambocorta (Italy, 2004) and De Graeve et al. (Belgium, 2007) include factors such as banks' costs, competition, risk, capital, structural breaks, non-linearities (menu costs and switching costs) and asymmetric adjustment. To varying degrees, they all find a role for all of these factors in explaining pass-through. Most of these papers use panel data and find that pass-through can vary considerably across institutions, even after including a range of institution specific controls.

Raknerud et al. (2011) use a dynamic factor model to analyse the effect of banks' funding costs on retail rates in Norway. The results point to incomplete pass-through and that, when market funding costs increase, banks' net interest margins decreases. However, there is considerable heterogeneity between institutions, with those that have a large share of market financing more vulnerable to increases in the market rate. In an Irish context, Bredin et al. (2001) find evidence of incomplete

pass-through for lending rates, with a pass through coefficient of between 0.5-0.6).

4 Modelling variable mortgage rates

This section presents the results from an empirical analysis of interest rate pass-through for five lenders: Allied Irish Banks, Bank of Ireland, Educational Building Society, Permanent tsb and ICS Building Society. We first summarise the data used in the analysis; next, we present the results from a structural break analysis which tests for a break-down in the relationship between the variable rates and Euribor after 2008; finally, we look in more detail at the determinants of the variable interest rates in the post-2008 period.

4.1 Data

Table 5 summarises the data used in the modelling. The price lenders have to pay for their funding is a key variable of interest in the analysis. In the case of Ireland up to the end of 2008, lenders tended to use the ECB base rate or three-month Euribor as a benchmark for adjusting the pricing of variable rate mortgage. However, as the financial crisis deepened and uncertainty in money markets rose, Irish banks' access to the interbank market became very restricted, which would imply that money market prices no longer remained a very relevant measure to these banks. Two key factors that are likely to be driving the cost of funds in recent years are increases in deposit rates and the costs attributed to the ELG.

4.2 Structural break tests

In the first instance we test for a breakdown in the relationship between the variable rate and Euribor in or around the end of 2008. Table 6 shows the detailed results from bank-by-bank Bai-Perron structural break tests. The results, which are illustrated in Figure 8, confirm our prior that the long-run relationship broke down some time after the end of 2008. Based on this result, the econometric models of interest rate pass through are estimated separately for the period up to the end of 2008, and thereafter.

4.3 Error correction models

4.4 Variable rates up to 2008

Building on the existing literature on the determination of variable retail interest rates, we estimate a panel error correction model specified as follows:

$$\begin{aligned} \triangle r_{i,t} &= \lambda(r_{i,t-1} - \alpha_0 - \beta_1 E_{t-1} - \beta_2 \mathbf{X}_{t-1}) + \sum_{j=1}^{4} \theta_j \triangle r_{i,t-j} + \sum_{j=0}^{4} \eta_j \triangle E_{t-j} + \\ & \sum_{j=0}^{4} \gamma_j \triangle \mathbf{X}_{t-j} + \psi_1 D_1 + \psi_2 D_2 + \mu_t. \end{aligned} \tag{2}$$

Where E_t is the three-month Euribor rate and $\mathbf{X}$ is a (K x N) matrix of other explanatory factors, such as deposit rates, loan to deposit ratios, a Herfindahl index to measure market concentration, bank bond yields, money market spreads and additional fees. Some of the additional explanatory variables come to the fore in the post-2008 period where the relationship between variable rates and Euribor breaks down. The D_1 and D_2 variables are dummy variables designed to pick-up asymmetric adjustments in the deviations from the long-run relationship between the variable rate and Euribor and are defined as follows:

$$\begin{aligned} D_1 = 1 \quad & iff(r_{i,t-1} - \alpha_0 - \beta_1 E_{t-1} - \beta_2 \mathbf{X}_{t-1}) > C^+, \quad (= 0 \quad otherwise) \\ D_2 = 1 \quad & iff(r_{i,t-1} - \alpha_0 - \beta_1 E_{t-1} - \beta_2 \mathbf{X}_{t-1}) < C^-, \quad (= 0 \quad otherwise) \end{aligned}$$

We impose a value of +/-7.5 per cent for the threshold values C^+ and C^-. These values capture the adjustment costs associated with a rate change. They are particular to the Irish data and are selected to fit past behaviour of interest rate changes.[8] Of particular interest in the analysis will be whether the coefficients on these asymmetric-adjustment terms change significantly pre- and post-2008.

In the model β_1 is set equal to 0.61 for all banks, based on the results from an FM-OLS group estimate, the results of which are shown in the Table 6. This measure captures the typical pass-through rate that prevailed across banks and building societies until 2008Q4. The results from estimating the long-run and short-run regessions for equation 2 until the end of 2008 are shown

[8] Previous studies also select the thresholds to suit past behaviour of interest rates in their dataset. For instance, Sander and Kleimeier (2004) and and De Graeve et al. (2007) select the threshold that minimises the residual sum of squares or results in the maximum likelihood model.

in Table 7 and 8 respectively. The additional explanatory variables included in the regression are deposit rates and a measure of degree of competition in the market, the Herfindahl concentration index (HHI) shown in the right-hand side of Figure 9.

The coefficients all have the expected sign, and the long-run relationship between the variable rate and Euribor is confirmed in this model. As expected, increases in the deposit rate - one potential source of funding - increases the variable rate. We also observe strong competition effects, that is, the higher the level of concentration in the market, as measured by HHI, the higher the mortgage interest rate, controlling (as we do) for funding costs. None of the bank fixed-effects are significantly different from one-another in the long-run regression, and the fixed effects imply a mark-up of around 1.6 percentage points. [9]

The results from the long-run model are largely confirmed by the Panel ECM, although the HHI is no longer significant in the latter, and we, therefore, drop it from the estimation. For comparison with the post-2008 period, the coefficients on the asymmetric adjustment terms (ψ_1 and ψ_2) are of particular interest. We find that when variable rates are above the level indicated by the long-run relationship with Euribor, the adjustment downwards is slower ($\psi_1 > 0$). Conversely, when variable rates are below the level indicated by the long-run relationship with Euribor, the adjustment upwards is faster ($\psi_1 < 0$). This is a noteworthy result, particularly if one accepts that we have controlled adequately for funding costs, as it indicates some degree of pricing power on the part of lenders. However, the coefficients are not significantly different from one-another in absolute terms.

4.5 Variable rates post-2008

This section explores the reasons for the growing spread between the short-term interbank rates (Euribor) and variable rates in the post-2008 period. We add explanatory variables to the previous panel ECM, as suggested by the literature and the previous discussion on the domestic banks funding difficulties. The results from the long-run regression for the post-2008 period are shown in Table 9. The results from the panel ECM model are shown in Table 10.

We report the long-run results, both with and without the fixed effects (Table 9). The reason for this is that for the shorter time period certain variables of interest with little time variation, but some cross sectional variation can be correlated with the fixed effects. The main variable, which interacts with the fixed effects is the share of loan balances that are tracker and it is, therefore, excluded from the panel specification (columns 3 and 4, Table 9). In the specification without fixed effects (columns 1 and 2, Table 9) we find that some lenders with higher shares of tracker loans on

[9] This figure was obtained by running the regression in levels not logs (not shown).

their books have higher variable rates. This is intuitive if tracker loans are loss-making and profit opportunities exist in the variable rate segment. We do not find HHI to be significant in the second specification, although competition factors could be picked up indirectly by other controls, such as lenders' ability to profitably impose higher rates on variable rate customers.

In the post-2008 period, the pass-through rate from Euribor to variable rates falls to less than 0.30 per cent, consistent with the structural break tests. The post-2008 model includes ELG fees and the spread between the 3 month Euribor and the Euro Overnight Index average, or Eonia, which is the average rate that banks lend to each other overnight. The Euribor-Eonia spread captures financial market uncertainty and risk, which increases funding costs for banks. Figure 11 shows the development of this spread and the increases during times of high uncertainty. Both the ELG fee and the Euribor-Eonia spread capture increased funding costs over and above Euribor, and they are both positively correlated with variable rates. A word of caution in interpreting the actual size of the ELG fee coefficient, which at first glance appears small: the ELG fee is zero prior to 2010, and it is only after this point that it begins to increase significantly, hence the relatively small coefficient.

We include the arrears rate in the regression to control for additional credit risk costs. We find it is positively correlated with the variable rate. This result probably captures the fact that the higher levels of arrears are causing greater losses for banks and, so, institutions may try to generate more revenue from performing loans to compensate for these losses. This hypothesis is consistent with the view that a higher arrears rate is a driver of interest rate spreads. It is very possible that causality also runs in the opposite direction, with higher interest rates pushing home owners into arrears, as suggested in the analysis in Section 2.2.

Table 11 presents the results from a set of Granger causality tests, providing strong evidence that higher arrears do cause higher interest rates. While these results justify our inclusion of arrears as an explanatory variable for interest rates, they do not exclude the possibility that causality is bilateral. Further evidence is provided in Figure 10, which shows a cross-plot of the standard variable rate against the arrears rate for the 2009 to 2011 period. A cross-plot of variable rates and arrears for the earlier period up to the end of 2008 would actually show a similar pattern. However, when we include arrears in the long-run regression for the earlier period we find that it is insignificant, after controlling for direct measures of funding costs.

The general-to-specific modelling approach means that we tried a number of other variables in the sepcification, such as the swap curve and the spread between Euribor and the German treasury bill (TED Spread) that were not significant in the final specification. We also included Merrill Lynch bank bond indices to try to capture the more expensive term debt story but they were found to be insignificant. It may be that Irish banks were more or less locked out of term markets over that time.

We also tested for a relationship between loan-to-deposit ratios and variable rates, the hypothesis being that those banks with higher ratios will increase rates more. We observe a positive and significant relationship between variable rates and loan-to-deposit ratios in a bivariate specification. However, the inclusion of additional controls such as the arrears rate and ELG fees in the multivariate setting makes it insignificant and we, therefore, exclude it from the final specification.

We find positive and significant bank fixed effects in the period after the end of 2008, with mark-ups in the range of 1.42 per cent to 1.7 per cent. The inclusion of the arrears and the tracker rate in the second period picks up a significant amount of cross-sectional variation. When it is excluded, the average mark-up is 2.8 per cent. As before, the fixed mark-ups are all jointly significant (F=71.8, p-value=0.000). However, in contrast to the earlier period, we find that the fixed mark-up of one bank (E) is significantly higher than its peers, while for one other bank (A) it is significantly lower, even after controlling for funding costs and profit pressures.

With the exception of the ELG fee and Eonia spread, which we find to be consistently reliable predictors of the variable rate in the post-2008 period, the panel specification is almost identical to that for the earlier period. Relative to the earlier period, and in absolute terms, both asymmetric adjustment variables have increased. This means that, relative to the period up to the end of 2008, lenders are slower to reduce rates when they are above the long-run level implied by funding costs, but quicker to increase rates when they are below the long-run level. This could be a reflection of lenders' increasing pricing power in this period. Furthermore, the error correction term has increased in absolute value, indicating that lenders are perhaps more sensitive to the funding cost pressures implied by the long-run relationship.

5 Conclusion

This paper has assessed the implications of the financial crisis on the pass-through relationship between policy and market variable rates. The crisis has had a particularly acute impact on the Irish banking sector. Given its substantial reliance on international wholesale funding and the heavily concentrated nature of its lending, the Irish financial system was effectively confronted by a "perfect storm" in 2008 with a litany of adverse consequences.

We find that before the end of 2008 variable rates are explained by three factors: funding costs, a mark-up over funding costs and competitive pressures. The two measures of funding costs that best explain variable rates in this period are deposit rates and the Euribor rate, with a pass-through rate of approximately 0.6. There is no particular reason to expect a one-to-one pass through from the Euribor rate to variable interest rates, as a variety of factors such as operating costs, credit

risk, menu costs and other longer-term funding costs not directly captured in our model could also determine rates. To an extent, some of these factors will be captured by the individual effects in our model. One of the key findings from the analysis of variable rates up to the end of 2008 is that while these individual bank effects are jointly significant, they are not significantly different from one-another.

The main reason variable rates diverge from tracker rates after 2008 is that banks' funding costs and related pressure on variable rates are no longer captured by Euribor, whereas tracker rates continue to follow policy rates and the Euribor rate. For example, we find that crisis-related measures of funding costs, such as the ELG fee and Eonia spreads, are positively correlated with variable rates and, in the case of the ELG fee, can account for approximately a sixth of funding costs. As a rough guideline, we estimate average funding costs, including ELG fees, at 2.6 percent in December 2011. This compares with an average standard variable mortgage rate of around 3.9 percent in December. However, this estimate excludes a margin relating to credit risk, operating costs, the costs of holding capital and liquidity costs.

The analysis suggests costs relating to increased credit risk may be becoming an increasingly important factor in setting variable rates. Banks with higher arrears rates tend to exhibit higher variable mortgage rates. The second result from our analysis is that it appears that some lenders are charging higher variables rates to compensate for the losses they are making on their tracker loans, controlling for our estimates of funding costs. A risk with such a strategy is that it may be counter-productive and continue to exert upward pressure on arrears. We find that after controlling for these additional factors, most of the divergence between banks SVRs is explained.

References

[1] Bredin, D., T. Fitzpatrick and G. O'Reilly, 2001, Retail interest rate pass-through: the Irish experience, Central Bank of Ireland Technical Paper 06/RT/01, November.

[2] Cecchin I., 2011, Mortgage rate pass-through in Switzerland, Swiss National Bank Working Paper Series, 2011/08.

[3] De Graeve, F., O. De Jonghe and R. Vander Vennet, 2007, Competition, transmission and bank pricing policies: Evidence from Belgian loan and deposit markets, Journal of Banking and Finance, 31, 259-278.

[4] Eurosystem Monetary Policy Commitee Task Force, March 2009, Housing Finance in the Euro Area, ECB Occasional Paper Series No. 101.

[5] Gambacorta, L., 2004, How do banks set interest rates? NBER Working Paper Series No. 10295.

[6] Goggin, J., S. Holton, J. Kelly, R. Lydon and K. McQuinn, Variable Rates in the Irish Mortgage Market, Central Bank of Ireland Research Technical Paper Series, Forthcoming.

[7] Ho., T.S.Y. and A. Saunders, 1981, The determinants of bank interest margins: Theory and empirical evidence, Journal of Financail and Quantitative Analysis, 16(4) November.

[8] Hofmann, B. and P. Mizen, 2004, Interest rate pass-through and monetary transmission: Evidence from individual financial institutions' retail rates, Economica 71, 99-123.

[9] Kelly, R., Y. McCarthy and K. McQuinn, Impairment and Negative Equity in the Irish Mortgage Market, Central Bank of Ireland Research Technical Paper, 09/RT/11

[10] Kennedy G. and T. McIndoe Calder, 2011, The Irish Mortgage Market: Stylised Facts, Negative Equity and Arrears, Central Bank of Ireland Research Technical Paper, 12/RT/11

[11] Klemperer, P., 1987, Markets With Consumer Switching Costs, Quarterly Journal of Economics, 102(2), May 1987

[12] McQuinn, K, Smyth, D. and G. O'Reill (2009), Supply response in an uncertain market: Assessing future implications for activity levels in the Irish housing sector, European Journal of Housing Policy, Vol 9(3), pp.259-283.

[13] Pautkuri, H., 2010, Housing loan rate margins in Finland, Bank of Finland Research Discussion Papers 10/2010.

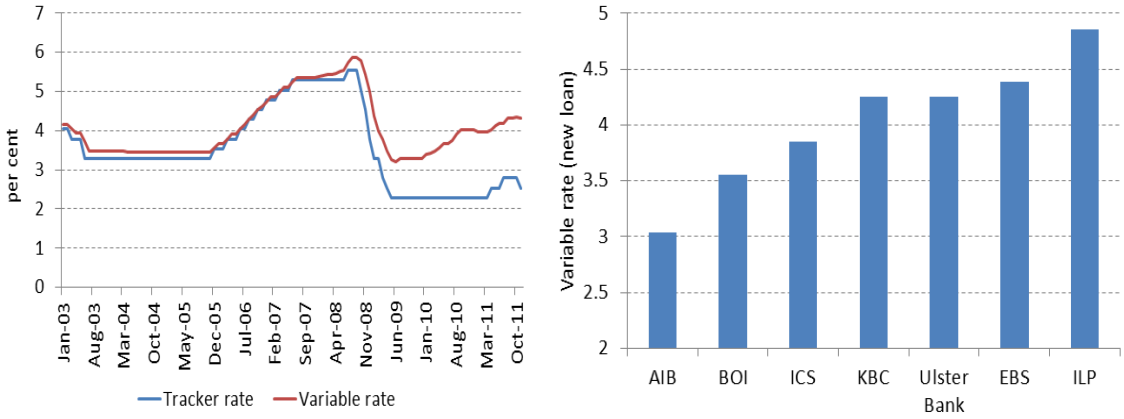
[14] Raknerud, A., B.H. Vatne and K. Rakkestad, 2011, How do banks funding costs affect interest margins? Norges Bank Working Paper, 2011/09.

[15] Rousseas, S., 1985, A markup theory of bank loan rates, Journal of Post Keynesian Economics, 8(1).

[16] Stiglitz J.E. and A. Weiss 1981, Credit Rationing in Markets with Imperfect Information, The American Economic Review, 71(3), 393-410.

6 Appendix

Figure 1: Trends in variable mortgae interest rates

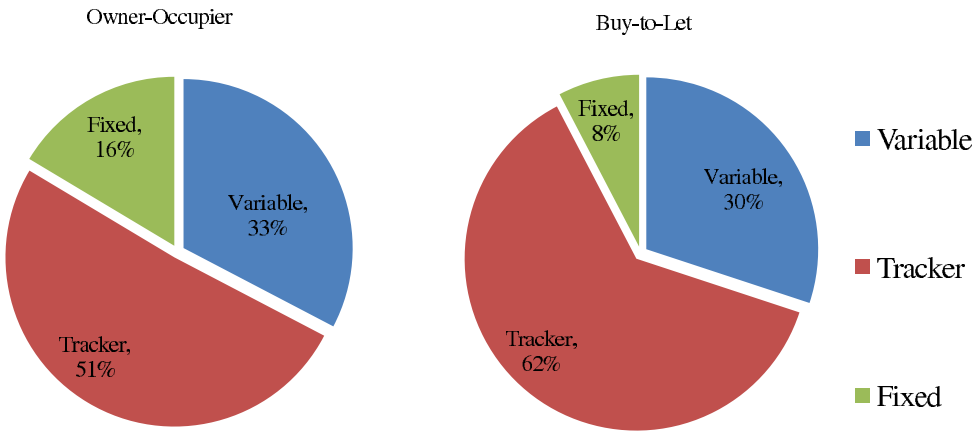


Source: Central Bank of Ireland(LHS)

www.nca.ie, www.permanenttsb.ie December 2011 (RHS)

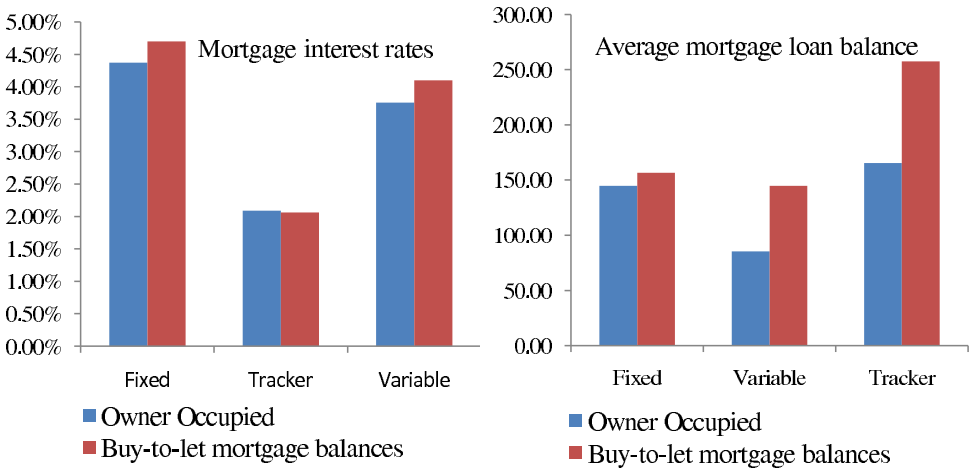
Notes: Rates are simple averages across institutions (LHS), Variable rate for new loan of €150,000, LTV 75%, 25 years. Variable rates for existing loans may be different, see for example http://www.askaboutmoney.com/showthread.php?t=159108 (RHS)

Figure 2: Interest rate type and share of balances



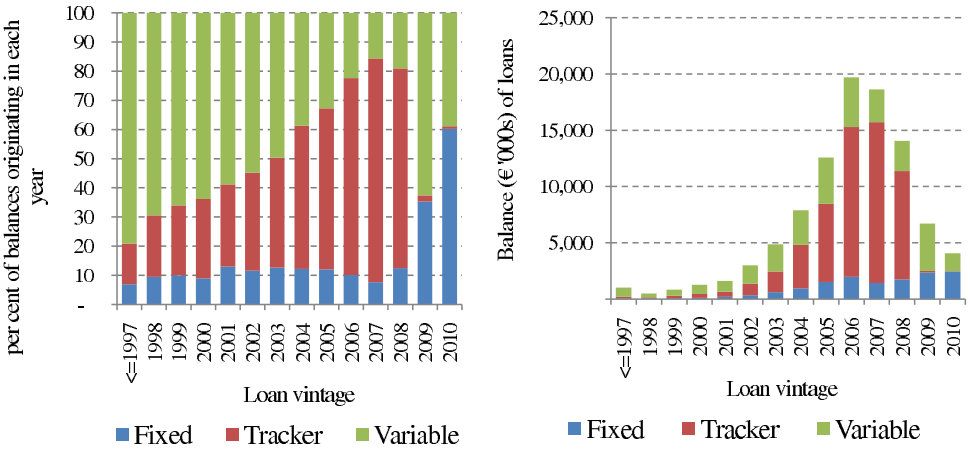
Source: Central Bank of Ireland, September 2011

Figure 3: Average interest rate by mortgage type and average balances



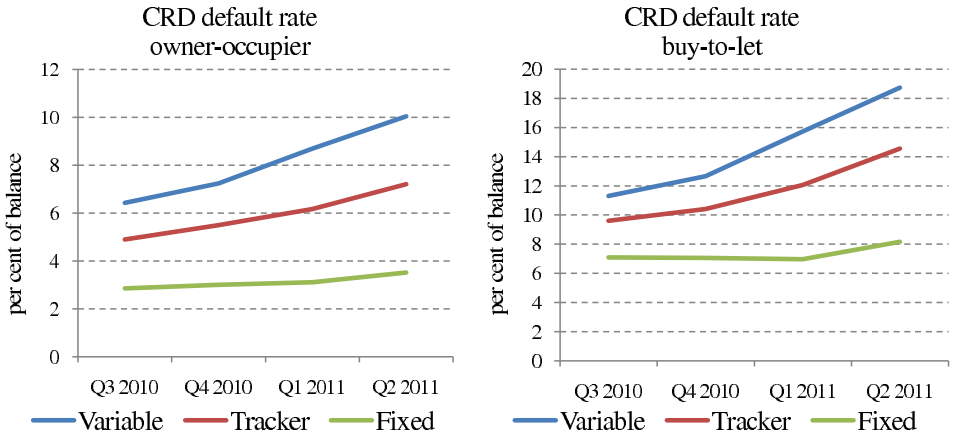
Source: Central Bank of Ireland, loan-level data December 2010

Figure 4: Current interest rate type by year of origination



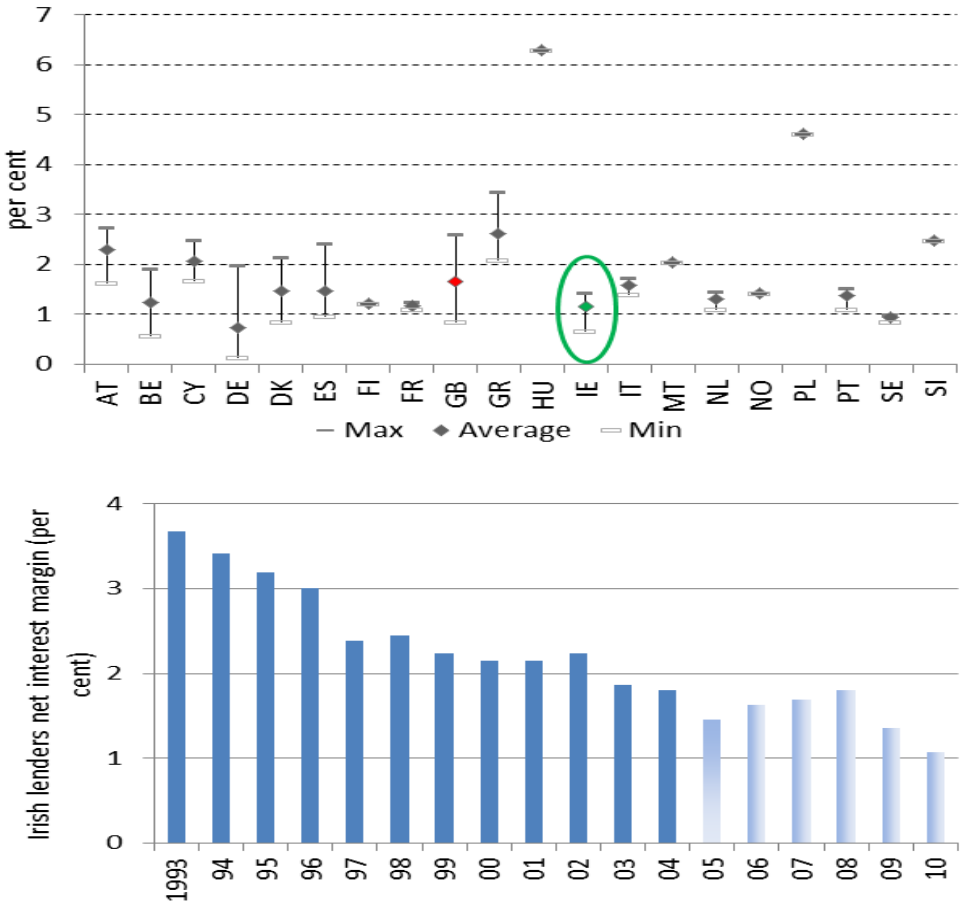
Source: Central Bank of Ireland, loan-level data December 2010

Figure 5: Mortgage distress and interest rate type



Source: Central Bank of Ireland, QFSR

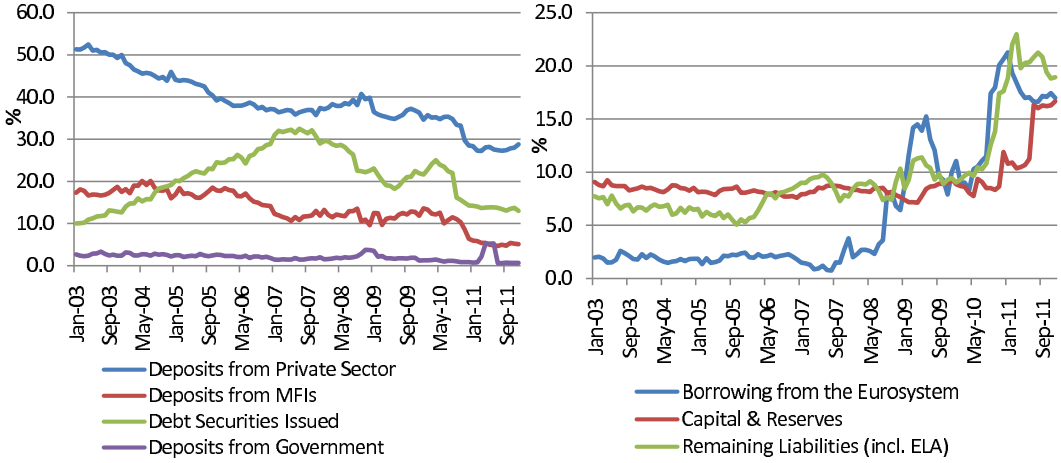
Figure 6: Irish Lenders' net interest margins



Source: EBA stress tests, December 2010 (top), Central Bank of Ireland (bottom)

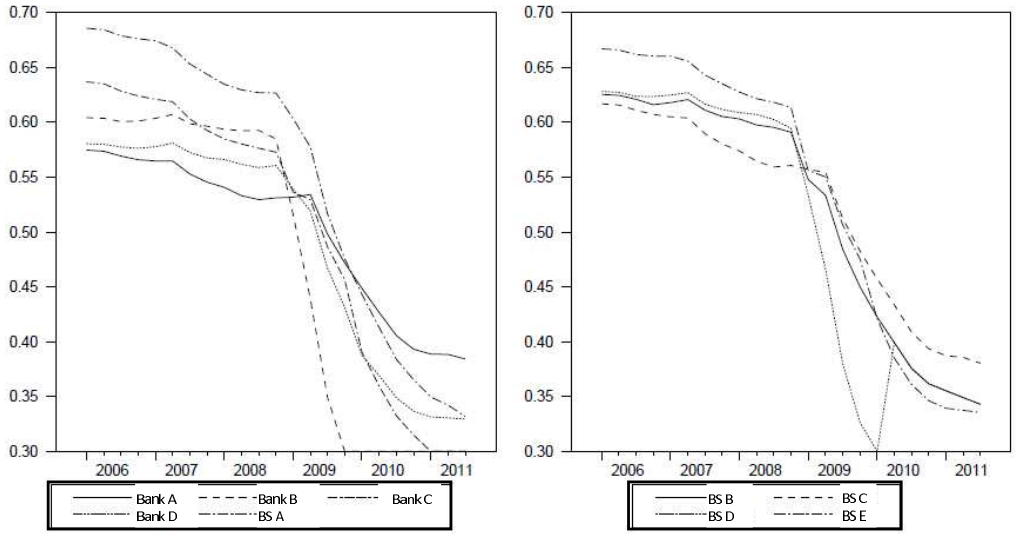
Note: Break in series from 2005 onwards (bottom)

Figure 7: Share of liability categories in total liabilities, domestic banks' aggregate balance sheet



Source: Central Bank of Ireland

Figure 8: Recursive estimates of the elasticity of variable rates to Euribor



Source: Central Bank of Ireland

Figure 9: ELG fee and Herfindahl index

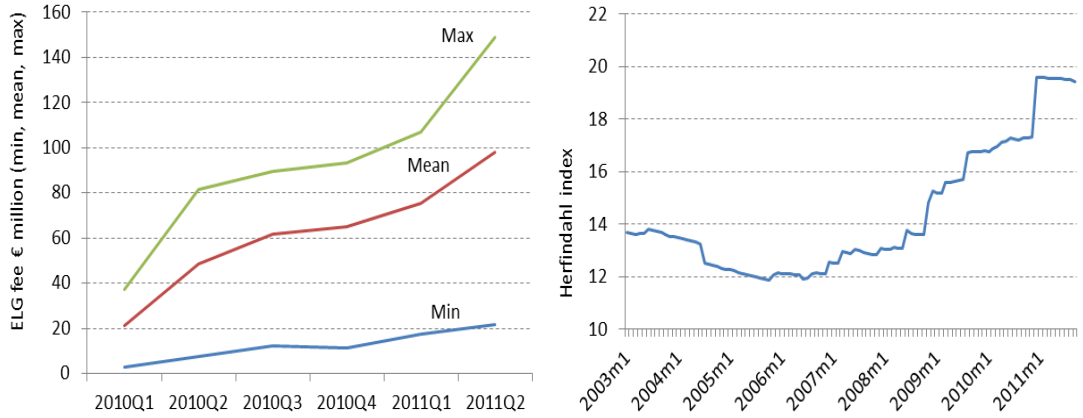
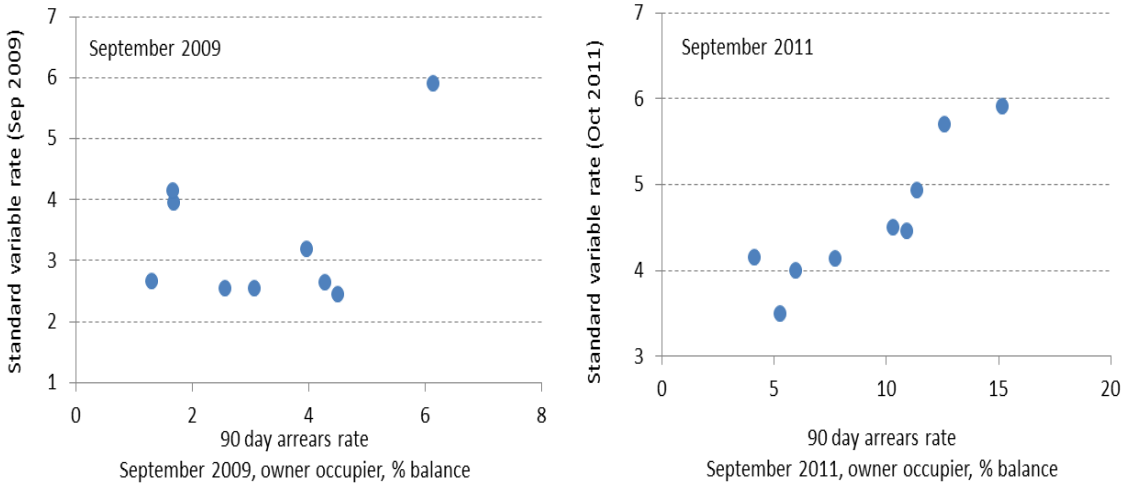
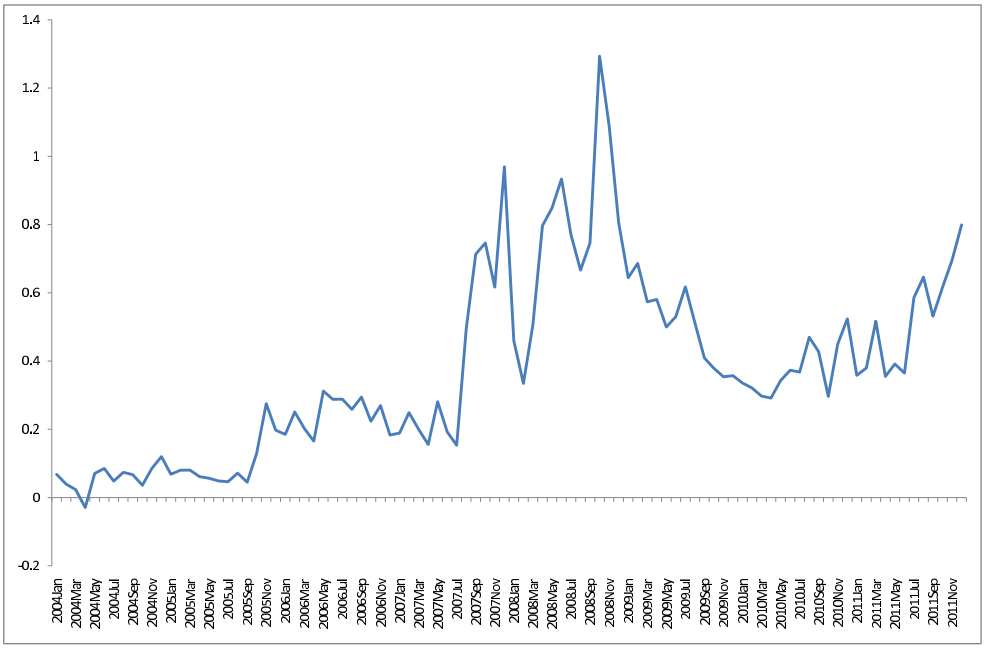


Figure 10: Cross plot of standard variable rates against arrears rate (2009m1- 2011m11)



Source: Central Bank of Ireland

Figure 11: Euribor-Eonia spread



Source: Central Bank of Ireland

Table 1: Interest Rates: Summary Statistics

Share of mortgage interest rate type (% balance)

	Owner-Occupier			Buy-to-Let		
	Mean	Min	Max	Mean	Min	Max
Variable	33	19	56	30	13	45
Tracker	51	22	62	62	49	85
Fixed	16	10	22	8	2	18

Range of interest rates (per cent) November 2011

	Owner-Occupier			Buy-to-Let		
	Mean	Min	Max	Mean	Min	Max
Variable	4.5	3.5	5.4	4.7	3.5	6.4
Tracker	2.3	2.1	2.6	2.3	2.2	2.3
Fixed	4.3	3.8	5.3	4.7	4.2	5.2

Source: Central Bank of Ireland, loan level data

Table 2: Probit Regression: Dependent variable equals 1 if loan is 90-plus days past due and zero otherwise

	Marginal effect	**t-statistic**
Interest Rate Type		
Fixed	Omitted	
Tracker	0.021	17.81
Variable	**0.041**	**30.41**
Current loan-to-value ratio	**Marginal effect**	**Z-statistic**
<50%	Omitted	
50-80%	0.024	17.44
80-90%	0.035	18.31
90-100%	0.042	22.51
100-110%	0.061	30.48
110-120%	0.083	36.73
120%+	0.112	57.97
Unemployment Change		
<2%	Omitted	
2% to 6%	0.012	15.59
6%+	0.025	19.76
Liquidity: Ratio mortgage payment to gross household income		
<20%	Omitted	
20-30%	0.004	5.30
30-40%	0.023	14.90
40-50%	0.043	12.33
50%+	0.047	12.34
Buyer Type		
Next-time buyer	Omitted	
First-time buyer	-0.021	-26.07
Buy-to-let	-0.001	-0.61
Bank		
A	Omitted	
B	0.025	20.88
C	0.037	26.06
D	0.039	33.32
Pseudo-R2 0.061, Obs. 319,212,	Observed Probability 0.052,	Predicted Probability 0.043

Source: Lydon and McCarthy (2011), data for December 2010 for the four FMP banks.

Table 3: Probit Regression: Dependent variable equals 1 if loan is 90-plus days past due and zero otherwise

	Model 1	Model 2	Model 3	Model 4	E[X]
Variable Rate (DV)	0.02	-0.05	-0.04	-0.02	0.59
	(24.78)	(-30.55)	(-23.9)	(-11.38)	
Log interest rate		0.12	0.12	0.08	-3.50
		(50.97)	(52.57)	(29.84)	
Log current balance			0.01	0.01	4.41
			(35.53)	(28.3)	
Log gross HH income at origination				0	10.92
				(-10.17)	
Original LTV				0.03	0.60
				(15.97)	
Log loan term				-0.01	5.60
				(-7.5)	
Have a BTL loan (dummy)				0.02	0.07
				(13.21)	

Source: Central Bank of Ireland. Model includes bank fixed effects

Table 4: High Level estimate of bank funding costs

	Billion	Average IR (per cent)
Total Retail Deposits	123.2	1.86
Total Corporate & NBFI Deposits	22.2	1.63
Certificates of Deposit	0.3	3.55
Total Long Term Debt Capital Markets		
Secured Borrowings	18.3	3.93
Unsecured Unguaranteed Borrowings	8.6	4.55
Unsecured Guaranteed Borrowings	17.0	4.18
Subordinated Debt	3.8	10.63
Repos and Other Secured Funding	14.9	3.54
Interbank	4.3	3.56
Central Bank	70.0	1.06
TOTAL FUNDING	282.5	
TOTAL COST OF FUNDING EX-ELG (b)	6.3	
TOTAL COST OF FUNDING EX-ELG (per cent)	2.2%	
Cost of ELG	0.4	
TOTAL COST OF FUNDING Incl. ELG, (per cent)	2.6%	

Source: Central Bank of Ireland, Bloomberg

Notes: FMP institutions only; average rates are simplified estimates across banks;

NBFI (Non-bank financial institution); ELG (Eligible liabilities Guarantee);

Debt capital market rates based on a sample of at issue yields from Bloomberg

Table 5: Data summary

Variable	Description
Standard variable rate, by lender	Lender standard variable rates (dependent variable).
EURIBOR	Monthly average three-month interbank offered rate.
Arrears rate (bank specific)	Percentage of owner-occupier balance 90plus days past due.
Loan-to-deposit ratio (bank specific)	All loans and deposits to/from Irish and other euro area households and NFCs, unconsolidated MFI data.
Deposit rate (bank specific)	Average deposit rate, share weighted by maturity, excluding overnight and redeemable at notice, unconsolidated MFI data.
Share of variable and tracker mortgages (bank-specific)	The share of the total loan book accounted for by tracker or variable rate mortgages in any given month.
HHI	Herfindahl Index constructed using monthly data on each lenders share of the stock of mortgage lending. A higher value indicates greater concentration
Other cost of funding measures	
Merrill Lynch bank bond index	Spread over benchmark government bonds.
Change in swap curve spread	3-12 months. Banks typically use this market as hedging and as a risk-free benchmark for pricing.
Euro Ted Spread	The EURIBOR minus German TBill spread, or the Euro Ted Spread is used to control for increased perceived counterparty risk during the crisis.
Euribor Eonia spread	3 month Euribor minus Eonia is used to control for increased perception of counterparty risk and increased costs of funding during the crisis.
Eligible liabilities Guarantee Fee (bank specific)	Actual amounts paid by institutions on a quarterly basis since January 2010.

Table 6: Coefficient on Euribor for different institutions by time period (logs)

Lender	Sample ends 2008Q4	Sample ends 2011Q3	Bai-Perron structural break tests
Average	0.411	0.114	2008Q3
Banks			
A	0.531	0.384	2009Q2
B	0.561	0.330	2009Q2
G	0.585	0.205	2008Q2
Building societies			
1	0.627	0.332	2009Q2
2	0.573	0.272	2009Q4
3	0.591	0.343	2008Q3
4	0.595	0.288	2008Q3
5	0.561	0.381	2009Q2
6	0.614	0.336	2009Q4

Source: Central Bank of Ireland

Table 7: Long-run model 2004m1-2008m12, Dependent variable is log of SVR

	Coefficient	t-statistic
HHI (concentration)	0.260	6.12
Deposit rates	0.060	2.99
Euribor	0.489	22.57
Bank A	0.133	1.22
Bank B	0.206	1.88
Bank C	0.139	1.30
Bank D	0.196	1.80
Bank E	0.196	1.82
Observations	300	
Sample	2004-2008	Monthly
R2	0.99	
Durbin-Watson Statistic	0.86	

Source: Central Bank of Ireland

Table 8: Panel ECM 2004m1-2008m12, Dependent variable is change in the log of SVR

	Coefficient	t-statistic
Error correction term	-0.318	-6.21
D_1	0.041	3.32
D_2	-0.060	-5.90
$\triangle SVR_{t-1}$	-0.175	-2.84
$\triangle SVR_{t-4}$	-0.105	-1.56
$\triangle SVR_{t-5}$	-0.124	-1.95
$\triangle Depositrate_{t-1}$	0.102	3.93
$\triangle Depositrate_t$	0.062	2.32
$\triangle Euribor_t$	0.355	11.91
$\triangle Euribor_{t-1}$	0.099	2.38
$\triangle Euribor_{t-5}$	0.168	3.69
Bank A	0.000	-0.13
Bank B	-0.001	-0.22
Bank C	-0.002	-0.76
Bank D	-0.001	-0.43
Bank E	0.001	0.28
Observations	295	
Sample	2004-2008	Monthly
R2	0.69	
Durbin-Watson Statistic	1.95	

Source: Central Bank of Ireland

Table 9: Long-run model 2009m1-2011m11, Dependent variable is log of SVR

	Coefficient	t-statistic	Coefficient	t-statistic
Deposit rate	0.107	5.38	-0.066	-1.66
Arrears rate	0.323	11.83	0.200	4.00
Share of tracker loans	0.264	5.19		
Euribor	0.230	8.45	0.289	10.45
Euribor-Eonia spread	0.109	3.58	0.068	2.05
ELG Fee	0.015	2.76	0.033	4.45
Bank A			1.422	11.02
Bank B			1.518	11.04
Bank C			1.554	13.35
Bank D			1.523	11.13
Bank E			1.692	14.16
Observations	150		150	
Sample	2009:1-2011:11		2009:1-2011:11	
R2, DW stat	0.78, 0.84		0.99, 0.89	

Source: Central Bank of Ireland

Table 10: Panel ECM 2009m1-2011m11, Dependent variable is change in the log of SVR

	Coefficient	t-statistic
Error correction term	-0.389	-6.677
D_1	0.066	3.580
D_2	-0.066	-5.085
$\triangle SVR_{t-1}$	-0.044	-0.698
$\triangle Arrears_t$	-0.256	-3.105
$\triangle ELGfee_t$	-0.006	-2.931
$\triangle ELGfee_{t-3}$	0.008	4.234
$\triangle ELGfee_{t-6}$	-0.004	-1.757
$\triangle Euribor - Eoniaspread_t$	0.082	3.984
$\triangle Euribor - Eoniaspread_{t-1}$	0.089	4.517
$\triangle Euribor - Eoniaspread_{t-2}$	0.096	4.390
$\triangle Euribor - Eoniaspread_{t-3}$	0.075	3.614
$\triangle Euribor - Eoniaspread_{t-5}$	0.047	2.801
$\triangle Euribor - Eoniaspread_{t-6}$	-0.070	-4.267
Bank A	0.107	7.315
Bank B	0.099	7.114
Bank C	0.098	7.480
Bank D	0.096	7.216
Bank E	0.041	3.802
Observations	145	
Sample	2009:1-2011:11	
R2 , DW stat	0.62, 2.26	

Source: Central Bank of Ireland

Table 11: Granger causality tests, null hypothesis that arrears do not Granger-cause interest rates, 2009m1-2011m11

	Lags	Wald statistic
Bank A	1	9.12***
Bank B	1	6.99**
Bank C	1	13.48***
Bank E	1	21.37***
Bank A	2	6.07***
Bank B	2	4.87**
Bank C	2	9.88***
Bank E	2	8.19***

Source: Central Bank of Ireland