Páipéar Taighde Teicniúil
Research Technical Paper

What Lies Beneath? Understanding Recent Trends in Irish Mortgage Arrears

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What Lies Beneath? Understanding Recent Trends in Irish Mortgage Arrears

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November 2011

Abstract

This paper presents a comprehensive analysis of Irish mortgage arrears using a new loan-level dataset which incorporates data from four Irish banks. We identify the main characteristics of accounts in arrears and examine the role of ability-to-pay and equity factors in the recent hike in mortgage delinquency rates. We find that borrowers who took out their mortgage for buy-to-let purposes, those with high loan-to-value ratios and those with high repayment burdens are all more likely to be in arrears. This is also the case for borrowers with properties in regions that have suffered more severe economic shocks, as proxied for by changes in the regional unemployment rate. Our empirical analysis suggests that affordability issues and general macroeconomic developments have had an important and sizeable effect on arrears trends over time, suggesting that policy efforts to target the growing level of mortgage arrears need to take account of these issues.

Non Technical Summary

The economic crisis that has engulfed the Irish economy in recent years has been associated with a marked deterioration in the Irish housing market and a sharp increase in mortgage arrears. By the end of June 2011, 7.2 percent of residential mortgage accounts were in arrears to the tune of 90 or more days; taking account of loans that have been restructured and arrears of less than 90 days puts this figure at almost 20 percent. In this paper, we explore the factors associated with the recent rapid rise in arrears in Ireland and present a comprehensive overview of the characteristics of accounts in difficulty.

We use a subset of a new loan-level dataset that was collected as part of the Central Bank of Ireland's March 2011 bank stress testing exercise for our study. We analyse the performance of over 420,000 mortgage loan accounts, accounting for approximately 50 percent of the stock of Irish mortgages outstanding at the end of 2010. For each loan account, a wide array of information is available that captures borrower and mortgage characteristics (usually at point of loan origination) and details on repayment behaviour throughout 2010. For a subset of borrowers with one bank we also have monthly data on individual loan performance back to mid-2008.

Our analysis points to higher arrears among borrowers who took out their mortgage for buy-to-let purposes, among those with high loan-to-value ratios or high repayment burdens and among those with properties in regions that have suffered severe economic shocks. Our empirical exercise suggests that affordability issues and general macroeconomic developments have had an important and sizeable effect on arrears trends over time.

In terms of future developments, we argue that while improvements in the macroeconomic environment will be important in helping to stall the rate of growth in arrears, reducing the build-up of arrears to date will take a significant amount of time and resources. The sizeable income shocks Irish borrowers have faced in recent years means that there is likely to be a large group of borrowers amongst those in deep arrears that are in a long-term unsustainable debt position - based on our sample of borrowers, we estimate that 40 percent of borrowers in 90-plus days arrears have been in that position for a year or more. Addressing the problems faced by these borrowers should be at the core of any strategy for reducing the pool of delinquent borrowers. This is likely to represent a significant challenge for policy makers and banks in the coming years.

1   Introduction

The economic crisis that has engulfed Ireland in recent years has severely impacted the Irish housing market. Falling incomes and rising unemployment have left many borrowers struggling to service outstanding mortgage debt. Figures from the Central Bank of Ireland (2011b) for the end of June 2011 show 7.2 percent of private residential mortgage accounts in arrears for 90 days or more. Including those loans that have had some form of restructuring plus loans in arrears of less than 90 days sees the figure rise to almost 20 percent, implying that almost one in five mortgage holders are facing, or have faced, some form of difficulty meeting their repayments. Identifying the appropriate response to this situation represents a significant challenge to both lenders and policy makers. Thus far, the approach to dealing with distressed borrowers has been mainly characterised by extensive and long periods of forbearance. In deciding how to address the problem in a more proactive manner, it will be important to have an understanding of the key drivers of mortgage arrears. The purpose of this paper is to contribute to this understanding by providing a detailed picture of borrowers in arrears and the factors associated with the evolution of mortgage arrears over time.

The primary data source that we use for our analysis includes a new loan-level dataset collected as part of the Central Bank of Ireland's March 2011 bank stress testing exercise. The sample of loans covers the four Irish banks included in the 2011 *Financial Measures Programme* (Central Bank of Ireland, 2011).[1] We analyse the performance of over 420,000 mortgage loans, accounting for approximately 50 percent of the stock of Irish mortgages outstanding at the end of 2010. For each loan account, a wide array of information is available that captures borrower and mortgage characteristics (usually at point of loan origination) and details on repayment behaviour throughout 2010. For a subset of borrowers with one bank we also have monthly data on individual loan performance back to mid-2008 for a sample of 125,000 loans. Recent papers by Kelly (2011) and Kennedy and McIndoe Calder (2011) use the same data source to analyse the Irish mortgage market. The sample of loans used in this paper represents a sub-set of the full loan book, in particular we have selected loans where accurate information on gross household income at loan origination was provided.

The existing international literature provides some guidance on the causes of mortgage arrears, suggesting that "ability-to-pay" and "equity" factors are both important. A borrower's ability-to-pay their mortgage can be affected by either income or payment shocks. Payment shocks can arise due to changes in interest rates - a particularly relevant factor for the Irish market where the majority of borrowers are on some form of variable interest rate - or changes in the mortgage contract. The equity-theory posits negative equity as the key driver of default or arrears. Negative equity can affect borrowers in two ways. First, it can prevent borrowers who have experienced income shocks from trading out of their difficulties, either by re-mortgaging or trading down. Second, some negative equity borrowers may be incentivised to default when the financial gains of defaulting outweigh the costs of continuing to service the mortgage, thus treating the mortgage as an option. Given the prominence of the US mortgage crisis, there is an extensive recent literature on the drivers of

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[1]The four banks are: Allied Irish Bank, Bank of Ireland, Irish Life and Permanent and the Educational Building Society (EBS).

mortgage default for prime and sub-prime borrowers, see for example Gerardi *et al.* (2008) and Foote *et al.* (2008). Aron and Muellbauer (2010) provide a comprehensive analysis for the UK and also include a detailed typology of UK empirical studies on mortgage arrears and repossessions. As to which of the two effects is most important, the general consensus is that it is some combination of the two factors that act as a "double-trigger" for mortgage default. In some cases it is argued that the equity effect dominates, except when negative equity is at a low level. Bhutta et al (2010) argue that when negative equity is above -10 percent among their sample of U.S. non-prime borrowers, liquidity shocks and life events drive default. On the other hand, they also find that when a borrower has significant negative equity (greater than -50 percent) the equity effect dominates.

From a policy perspective, it is vital to understand if ability-to-pay, equity factors, or some mix of both drive mortgage arrears since policies to alleviate distress will differ depending on the relative importance of both factors. If it is the case, for example, that unemployment related income loss is the primary cause of the escalation in mortgage arrears, then the appropriate policy response might include measures which help to alleviate temporary shortfalls in income. On the other hand, if negative equity is a key factor determining mortgage arrears, then a policy response will have to take this into account.

In this paper, we adopt a dual approach to analysing mortgage arrears and assessing the impact of ability-to-pay and equity factors on recent arrears trends: first, we exploit the four bank loan-level dataset, draw out key descriptive statistics from our data and undertake a static regression analysis for December 2010. The idea here is to enhance our understanding of the types of borrowers who are in difficulties and to quantify the importance of the various factors that impact mortgage arrears in the Irish case. As a second step, we narrow our focus to the subset of the loan-level data for which we have a long time series of data. We undertake a dynamic regression analysis, drawing lessons from the first step on which variables are quantitatively and economically important for the Irish case. The analysis in the second stage is at a portfolio and regional level, comparing trends in loan performance with trends in key macroeconomic factors, such as unemployment, house prices (through loan-to-value ratios) and rental rates. In both cases our results suggest that affordability issues and general macroeconomic developments had an important and sizeable effect on recent trends in Irish mortgage arrears. For the buy-to-let market, there is some evidence to suggest that equity factors are also important.

The rest of this paper is structured as follows: In the next section we describe the data. Section 3 follows with an overview of recent trends in Irish mortgage arrears and presents information on the borrower and mortgage characteristics of those in arrears. In Section 4 we model mortgage arrears and identify the key factors related to the recent hike in mortgage delinquency rates in Ireland. Finally, in Section 5, we conclude.

2

2 Data and Descriptive Statistics

The dataset used in this paper was collected as part of the March 2011 stress-testing exercise undertaken by the Central Bank of Ireland to assess the potential capital requirements of the Irish banks under various stress scenarios.[2] The dataset contains a snapshot of loan-level information for the entire residential mortgage books outstanding at the end of December 2010 for four Irish banks. A wide array of information is captured for each loan in our dataset, including for example, information on repayment performance over at least the 13 months to the end of December 2010 (for three of the banks), information on borrower, property and mortgage characteristics (usually from the point of loan origination) and information on the current outstanding balance and current repayment terms applying to each loan.[3]

We have data for 421,890 loans, secured against 323,388 properties. We identify the "primary loan" for each property as the original mortgage loan. The additional 98,502 loans are equity release loans. Table 1 shows a breakdown of our sample by year of loan origination. The third column shows that the largest number of primary loans (just over 70,000) was extended in 2006, when house prices were close to their peak.

For the static analysis of mortgage arrears that follows, we focus on loan accounts at the *total property level*, a sample size of 323,388. This means that we aggregate up all outstanding balances and arrears amounts on all loans secured on the same property to arrive at *total property debt* and *total property arrears* figures. We do this so that we can get an accurate picture of the current loan-to-value ratio (or equity position) faced by a borrower for an individual property. If we instead undertook our analysis at the individual loan level, then we would substantially under-estimate the current loan-to-value ratio on loans which were taken out as an equity release. For each property level account we take the initial borrower and mortgage characteristics attached to the primary loan. We also augment the loan-level data with information on yearly changes in county level unemployment rates, so that local economic trends can be incorporated into our analysis of mortgage arrears. The county level unemployment data are from the Central Statistics Office. Table 2 compares the balance and arrears rates among our loan sample with the population of loans that were outstanding at the end of 2010.

The outcome variable of interest in our study is whether or not a borrower is at least 90 days in arrears at a point in time. Since our analysis of mortgage arrears is conducted at the total property level, this means that a loan is deemed to be at least 90 days in arrears when the ratio of the *total property arrears balance* to the *total property monthly repayment* is greater than or equal to three.

2.1 Creation of Additional Variables

We use the current loan-to-value (LTV) ratio to capture how equity factors affect mortgage arrears while we use a mortgage-repayment-to-income (MRTI) measure and changes in local unemployment

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[2]Full details of the stress testing exercise and the loan level data are provided in The Financial Measures Programme Report, available for download from www.centralbank.ie.

[3]A detailed description of the loan-level dataset is available in Kennedy and McIndoe Calder (2011).

rates to capture the impact of ability-to-pay factors. The calculation of the LTV ratio and the MRTI ratio is discussed below.

2.1.1 Loan-to-Value Ratio

To capture housing equity for each property in our sample we need two pieces of information: the current value of the property and the loan outstanding on the property. In terms of the latter, we add up the current balance outstanding on all loans secured on the same property to derive a total property debt figure. In terms of the former, our dataset includes the value of the house for which the original mortgage was taken out as well as the valuation date. We calculate the value of the property (P) at time (t) as follows:

$$P_t = P_0 \times \frac{\overline{P}_t}{\overline{P}_0} \tag{1}$$

where P_0 is the value of the property at the time of loan origination, and $\frac{\overline{P}_t}{\overline{P}_0}$ is the change in the average value of 'similar' properties between $t=0$ and $t=t$.

We use the CSO property price index to calculate the change in house prices over time. We match 'similar' properties on the basis of region (Dublin and non-Dublin) and type (house, apartment, other). The CSO index only goes back to 2003. Prior to 2003 we use the ptsb/ESRI house price index, which has a similar geographic breakdown, but not a similar breakdown by property type. We therefore apply the ptsb/ESRI price index changes to all house-types. Our loan-to-value ratio is then calculated as follows:

$$LTV_t = \frac{Debt_t}{P_t} \tag{2}$$

We plot the annual change in house prices according to both the CSO and ptsb/ESRI house prices indices in Figure 1. In Figure 2 we show the distribution of housing equity across our sample, as at end December 2010. About 65 percent of our sample has positive equity in their properties, as indicated by a current loan-to-value ratio of 100 or less. Another 18 percent of our sample is in negative equity which accounts for up to 20 percent of the value of the underlying property (captured by those with a current loan-to-value ratio of between 100 and 120). The majority of the remaining portion of our sample has negative equity somewhere in the region of 20 to 40 percent. Kennedy and McIndoe Calder (2011) provide a detailed description of the negative equity situation as at end-2010.

2.1.2 The Mortgage Repayment-to-Income Ratio

The mortgage repayment-to-income ratio (MRTI) captures the share of a borrower's income that is committed to paying interest and principal on its mortgage debt and therefore provides a valuable

insight into the ability of a household to service its mortgage. To calculate the ratio, we need information on the total mortgage repayment facing a borrower - this is already available in our dataset. We also need information on the current income of a borrower. A weakness of our loan level dataset is that it only incorporates information on *gross household income at the time of loan origination*. In the absence of an alternative, we use this as a proxy for a borrower's current income. More specifically, we update income at origination to 2010 levels using information on how average household incomes have changed since the time when a borrower's loan was originated:

$$Y_{2010} = Y_0 \times \frac{\overline{Y}_{2010}}{\overline{Y}_0} \tag{3}$$

where Y_{2010} is the estimated borrower gross income in 2010; Y_0 is the reported borrower gross income at point of loan origination; and $\frac{Y_{2010}}{Y_0}$ is the change in average incomes between $t=0$ and $t=2010$.

To estimate the latter term in equation (3) - the change in a borrower's income since loan origination - we refer to the Survey on Income and Living Conditions (SILC) which captures developments in household incomes in Ireland. The latest available survey is for 2009, while the survey has only been undertaken on a full year basis since 2004. To arrive at an estimate for 2010, we apply the percentage change in gross national income (from the National Income and Expenditure Accounts - at current market prices) between 2009 and 2010 to all borrowers' estimated 2009 income. Table 3 reports the annual average change in household income for each year from 2004 to 2010 that we apply to our data.

We calculate our MRTI ratio for each property-level account. Figure 3 shows the distribution of the MRTI ratio across our sample. Roughly 60 percent of our sample had an MRTI ratio of up to 20 percent; a further 20 percent of our sample had a mortgage repayment which consumed between 20 and 25 percent of gross borrower income. Of the remaining 20 percent of our sample, most faced an MRTI ratio of between 25 and 35 percent of gross borrower income.[4] A weakness in our MRTI measure is that measurement error in income is likely to be positively correlated with our dependent variable. This is because borrowers that have experienced significant income shocks, such as unemployment, and are not captured by our "average-changes" approach, are also, *a priori*, more likely to be in arrears. We believe that the MRTI variable should more appropriately be viewed as capturing borrower credit quality characteristics at origination, rather than actually measuring the *current repayment burden*. This is less of an issue for our regional portfolio approach, as discussed later.

2.2   Overview of Dataset

Table 4 provides an overview of borrower and mortgage characteristics by year of loan origination of the primary loan. The first three rows show the proportion of accounts that recorded any (row 1),

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[4]Note that the MRTI ratio reports mortgage repayments as a proportion of *gross* borrower income. For this reason, the figures are not directly comparable to those presented in previous studies which have looked at the distribution of the MRTI (measured using *net* income) among mortgaged Irish households (Kelly et al (2011) for example).

60-90 days (row 2) or 90 days or more arrears (row 3) during December 2010. Whilst 12.5 percent of accounts were in arrears in December 2010, many of these accounts recorded a low level of arrears; only 5.2 percent of accounts had arrears which equalled 90 or more days worth of payments.[5] In all three cases, the arrears rate was highest for loans originating in 2007, when house prices were close to their peak.

As house prices increased up to 2007, so did the average mortgage size, which peaked at €256,000 in 2007 (row 4). By 2010, the average mortgage, at €185,000, had fallen back to levels last seen in 2004. Loans originating in 2007 also have the highest level of outstanding balance at end-2010, at €242,000. This figure takes account of equity releases or other top-up loans against the property that were taken out since the property was purchased. Given all of the above, it is unsurprising that we find that loans originating in 2007 also have the highest average current LTV, at almost 87 percent (row 7). For comparison, the average LTV for loans originating in 2010, albeit a smaller number of transactions, is 64.7 percent.

Gross household income averaged €75,000 at the point of loan origination for the borrowers in our sample, while the highest reported income was recorded for loans originated in 2008 (at €80,000) (row 9). Interestingly, the average loan-to-income ratio for all borrowers is 3.0, whereas for the peak year of the boom (2007) the ratio was 3.2 (row 4/row 9). Over our sample for 2004-2010, we estimate that borrower income at the end of 2010 averaged €74,000 (row 10). Only loans originated over the period 2007-2009 are estimated to be associated with lower borrower income at the end of 2010 relative to when the loans were originated. The mortgage repayment-to-income ratio is estimated to average 18.9 in our sample, implying that the average borrower faces mortgage repayments that consume almost one fifth of that borrower's gross income.

In rows 12 to 14 we present a breakdown of the primary mortgages by buyer type.[6] First time buyers account for almost 40 percent of the number of primary mortgages outstanding at end-2010, while 15 per cent of mortgages are accounted for by 'buy-to-let' borrowers. The remaining loans are accounted for by 'next-time buyers' (trade-up and trade-down) and other categories. It is interesting to note that the share of first time buyers increased substantially among loans originating in 2010 while the share of buy-to-let borrowers fell by a sizeable amount. Rows 15 to 17 provide a breakdown of interest rate types by year of origination. At the end of 2010, 17.9 percent of the primary loans in our sample were fixed rate mortgages, 30 percent were variable rate mortgages and the remaining 52 percent were tracker mortgages. These average figures disguise the rapid rise and fall of tracker loans, peaking at 74 percent of loans originating in 2007 and falling to practically zero by 2010.

The final rows in Table 4 show the geographic breakdown of the primary loan sample using the NUTS III regional breakdown used by the CSO for reporting quarterly unemployment figures (see Table 5 for the definition of the NUTS III categories). Dublin accounted for the largest proportion of primary mortgages in our sample, at 26 percent. The South-West (Kerry and Cork) accounted for the second largest proportion, at almost 15 percent, while the Mid-East (Kildare, Meath and

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[5]Note: this arrears rate is based on property level payments and debts. Some properties will have multiple loans where some, but not all, loans are in (90+ days) arrears.

[6]Note that some degree of judgement was required to allocate buyer categories to some loans.

Wicklow), accounting for slightly under 13 percent of primary mortgages, ranked third.

3 What do we know about Irish mortgage arrears?

This section addresses two questions: (1) How have mortgage arrears evolved over time; and (2) What does the loan-level data tell us about accounts that were in arrears at the end of 2010? The answers to both of these questions will inform our modelling approach later in the paper.

3.1 Trends in Mortgage Arrears

Figure 4 shows the evolution of mortgage arrears between January 2004 and December 2010 for loans secured on primary dwelling households ("PDH") alongside the unemployment rate and current loan to value (LTV) ratios.[7] The bottom panel shows annual changes in arrears and unemployment rates. Mortgages secured against PDHs include loans for first-time buyers, next-time buyers (trade-up/-down) and equity release. The charts show that mortgage arrears increased significantly over time in line with the marked deterioration in the Irish economy. From an extremely low level in 2004 - in fact, close to zero - arrears increased slowly at first from 2007 onwards, and began to take-off with the rapid increase in unemployment from early 2008 onwards. Arrears, unemployment and LTVs have all been moving in broadly the same direction in the last number of years, with the trend in the latter driven primarily by the collapse in house prices (a trend that has continued into 2011).

Figure 5 shows the evolution of mortgage arrears for buy-to-let/residential investment property loans ("BTL"). From a very small share of the market in the early part of the decade, this "small" investor segment increased rapidly during the period of the housing boom, and accounted for around one-fifth of the total stock of outstanding mortgage balances by the end of 2010. The top panel in Figure 5 shows the actual arrears rate alongside unemployment and LTV trends, and the bottom panel shows the annual changes. As with loans secured against primary dwelling households, the trends all move in a very similar direction. Comparing the BTL and PDH arrears trends, one observation worth noting is the difference in the relationship between arrears and unemployment: relative to PDH loans, the arrears rate for BTL loans responds much more quickly to changes in unemployment. The difference could arise for a number of reasons, not least the fact that relative to PDH borrowers, BTL borrowers may have lower incentives to keep up payments on a property that they are not actually living in.

3.2 Overview of Borrower and Loan Characteristics (December 2010)

We showed earlier in Table 4 that 5.2 percent of property level accounts were in arrears to the tune of 90 or more days at the end of December 2010. The outstanding balance on these accounts at the end of December 2010 was €4.5 billion, while outstanding arrears amounted to €0.25 billion.

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[7]The aggregate trends in this section rely on bank-specific portfolio information for the four banks. We have aggregated this using the relative stock of debt in each bank/portfolio as weights.

Figure 6 shows how the aggregate arrears figure (of 90+ days past due) breaks down by year of loan origination, geographic location, buyer type and equity position. The largest proportion of accounts in arrears was originated in the years 2006 - 2007, accounting for over half of all accounts in such a condition. In terms of the geographic spread of arrears, loans that were secured on properties in Dublin account for the largest proportion of arrears, at 21 per cent, with loans originating on properties located in the Mid-East and Border regions ranking joint second (each accounting for 15 percent of the total). The bottom left panel of Figure 6 shows how arrears are distributed among the various buyer types. Loans taken out by first time buyers account for almost a third of the number of accounts in arrears at the end of December 2010 while BTL loans account for a quarter. The chart in the bottom-right panel shows the current loan-to-value (CLTV) ratio of accounts in 90+ days past due (DPD) arrears. Just under half of the accounts that were in arrears for 90 or more days at the end of December 2010 were in a position of positive equity (a CLTV ratio of less than or equal to 100 percent) while just over half were in a position of negative equity (a CLTV ratio of over 100 percent).

Figure 7 shows the outstanding balance on accounts in arrears for 90 or more days. The first chart shows the current outstanding balance (left vertical axis) on accounts by year of origination and geographic location as well as the proportion of the outstanding balance that is in arrears (right vertical axis). Previously we showed how accounts originating in 2006 and 2007 make up almost half of the number of accounts in arrears at the end of December 2010. Here we can see that pattern is similar when we examine the current balance on accounts in arrears. For those accounts originating in 2006, the outstanding balance on these accounts at the end of December 2010 was €1.27 billion while the outstanding balance on accounts originating in 2007 was €1.4 billion, so that over 55 percent of the outstanding balance on all accounts in arrears at the end of December 2010 comprised accounts originating in 2006 and 2007. Arrears on these accounts amount to between 5 and 6 percent of the outstanding balance on these accounts.

The geographic trends are also similar to those presented in Figure 6. Accounts secured on properties based in the Dublin region make up the largest portion of the outstanding balance on accounts in arrears (at €1.3 billion or almost 30 percent of the total over the entire sample). The Mid-East category accounts for 15 percent (€700 million) of the outstanding balance on accounts in arrears at the end of December 2010, while the Border category accounts for a further 12 percent (€560 million).

The second chart in Figure 7 shows the current balance outstanding by buyer type. First-time-buyers who had accounts that were in arrears for 90 or more days at the end of December 2010 made up 30 percent of the total outstanding balance on accounts in arrears over the entire sample, though this figure fluctuates slightly when we examine the breakdown in individual years. Buy-to-let customers account for a further 28 percent over the entire sample, while the remaining 42 percent is made up of other buyer types.

The final chart in Figure 7 shows the breakdown of the outstanding balance on accounts in arrears by the equity position of the borrower. Again the picture is similar to the one presented earlier in Figure 6. Over the entire sample, 55 percent of the outstanding balance on accounts in

arrears is made up of loans secured on properties that were in negative equity at the end of 2010. This effect is most pronounced for loans originated in 2006 or 2007, when house prices were at or close to their peak.

In summary, the analysis so far highlights a number of key points which need to be taken into account in our empirical analysis: Firstly, there appears to be a strong association between recent trends in arrears and developments in the rate of unemployment. This effect is most pronounced for buy-to-let customers, but it also exists for borrowers who took out a mortgage to purchase their principal private dwelling. Secondly, current loan-to-value ratios also appear to be related to mortgage arrears; both series moved in tandem in recent years, while many of the people who were in arrears at the end of 2010 were in a position of negative equity. Finally, there are differences across borrower types and year of origination in terms of the intensity of arrears.

4 Empirical Approach and Model Results

As discussed in the Introduction, our empirical approach is twofold. As a first step, we pool the data for our four banks and undertake a static probit analysis for December 2010. The purpose of this step is to identify and quantify the importance of the various factors that impact mortgage arrears in the Irish case at a point in time. As a second step, we narrow our focus to those borrowers for whom we have a longer time series of data (monthly June 2008 to Dec 2010) and we undertake a dynamic panel data analysis. For the panel data analysis we aggregate our individual loan observations to a portfolio-regional level so that we can incorporate additional key macroeconomic factors, such as unemployment and house price changes (through LTVs) into the analysis. Our results suggest that affordability issues and general macroeconomic developments have had an important and sizeable effect on recent trends in Irish mortgage arrears. Equity considerations, as captured by the LTV ratio, also appear to have an impact, although our data do not allow us to differentiate this result being a reflection of general macroeconomic trends as opposed to genuine "equity" effects.

4.1 Four Bank Static Analysis

The independent variables used at this stage of our analysis are described in Table 6. Drawing on the existing literature on mortgage delinquency, we assess the impact of negative equity and liquidity factors on the incidence of mortgage arrears in December 2010. The results of our probit regression are shown in Table 7 where we report the marginal effects and associated standard errors for our model parameters.

Turning first to the variables capturing housing equity, it is interesting to note that the marginal effects on the loan-to-value ratio are significant and monotonic, suggesting that greater levels of negative equity are associated with an increasing probability of arrears. For example, going from a current loan-to-value ratio of below 50 percent to one between 110 and 120 percent increases the probability of going into arrears by 8 percent, while going to a current loan-to-value ratio of over 120 percent increases the probability by 11 percent.

Much like the LTV, our measure of MRTI (based on updated income from point of loan origination) enters the regression in a piece-wise fashion. The coefficients on the MRTI variables are positive, significant and monotonically increasing in MRTI. This suggests that ability-to-pay factors are also important determinants of mortgage arrears, even after controlling for negative equity. Relative to borrowers with a low MRTI (<0.20), we find that borrowers with a high MRTI are more likely to be in arrears, with a marginal impact of as high as 5 percent for borrowers with an MRTI greater than 0.50. These results are consistent with the "double-trigger" hypothesis of mortgage delinquency, which argues that both negative equity and liquidity considerations are important determinants of arrears.

Turning to the unemployment dummy variables, the coefficients on these variables are positive and significant. To the extent that changes in local unemployment rates reflect the impact of macroeconomic shocks on the ability or willingness of a borrower to repay his mortgage, the results suggest that the greater the shock, the larger the impact on the probability of a borrower going into arrears on his mortgage.

Our results also support the hypothesis that, controlling for other factors such as LTV and repayment burden, borrower characteristics are important determinants of mortgage repayment difficulties. The coefficients on our "buyer-type" variables suggest that first-time buyers are less likely than other borrowers to go into arrears on their mortgage while those borrowers who took out a mortgage for buy-to-let purposes are more likely to go into arrears than individuals with a mortgage on their principal private residence, albeit this marginal effect is relatively small. This result is interesting and it highlights the need for additional borrower level information in understanding what drives mortgage repayment behaviour. On the one hand, it may be the case that owner occupiers simply have other resources from which to meet mortgage repayments (savings, family, etc.) while non-owner occupiers do not. On the other hand, the results could be picking up differences in repayment incentives among the alternative borrower types. Ultimately, any policy response to address mortgage repayment difficulties would need to be based on a thorough exploration of this issue.

Finally, the bank dummy variables suggest that the probability of arrears differs across the banks included in our sample. However, it is very difficult to identify the reasons for these differences with our current dataset. The differences across banks could, for example, be due to a varying treatment of customers in financial difficulties. It could also be the case that there are differences in the profile of mortgagees.

4.2   Dynamic Panel Data Analysis

As a next step in our analysis, we model loan delinquency at the portfolio-regional level. The macro panel data is constructed by aggregating-up the subset of monthly data we have on loan performance data dating back to mid-2008. By aggregating the data to the regional level we can look at how macro factors, such as unemployment, income and house prices (through changes in the loan-to-value ratio) affect the overall arrears trend. Banks and ratings agencies carry out similar types of

analysis when assessing how the performance of a portfolio of loans changes with key macroeconomic factors. The approach is also similar to that adopted in Muellbauer *et al.* (2010) for modelling UK delinquency trends. However, it is important to point out that whereas Muellbauer *et al.* (2010) explicitly control for the flows out of the stock (i.e. defaults) we only look at net changes in the stock. Given the relatively low level of defaults/repossessions observed in Ireland to date, the analysis of the change in the stock can broadly be interpreted as an analysis of the determinants of inflows to the stock.[8]

The macro panel data we construct records the number of accounts in 90-plus days arrears in a given region on a monthly basis between June 2008 and December 2010 (31 months). In addition to analysing the data at a regional level, we also estimate separate models for three different borrower-type portfolios: first-time buyers (FTB), next-time buyers (NTB) and buy-to-let (BTL). Table 8 shows the evolution of the arrears rate over time for the sample period for each of the portfolio. The regions are the eight NUTS III regions used by the CSO for the recording of unemployment trends, as defined in Table 5.

Table 9 presents the summary statistics for the key variables across each of the eight regions. The arrears figures relate to the percentage of loans in arrears, whereas the balance and LTV figures are all at the property level. There are significant differences in the proportion of accounts in arrears across each of the regions, with borrowers in both Dublin and the Mid-East faring better, particularly compared with borrowers in the Border and Midland regions. Interestingly, the Midland region has been particularly hard hit by the recession, with the rate of unemployment rising from just 4 per cent in mid-2007 to almost 16 per cent by the end of 2010, some two percentage points higher than the unemployment rate for the State as a whole. Table 9 also presents the summary statistics for the different borrower-types. Loan performance varies considerably across borrower-type, with first-time (FTB) and next-time buyers (NTB) showing similar patterns of arrears while BTL/RIP buyers fare worst of all. Again, there are regional differences to this overall pattern. The table also reports LTVs, both conditional and unconditional on being in arrears. These are *average* LTV figures, the actual shape of the distribution is also important, as shown in Figure 2 for housing equity. Without exception, we find that the average LTVs are higher for those loans in 90 days arrears. This is a fairly common finding in the arrears literature. For Irish borrowers it is not clear whether or not this observation is capturing borrower characteristics, i.e. those borrowers with higher LTVs are also more likely to have suffered income or employment shocks affecting their ability to pay; or whether this is capturing a genuine "equity effect", i.e. these borrowers are effectively exercising the put-option on their loan.

Given the differences we observe across the different borrower-types, we estimate separate arrears equations for each type. The basic arrears equation has the following structure:

$$A_{jt} = \alpha + \beta_1 A_{j,t-1} + \beta_2 X_{jt} + u_{jt} \tag{4}$$

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[8]In Q1 2011, a total of 140 properties in Ireland were repossessed. This accounts for 0.02% of the outstanding stock of mortgages. At the peak of the early 1990s property crash in the UK, the quarterly rate of repossessions was close to 0.20%, Muellbauer *et al.* (2010).

where A_{jt} measures the proportion of loans in region j with greater than or equal to 90 days arrears at time t and $\mathbf{X}_{jt}$ is a matrix of explanatory variables such as unemployment, housing equity, monthly repayments and rent[9]. The disturbance term embeds a two-way error component model: $u_{jt} = \mu_i + v_{jt}$ (Baltagi, 1995), where μ_i is a region-specific effect. We include a lag of the dependent variable and estimate undifferenced, differenced and dynamic panel data (DPD) regressions, similar to the approach in Louzis *et al.* (2010).

In the first instance we report the results from a bivariate regression where the dependent variable is the proportion of accounts in 90-plus days arrears in each region-month. We estimate undifferenced (top panel) and differenced specifications and the regressions are log-log. The results are summarised in Table 10 for each of the borrower types. The explanatory variables in each regression are region and time-specific and are one of: unemployment, current LTV, mortgage-payment-to-income ratio (MRTI), monthly mortgage payment (BTL only), and rental rates (BTL) only. The tables only report the coefficients from each bivariate regression, along with standard errors. For the BTL regression we use average rents in a given region-month, as opposed to average income, as we think this is a more appropriate measure of "income" for these borrowers.

The bivariate regression results in Table 10 tally closely with the summary statistics and trends shown earlier. There is a strong positive correlation between unemployment trends and arrears, a result which holds in both the undifferenced and differenced specifications. For BTL loans, unemployment appears to have a much larger (or quicker) impact on arrears trends, as shown by the relative scale of the coefficients across borrower types. The "long-run" unemployment elasticity, as estimated in the undifferenced specification, is large, ranging from 1.4 for FTB and NTB borrowers, to 1.9 for BTL borrowers. The short-run elasticity, from the differenced specification, is smaller (up to 1.1 for BTL borrowers), but still significant. For BTL, trends in average regional rents are negatively correlated with arrears, an economically intuitive result, i.e. as rents rise, loan-portfolio performance improves. Interestingly, the results for the first-difference bivariate regression indicate that the relationship between arrears rents and rental rates for the BTL segment is highly elastic, with a coefficient of -1.8. The third column in Table 10 shows the coefficient on the LTV variable from each of the bivariate regressions. As expected, from the trends shown earlier, the LTV variable is highly correlated with arrears. This is a common result in the literature, both in a time-series setting and when looking at loan-level data, as shown by our earlier results. When we move to the differenced specification the statistical significance of this result tends to fall away, with the exception of BTL, where the coefficient remains statistically significant and elastic (1.3) . This would lead us to believe that, for our owner-occupier segments (FTB and NTB) the undifferenced result is picking up non-stationarity effects (common trend) rather than a genuine economic relationship. The fourth column in Table 10 shows the coefficient on the MRTI ratio in each of the bivariate regressions. In the undifferenced specification the MRTI is surprisingly negatively correlated with arrears for the FTB segment, possibly picky up regional effects. This is confirmed when this result falls away in the differenced specification.

We next present the results from estimating the full specification of equation 4 above, that is,

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[9]We thank Ronan Lyons of Daft.ie for the regional rent time series.

including a lagged dependent variable (LDV) in a multivariate regression. The inclusion of an LDV in the regression means that there is a constructed correlation between the LDV and the region specific component μ_j of the error term in equation 4. In order to address this we follow the standard approach in the literature, where the endogenous variables are instrumented using higher order lags of themselves. We estimate an Arellano-Bond dynamic panel data model by GMM, where LTV, unemployment and rent (BTL only) are each treated as endogenous explanatory variables. The results from the estimation are shown in Table 11 below.

Turning first to the coefficient on the lag of the arrears rate, we see that it is large, positive and significant for all borrower types. Indeed, for all borrower types, in the range of 0.68 to 0.85. The coefficient on the LDV for BTL borrowers is lowest, at 0.68, but not significantly different. This relatively large and significant coefficient on the LDV implies large multiplier effects (1/(1-coeff)) from a change in the arrears rate. In other words, policy interventions to address the rising arrears rates, through incrementally targeting affordability, unemployment or LTVs will have a limited impact initially. This is clearly evident in the time-trend which shows arrears rising fairly relentlessly for the period under investigation. Clearly, the build-up of mortgage arrears over the last number of years is not a problem that can be solved over a short time-horizon, particularly if one is relying on a positive macroeconomic environment to contribute to that solution.

Without exception, we find that increases in the unemployment rate lead to increases in arrears. The coefficients for our owner-occupier (FTB and NTB) segments, while significant, are relatively small. For the BTL portfolio we observe a coefficient of 0.45 on unemployment, with no significant effect for the twelve-month lag. We see our unemployment measure acting as a more general "catch-all" for the macroeconomic conditions in a given region at a point in time. It is perhaps too crude a measure to get at the "ability-to-pay" question we raised in the Introduction. A more direct measure of affordability is the ratio of mortgage payments to income (MRTI). Intuitively we would expect to observe an increase in arrears as the MRTI increases and this is precisely what we find for our main owner-occupier groups. Relative to the other macro factors captured in the model, the MRTI coefficients are large, 0.34 for FTB and 0.89 for NTB. The MRTI can change for a number of reasons, although the two main drivers in our sample are changes in the interest rate and changes in average incomes. To give an idea of the scale of changes that can occur here, between the end of 2008 and mid-2009, a period when the ECB began to rapidly cut interest rates, we observe that the average mortgage repayment for NTB borrowers fell from approximately €1,060 to €960 (9.4 percent). This was also a period when the unemployment rate was rising rapidly, growing at a rate of 0.7 percent per month on average. Clearly the prevalence of tracker rate mortgages, particularly amongst highly leveraged borrowers, was acting (and continues to act) as a kind of in-built forbearance holding down the increase in arrears that might have otherwise occurred.

Turning to the coefficient on the LTV variable, similar to the bivariate differenced specification, we find a weak relationship between LTVs and arrears rates for our owner-occupier segments. LTV is positive and significant in the BTL model (0.40). Overall, we believe that this result, along with the differenced bivariate regressions, points to weak evidence for an "equity effect" driving Irish mortgage arrears trends, to date. This does not necessarily imply that changes in LTVs are not a

good predictor of changes in arrears rate. The charts in the trends section show that, quite clearly for the period we look at, they are. One difficulty with the model and sample used here is that, as pointed out above, the trends in our various drivers are correlated over time. When we estimate a version of the dynamic panel data model (see Table 12) we find a strong and significant role for LTVs in explaining arrears trends. Much like unemployment trends, for the period we look at, we believe that LTV trends are picking up general changes in the macro-economic environment that also predict mortgage arrears. Further extensions to our sample period, both further back in time and updating it for events in 2011 will help clarify the relative impact of the various drivers.

The BTL regression includes a measure of average regional rental rates as an explanatory factor. We observe a significant negative relationship between changes in rents and arrears, in both the specification including unemployment (-0.57) and excluding unemployment (-0.97). This is consistent with our priors that rental rates are negatively related to arrears. In this context, the recent stabilisation of rental rate trends could be seen as one piece of good news for BTL borrowers.[10]

In summary, the results in this section tally to a large extent with those from our static probit analysis. The main exception, however, is that here our LTV variable does not show up as being significant for our owner-occupier segment. The two sets of results could therefore be seen as conflicting but we do not believe this to be the case. Rather, it could be that the LTV effect in the static analysis is proxying for other things, such as the underlying credit quality of the borrowers in our dataset for example. In other words, it could be the case that borrowers with little or no equity are also those who were most stretched at the time of the boom, with fewer lifetime resources or savings to draw on when harder times hit. Our current dataset does not allow us to address this issue in more detail, since it contains only a snapshot of information for loans outstanding at the end of 2010 and does not contain detailed information on the current economic circumstances of borrowers. However, a more detailed exploration of this issue should be possible in the future, if further versions of the data are collected along with more detailed current income information for mortgage holders.

5   Conclusions

This paper presents a comprehensive analysis of the main drivers of the growth in Irish mortgage arrears over the last number of years. Our analysis confirms that both housing equity, as measured by loan-to-value ratios, and measures of affordability are correlated with changes in mortgage arrears.

In our loan-level cross-sectional analysis, we find that borrowers with high LTVs and high repayment burdens, as measured by the MRTI, are all more likely to be in arrears. In the time-series data, we observe an arrears rate for BTL roughly double that of owner-occupiers. However, when we control for the MRTI and LTVs the BTL differential is reduced. We also find that borrowers living in regions that have suffered more severe economic shocks, as proxied for by changes in the unemployment rate, are also more likely to be in arrears.

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[10]See the Daft.ie Q2 2011 Rental Report, available on Daft.ie.

Much of what we learn in our cross-sectional loan-level analysis is confirmed by the results from our panel data analysis, which looks at arrears trends over a longer period of time across eight Irish regions. The one significant difference in the results is that the LTV effect is not evident for our owner-occupier segment when we also control for unemployment changes. This leads us to conclude that, to date, equity considerations have not been a major factor driving Irish mortgage arrears, and it is affordability issues, along with changes in the general macroeconomic environment, that is driving developments here. The absence of a strong LTV effect in the panel data analysis could be seen as conflicting with the opposite result we find in our cross-sectional loan-level analysis. We do not believe this is the case. Rather, we believe that the LTV effect in the latter is possibly proxying for underlying borrower credit quality. In other words, rather than it being the lack of significant equity in the property driving the decision to default, it is the fact that borrowers with little or no equity are also likely to have been the most stretched at the time of the boom, with fewer lifetime resources, such as accrued savings, to draw on when harder times hit. We note that this is only conjecture at this stage, and should be tested by further analysis of the panel data at the loan level. This is an area of further work which we will undertake, particularly with the collection of new loan level data for 2011.
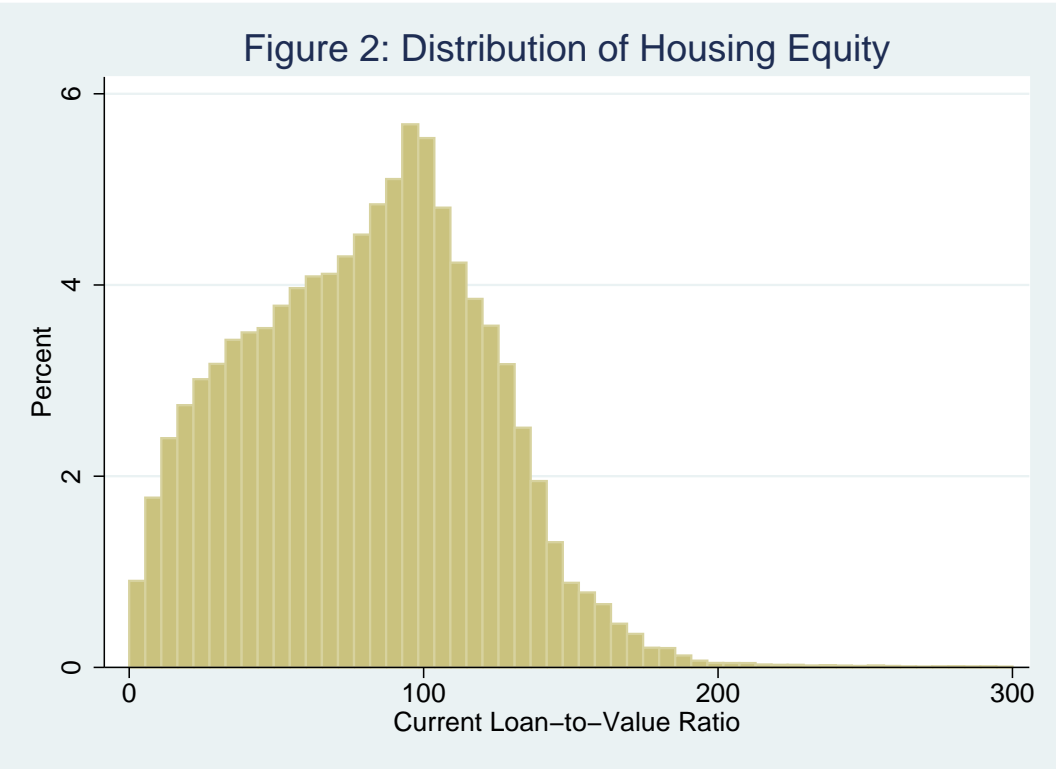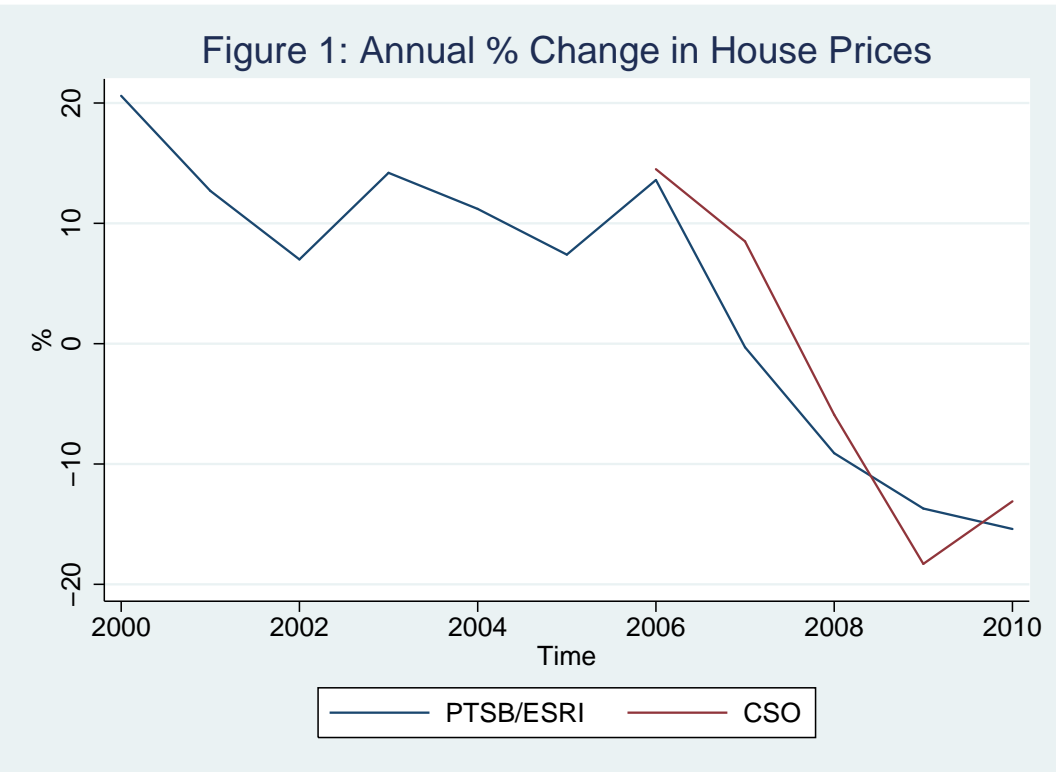
The results in our paper can be used to inform the policy debate as to how the build-up of arrears amongst Irish mortgagees might be addressed and where arrears might go in the future. A more benign macroeconomic environment would help the situation, particularly in terms of slowing down the rate of growth of arrears. However, we would caution against expectations of a sudden drop in the pool of mortgages in arrears: even with a more benign macroeconomic environment, it is quite clear that reducing the build-up of arrears to date will take a significant amount of time, and resources. A risk factor for the future is the affordability constraint, particularly for owner-occupiers (FTB and NTB). We find a significant and (relatively) large effect for changes in the MRTI on changes in arrears. Clearly further income or payment shocks could hold back a recovery. We believe that this is one factor that has driven the increase in arrears throughout 2011 - a period when the rate of unemployment growth appears to have tailed off.

The sample period in our analysis does not cover a period when repossessions, formal defaults/bankruptcy or any forms of loan restructuring have been a significant feature of the Irish mortgage market. Indeed, in contrast to other countries, such as the US and UK, none of these factors have *ever* been a significant feature of the Irish mortgage market. Our results indicate that even if we were to see a significant improvement in the macroeconomic environment, the ability of these factors to significantly reduce the pool of arrears that has built-up is likely to be limited in the short-term. The significant income shocks Irish borrowers have faced in recent years means that there is likely to be a large group of borrowers amongst those in deep arrears that are in a long-term unsustainable debt position - based on our sample of borrowers, we estimate that 40 percent of borrowers in 90-plus days arrears have been in that position for a year or more. Addressing the problems faced by these borrowers should be at the core of any strategy for reducing the pool of delinquent borrowers. This is likely to represent a significant challenge for policy makers and banks in the coming years.

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Figure 1: Annual % Change in House Prices

Figure 2: Distribution of Housing Equity

Figure 3: Distribution of MRTI
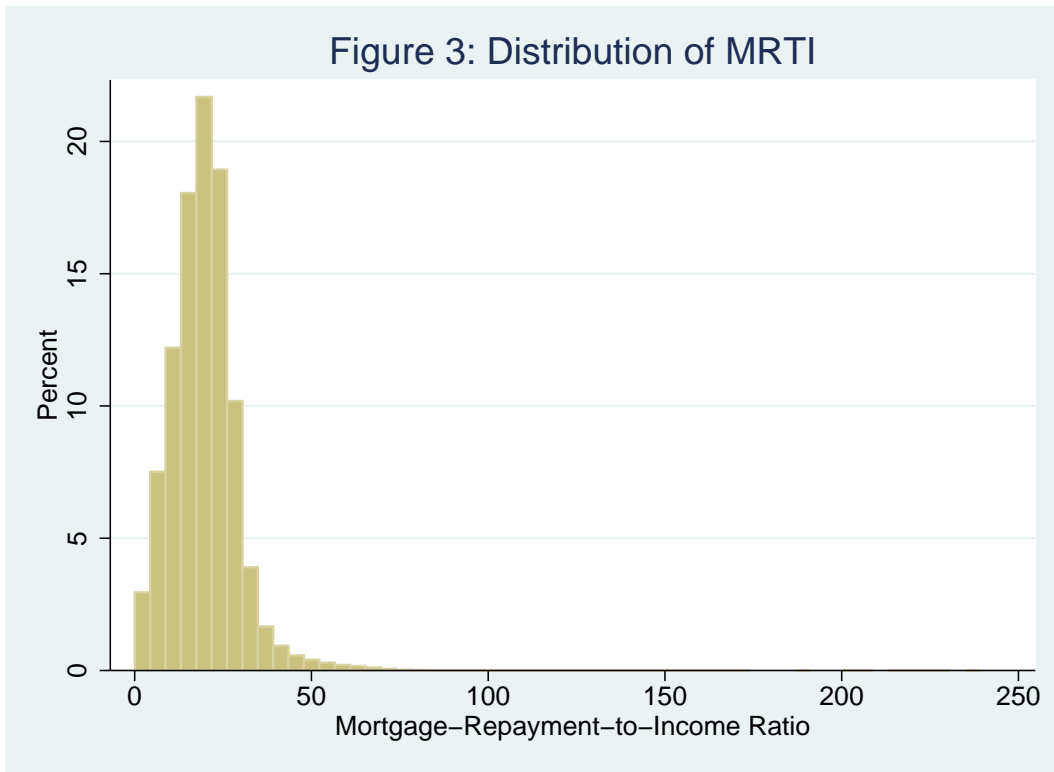
Table 1: Overview of Loan-Level Dataset

Year of Origination	No. of Accounts (%)	Total Book Value (€bn)	No. of Primary Mortgages (%)	Total Book Value (€bn)
	(1)	(2)	(3)	(4)
2004	44,540 (10.6)	7.2	34,888 (10.8)	6.5
2005	72,634 (17.2)	13.2	56,917 (17.6)	12.0
2006	91,458 (21.7)	19.0	70,265 (21.7)	17.1
2007	82,658 (19.6)	17.8	63,399 (19.6)	16.2
2008	67,195 (15.9)	13.5	49,828 (15.4)	12.2
2009	38,668 (9.2)	6.6	28,714 (8.9)	5.9
2010	24,737 (5.9)	4.0	19,377 (6.0)	3.6
Total	421,890	81	323,388	74

Figure 4

(a) Historical levels of arrears and unemployment, primary dwelling households

(b) Annual changes in arrears and unmployment, primary dwelling households
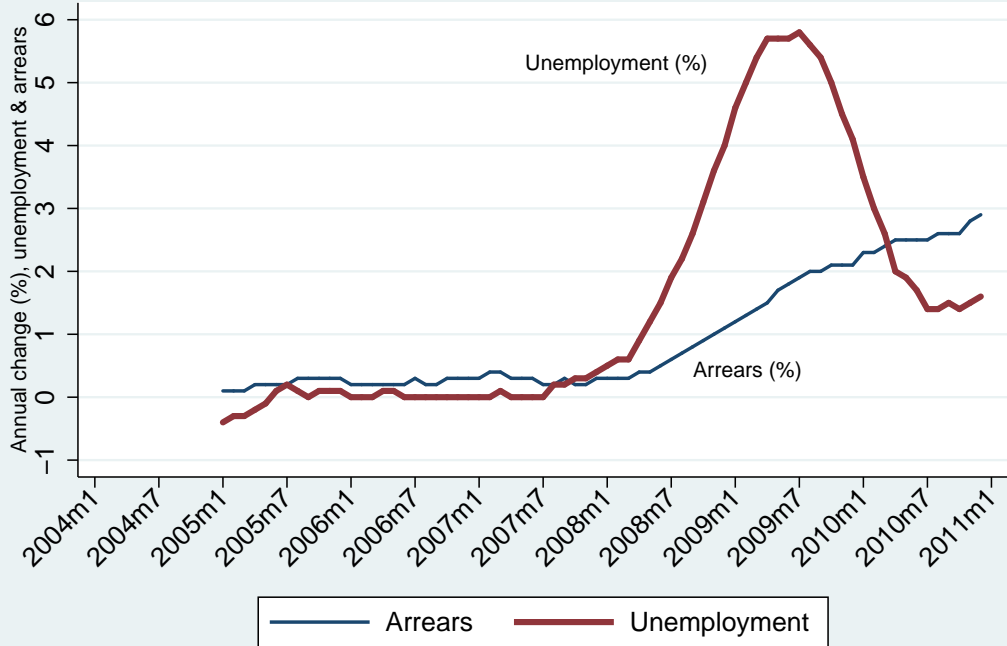
Source: Authors' calculations based on loan–level data from Banks A, B and C

Figure 5

(a) Historical levels of arrears and unemployment, buy–to–let

Unemployment (%)

Arrears (%)

(b) Annual changes in arrears and unmployment, buy–to–let

Unempl. (%)

Arrears (%)

— Arrears   — Unemployment
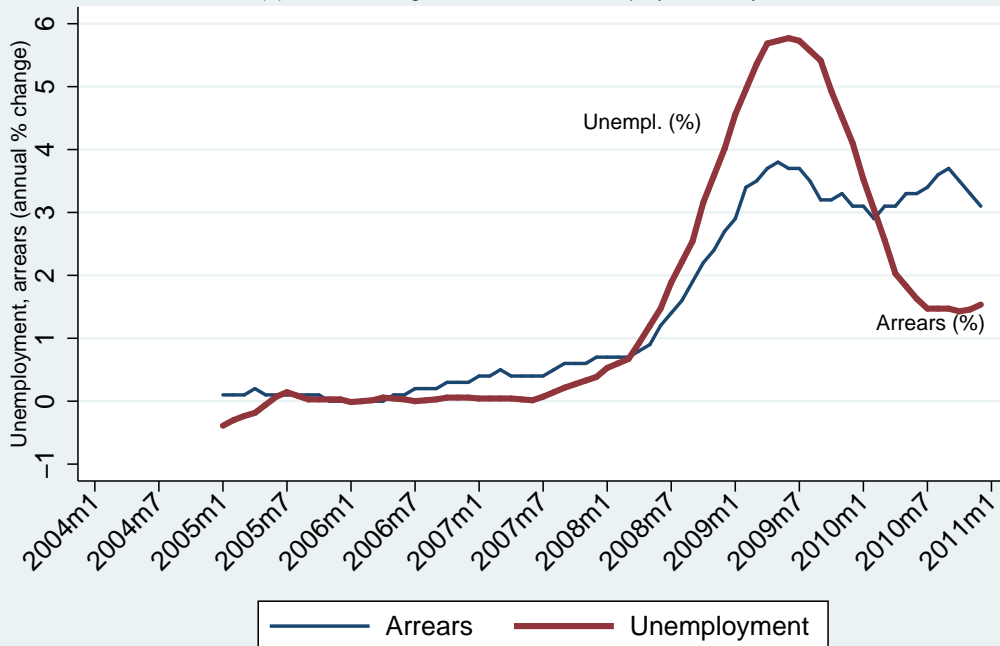
Source: Authors' calculations based on loan–level data from Banks A, B and C

Figure 6: Accounts in 90+ DPD Arrears

By Year of Account Origination

- 2010: 0%
- 2009: 2%
- 2004: 10%
- 2008: 16%
- 2005: 18%
- 2007: 27%
- 2006: 27%

By Geographic Location

- West: 9%
- South-West: 12%
- South-East: 13%
- Midland: 8%
- Mid-West: 7%
- Mid-East: 15%
- Dublin: 21%
- Border: 15%

By Buyer Type

- FTB: 30%
- BTL: 25%
- Other: 45%

22

Current Loan-to-Value Ratio (CLTV)

- CLTV of 120%+: 33%
- CLTV of 0-80%:
- CLTV of 80-90%: 8%
- CLTV of 90-100%: 10%
- CLTV of 100-110%: 11%
- CLTV of 110-120%: 11%
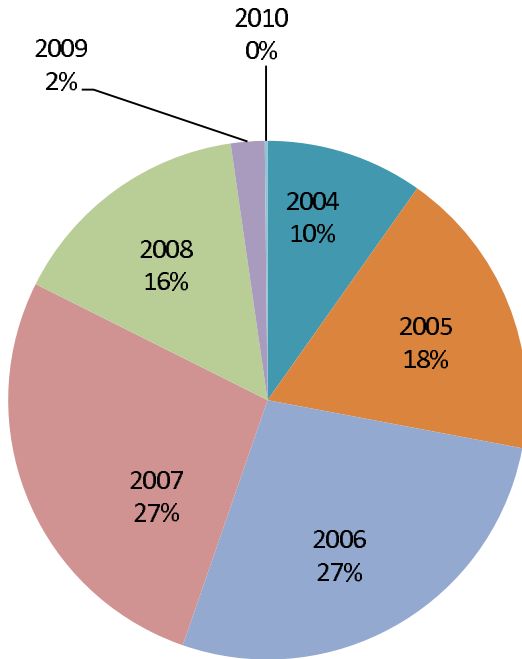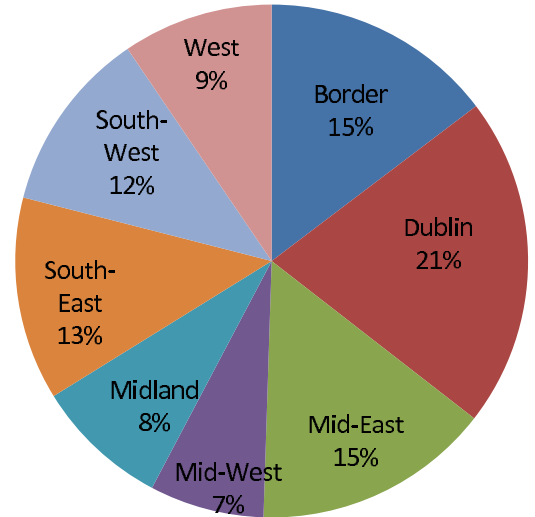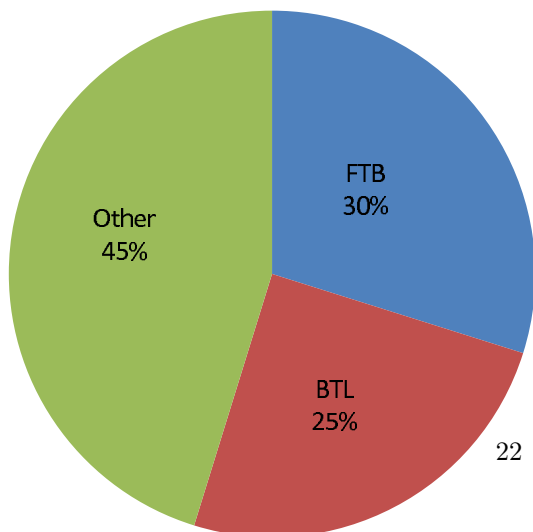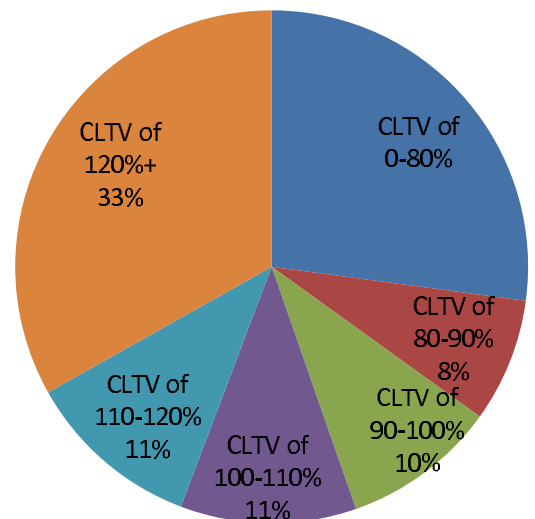
Figure 7: Current Balance on Accounts in 90+ DPD Arrears

By Geographic Region

Legend: Border, Dublin, Mid-East, Mid-West, Midland, South-East, South-West, West, % Arrears

By Buyer Type

Legend: FTB, BTL, Other

By CLTV Ratio

Legend: 0-80%, 80-90%, 90-100%, 100-110%, 110-120%, 120%+
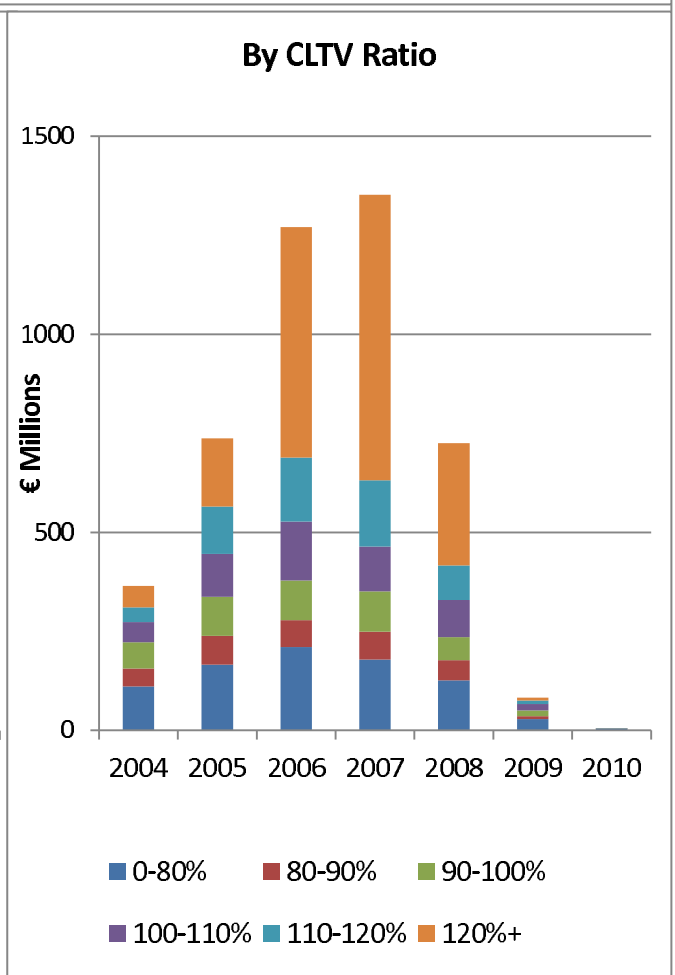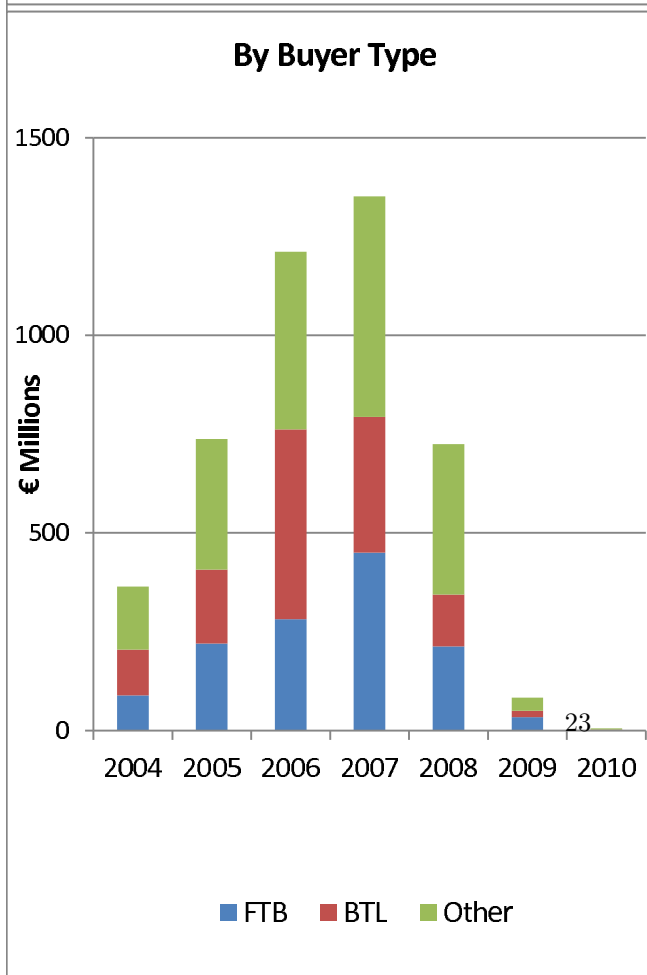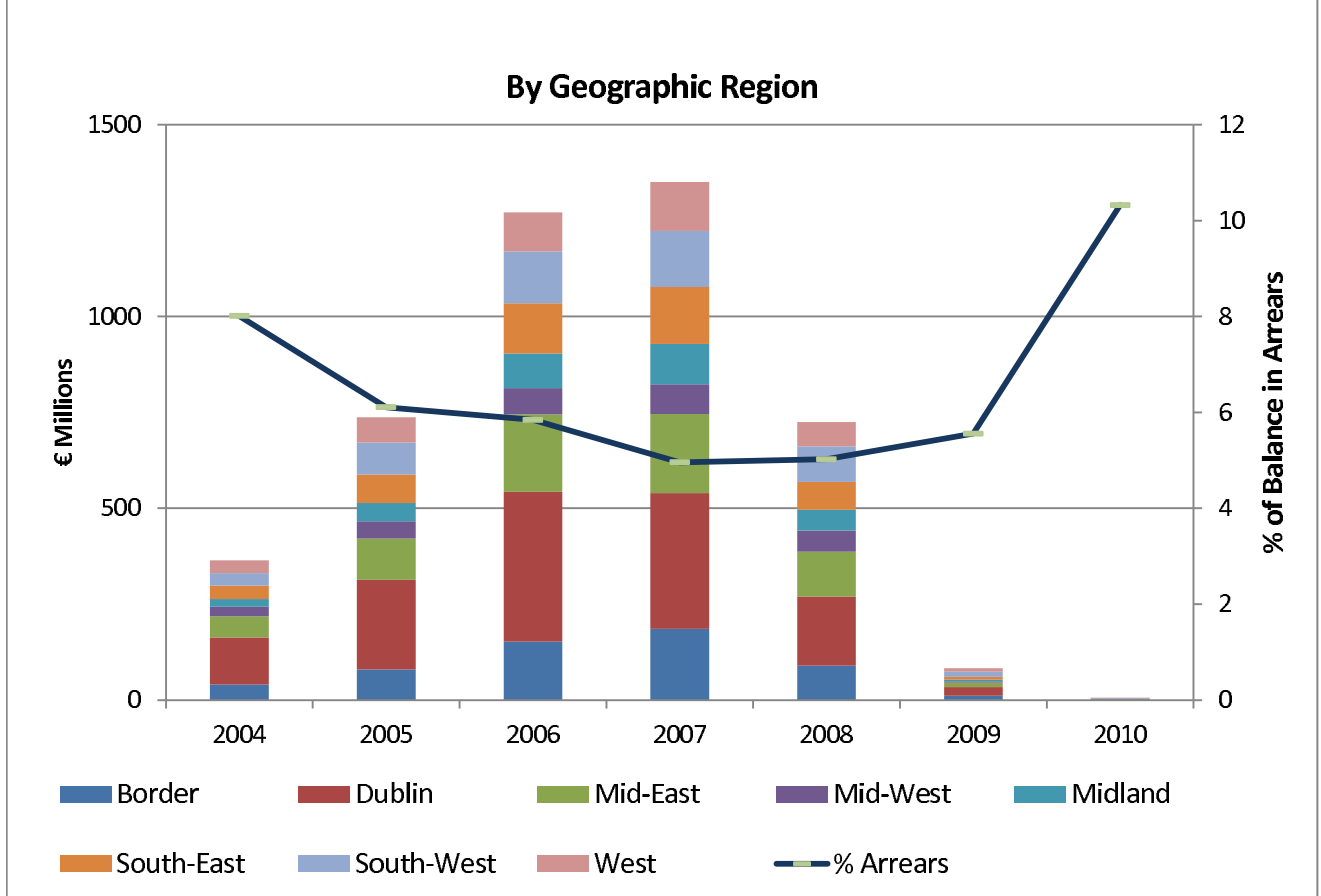
Table 2: Overview of Dataset

Borrower type	No. of loans	No. of properties	Balance €(bn)	% of the market
Owner occupier	364,239	276,117	57.4	49.0
Buy-to-let	57,651	47,271	11.6	47.0
Total	421,890	323,388	69.0	49.0

90+ days arrears	Sample % loans	Popn. % loans	Sample % balance	Popn. %balance
Owner occupier	5.2	5.7	6.1	7.4
Buy-to-let	6.7		9.7	10.9

Table 3: % Change in Gross Household Income from Time t to 2010

Time 't'	% Change
2004	10.9
2005	7.1
2006	-0.7
2007	-8.5
2008	-9.7
2009	-3.2
2010	0.0

Table 4: Mortgage Characteristics by Year of Loan Origination, Property Account Level (unless otherwise stated)

		2004	2005	2006	2007	2008	2009	2010	Total
(1)	Any Arrears (%) (in December 2010)	10.3	13.5	15.2	16.2	13.1	4.8	1.5	12.5
(2)	60 to 90 DPD Arrears (%) (in December 2010)	0.9	1.0	1.1	1.3	1.1	0.5	0.1	1.0
(3)	90+ DPD Arrears (%) (in December 2010)	4.8	5.4	6.6	7.2	5.2	1.2	0.2	5.2
(4)	Primary Mortgage Balance at Origination (€000s)	187	211	244	256	245	206	185	228
(5)	Total Property Debt at end-2010 (€000s)	168	192	227	242	234	198	182	213
(6)	Original LTV	58.8	63.4	64.0	60.2	58.1	60.0	62.2	61.1
(7)	Current LTV (end-2010)	59.2	71.0	83.4	86.7	81.3	70.4	64.7	76.6
(8)	Mortgage Term (Years)	24	25	26	26	26	26	27	26
(9)	Borrower Income at Origination (€000s)	69	71	75	79	80	72	69	75
(10)	Borrower Income at end-2010 (€000s)	79	77	75	73	72	70	69	74
(11)	MRTI at end-2010	16.8	17.9	18.6	19.7	20.4	19.8	17.9	18.9
	Share of loans that are:								
(12)	First-Time-Buyers	31.1	34.0	39.3	37.2	34.3	44.0	52.1	37.5
(13)	Buy-to-Lets	21.1	17.6	17.2	16.2	13.1	7.1	4.6	15.2
(14)	Other Buyer Types	47.9	48.5	43.5	46.6	52.6	49.0	43.3	47.3
(15)	Fixed Rate Mortgages	14.2	14.6	12.6	9.7	14.7	35.8	61.5	17.9
(16)	Tracker Mortgages	43.3	49.9	62.3	74.2	66.6	1.4	0.4	51.9
(17)	Variable Rate Mortgages	42.6	35.5	25.1	16.1	18.7	62.7	38.1	30.2
(18)	Border Region	10.5	11.2	12.0	12.0	11.4	10.8	9.7	11.4
(19)	Dublin Region	27.0	26.1	25.1	24.7	25.6	28.1	31.7	26.2
(20)	Mid-East Region	12.4	13.3	13.4	12.4	12.5	12.7	13.3	12.9
(21)	Mid-West Region	8.1	7.6	7.3	7.8	7.5	6.8	6.2	7.4
(22)	Midlands Region	5.1	5.5	5.9	6.1	5.4	4.6	4.7	5.5
(23)	South-East Region	12.3	12.5	12.4	12.8	12.5	12.1	10.8	12.4
(24)	South-West Region	15.1	14.5	14.3	14.4	15.7	15.6	14.9	14.8
(25)	West Region	9.6	9.3	9.6	9.9	9.5	9.3	8.6	9.5

Table 5: NUTS III Regions

Name of Region	County/City Council
Border Region	Cavan, Donegal, Leitrim, Louth, Monaghan and Sligo
Dublin Region	Dun Laoghaire-Rathdown, Fingal, South Dublin and Dublin City Council
Mid-East Region	Kildare, Meath and Wicklow
Mid-West Region	Clare, North Tipperary, Limerick and Limerick City Council
Midlands Region	Laois, Longford, Offaly and Westmeath
South-East Region	Carlow, Kilkenny, South Tipperary, Wexford, Waterford and Waterford City Council
South-West Region	Kerry, Cork and Cork City Council
West Region	Mayo, Roscommon, Galway and Galway City Council

Source: Central Statistics Office

Table 6: Description of Independent Variables

Variable Group	Variable Name	Description
Current LTV	50-80%	Dummy variable taking a value of 1 if the borrower has a current loan-to-value ratio of 50 to 80 percent (i.e. the borrower has positive equity in the property); 0 otherwise.
	80-90%	Dummy variable taking a value of 1 if the borrower has a current loan-to-value ratio of 80 to 90 percent (i.e. the borrower has positive equity in the property); 0 otherwise.
	90-100%	Dummy variable taking a value of 1 if the borrower has a current loan-to-value ratio of 90 to 100 percent (i.e. the borrower has positive equity in the property); 0 otherwise.
	100-110%	Dummy variable taking a value of 1 if the borrower has a current loan-to-value ratio of 100 to 110 percent (i.e. the borrower is in a position of negative equity); 0 otherwise.
	110-120%	Dummy variable taking a value of 1 if the borrower has a current loan-to-value ratio of 110 to 120 percent (i.e. the borrower is in a position of negative equity); 0 otherwise.
	120%+	Dummy variable taking a value of 1 if the borrower has a current loan-to-value ratio in excess of 120 percent (i.e. the borrower is in a position of negative equity); 0 otherwise.
Liquidity MRTI Ratio	20-30%	Dummy variable taking a value of 1 if the borrower's mortgage repayment (interest plus capital) to income ratio is between 20 and 30%; 0 otherwise.
	30-40%	Dummy variable taking a value of 1 if the borrower's mortgage repayment (interest plus capital) to income ratio is between 30 and 40%; 0 otherwise.
	40-50%	Dummy variable taking a value of 1 if the borrower's mortgage repayment (interest plus capital) to income ratio is between 40 and 50%; 0 otherwise.
	50%+	Dummy variable taking a value of 1 if the borrower's mortgage repayment (interest plus capital) to income ratio is 50% or more; 0 otherwise.
Buyer Type	FTB	Dummy variable taking a value of 1 if the borrower was a first time buyer at loan origination and was taking the loan out to purchase their primary dwelling; 0 otherwise.
	BTL	Dummy variable taking a value of 1 if the borrower was a buy-to-let customer at loan origination; 0 otherwise.
Unemployment Change	2% to 6%	Dummy variable taking a value of 1 if the annual rate of change in the borrower's local unemployment rate was between 2 and 6 percent; 0 otherwise. The local unemployment rate is defined as the county in which the borrower's property is located.
	6%+	Dummy variable taking a value of 1 if the annual rate of change in the borrower's local unemployment rate was greater than 6 percent; 0 otherwise. The local unemployment rate is defined as the county in which the borrower's property is located.
Bank	Bank B	Dummy variable taking a value of 1 if the borrower is from the property portfolio of Bank B; 0 otherwise.
	Bank C	Dummy variable taking a value of 1 if the borrower is from the property portfolio of Bank C; 0 otherwise.
	Bank D	Dummy variable taking a value of 1 if the borrower is from the property portfolio of Bank D; 0 otherwise.

Table 7: Probit Results (Dependent Variable: Mortgage Arrears (90+ days))

	Marginal Impact	Std. Error
Housing Equity		
Current LTV		
50-80%	0.02***	0.0015
80-90%	0.03***	0.0022
90-100%	0.04***	0.0022
100-110%	0.06***	0.0025
110-120%	0.08***	0.0030
120%+	0.11***	0.0025
Liquidity		
MRTI Ratio		
20-30%	0.00***	0.0008
30-40%	0.02***	0.0017
40-50%	0.03***	0.0041
50%+	0.05***	0.0049
Buyer Type		
First Time Buyer	-0.02***	0.0008
Buy-to-Let	0.00***	0.0010
Unemployment Change		
2% to 6%	0.01***	0.0008
6%+	0.03***	0.0015
Bank		
Bank B	0.02***	0.0013
Bank C	0.04***	0.0017
Bank D	0.04***	0.0013
N		323,388
LR chi2		7101.58
Prob chi2		0.0000
Pseudo R2		0.0535

Omitted categories for dummy variables: CLTV of less than 50%; MRTI ratio of less than 20%; Other buyer types; Unemployment change of less than 2%; Bank A.
*** Significant at 1% level; ** Significant at 5% level.

Table 8: Arrears Rate Over Time, by Borrower Type

Borrower type	Jun-08	Dec-09	Jun-09	Dec-09	Jun-10	Dec-10
Loan purpose						
First-time buyer (FTB)	1.2	1.4	2.2	3.0	3.7	4.4
Next-time buyer (NTB)	1.3	1.7	2.7	3.6	4.3	5.3
Buy-to-let (BTL)	1.0	1.5	2.9	3.8	4.9	6.0
All borrower types	1.1	1.5	2.5	3.2	4.0	4.8

Table 9: Summary Statistics - By Region and Loan Purpose

Region	Obs	% arrears	%90d arrears	Total Bal.	Avg. Bal.	Avg. Bal.|90 days arrears	Curr. LTV	Curr. LTV|90 days arrears
Loan purpose	**FTB**							
Border	3006	8.5	4.8	433	144,010	191,744	78.4	100.8
Dublin	7864	5.7	3.0	1,834	233,265	257,373	103.8	121.3
Mid-East	3325	7.7	4.4	659	198,076	246,362	84.2	99.6
Mid-West	3751	7.6	4.8	555	147,971	166,825	79.0	90.3
Midland	2082	10.1	6.3	314	150,977	188,748	82.2	104.9
South East	3230	7.6	4.7	493	152,531	182,853	79.5	92.7
South West	5085	6.2	3.3	848	166,833	188,853	76.8	89.9
West	4399	5.9	3.4	671	152,608	170,873	75.4	87.2
Region	**Obs**	**% arrears**	**%90d arrears**	**Total Bal.**	**Avg. Bal.**	**Avg. Bal.|90 days arrears**	**Curr. LTV**	**Curr. LTV|90 days arrears**
Loan purpose	**NTB**							
Border	2673	9.6	6.4	438	164,025	202,484	67.4	81.7
Dublin	9130	6.5	3.7	2,628	287,835	450,668	80.1	90.3
Mid-East	4032	8.6	5.1	882	218,632	311,078	67.6	77.5
Mid-West	3133	8.6	5.5	507	161,749	202,071	66.2	76.7
Midland	1693	10.7	6.7	274	161,660	235,374	68.9	91.1
South East	2983	10.0	6.2	495	165,848	218,828	66.8	83.1
South West	4337	7.4	4.7	801	184,597	231,188	65.2	75.6
West	3278	6.8	4.2	567	173,122	234,609	65.4	78.8
Region	**Obs**	**% arrears**	**%90d arrears**	**Total Bal.**	**Avg. Bal.**	**Avg. Bal.|90 days arrears**	**Curr. LTV**	**Curr. LTV|90 days arrears**
Loan purpose	**BTL/RIP**							
Border	2178	10.9	7.1	365	167,681	243,767	80.0	93.9
Dublin	6781	8.8	6.2	2,269	334,555	524,292	100.2	123.2
Mid-East	1552	10.3	6.0	346	222,854	332,400	81.0	94.0
Mid-West	2687	7.5	4.8	503	187,314	279,233	80.2	86.7
Midland	1232	11.6	7.4	232	188,340	304,288	82.4	102.4
South East	2247	8.7	5.0	396	176,429	222,186	80.1	89.3
South West	3891	8.0	5.3	871	223,890	387,172	78.6	90.0
West	3310	9.6	5.9	632	191,012	370,410	75.4	101.1

Table 10: Results from bivariate regressions

Dep. Var.	Borr. Type	% Unempl.	LTV	MRTI	Payment	Rent
A_t	FTB	1.405	2.091	-2.940		
A_t		(0.049)	(0.174)	(0.644)		
A_t	NTB	1.443	3.346	1.814		
A_t		(0.051)	(0.187)	(0.793)		
A_t	BTL	1.868	4.141		-2.628	-1.295
A_t		(0.071)	(0.230)		(0.212)	(0.161)

Dep. Var.	Borr. Type	% Unempl.	LTV	MRTI	Payment	Rent
ΔA_t	FTB	0.289	0.216	0.424		
ΔA_t		(0.078)	(0.302)	(0.182)		
ΔA_t	NTB	0.357	-0.653	1.247		
ΔA_t		(0.116)	(0.414)	(0.176)		
ΔA_t	BTL	1.091	1.266		-1.33	-1.794
ΔA_t		(0.143)	(0.678)		(0.224)	(0.496)

Source: Data as of December 2010

FTB: first-time buyer; *NTB:* switchers and next-time buyers; *BTL/RIP:* buy-to-let or other residential investment property.

Table 11: Results from Dynamic Panel Data Estimation

	FTB	NTB	BTL
VARIABLES	A_t	A_t	A_t
A_{t-1}	0.850***	0.764***	0.683***
	(0.036)	(0.045)	(0.035)
LTV_t	0.096	0.204	0.391**
	(0.134)	(0.178)	(0.188)
$Unemployment_t$	0.115***	0.192***	0.453***
	(0.034)	(0.039)	(0.058)
$Unemployment_{t-12}$	0.056*	0.076**	0.031
	(0.029)	(0.029)	(0.030)
$MRTI_t$	0.336***	0.888***	
	(0.153)	(0.158)	
Monthly payment			0.416***
			(0.103)
Rental rates			-0.572***
			(0.262)
Sargen ID test			
Chi2	206.4	188.3	245.5
Prob > Chi2	0.83	0.91	0.18
Observations	232	232	232
Number of regions	8	8	8

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 12: Results from Dynamic Panel Data Estimation, Excluding Unemployment

| | FTB | NTB | BTL |
VARIABLES	A_t	A_t	A_t
A_{t-1}	0.893***	0.881***	0.817***
	(0.029)	(0.039)	(0.028)
LTV_t	0.425***	0.446**	0.194
	(0.121)	(0.190)	(0.194)
$MRTI_t$	0.498***	1.025***	
	(0.152)	(0.163)	
Monthly payment			0.156
			(0.101)
Rental rates			-0.965***
			(0.280)
Sargen ID test			
Chi2	188.3	182.5	257.5
Prob > Chi2	0.91	0.96	0.087
Observations	232	232	232
Number of regions	8	8	8

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1