09/RT/11

Páipéar Taighde Teicniúil
Research Technical Paper

Impairment and Negative Equity in the Irish Mortgage Market

Robert Kelly, Yvonne McCarthy and Kieran McQuinn

Banc Ceannais na hÉireann
Central Bank of Ireland
Eurosystem

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May 2011

Abstract

Understanding the true scale of the difficulties in the Irish mortgage market is of key importance from a financial stability, fiscal and social perspective. To date, much of the analysis and discussion of the Irish market has tended to focus on either the concept of mortgage repayment distress or potential negative equity. However, the combination of these two factors raises fundamental policy issues. Building on earlier work, which used the Survey on Income and Living Conditions (SILC), we marry existing estimates of repayment distress with estimates of negative equity for a representative sample of Irish households. Using copula modelling we then examine the dependence structure across the distributions of mortgage delinquency and solvency for these households. As a result, we are in a position to estimate the probability that a household experiencing repayment distress might also be in negative equity.

JEL classification: D14, C16, C81.

Keywords: Credit, Solvency, Delinquency, Copula.

*E-mail: robert.kelly@centralbank.ie, yvonne.mccarthy@centralbank.ie and kmcquinn@centralbank.ie. The views expressed in this paper are those of the authors and do not necessarily reflect those of the Central Bank of Ireland, the European Central Bank or the Central Statistics Office. We would like to thank Patrick Honohan for comments on an earlier draft and all those who participated at seminars in UCD, the ESRI and at the Irish Economics Association annual conference. We would also like to thank Marion McCann of the Central Statistics Office for providing invaluable help in accessing and using the SILC data. Any remaining errors are our own.

Non Technical Summary

In this paper we examine the potential for impairment in the Irish mortgage market. In particular, we estimate the joint probability of a household facing both mortgage repayment distress and negative equity. Existing research on the Irish mortgage market has used the Survey on Income and Living Conditions (SILC) to calculate a mortgage-repayment-to-income ratio (MRTI) for a representative sample of Irish households. Using the same survey, we build on this research by firstly generating an estimate of equity for the representative sample of Irish households and, secondly, using copula modelling to generate a joint probability based on the two different distributions of repayment distress and negative equity.

We examine the impact on this joint probability of a series of austerity measures outlined in November 2010 as part of a four year plan to restore long-term sustainability to the Irish public finances. Scenario analysis demonstrates that the probability is most affected by likely future changes in Irish house prices, which are generally expected to continue to decline into 2011.

1 Introduction

At present it is particularly useful to couch analysis of distressed mortgage markets in the context of credit default. With respect to secured loans such as residential mortgages, most definitions of credit default are typically underpinned by two concepts. One is delinquency - defined as the failure to meet a loan payment by a particular time, while insolvency is a situation whereby assets are worth less than the associated liabilities. For example, Moody's defines credit default as a situation involving both delinquency and the notion of expected loss to the lender. Therefore, under this definition, neither delinquency nor insolvency alone is sufficient to cause a credit default. Both are necessary and sufficient for credit default.

In the Irish mortgage market, it is necessary to think of present difficulties as the potential combination of delinquency (heightened levels of mortgage distress leading to default) and insolvency (negative equity). The potential scale of the problem in an Irish context is quite sizable. Since they reached a peak in early 2007, Irish house prices have, as of late 2010, fallen by nearly 40 percent. Over the period 2004 - 2006, when house prices were at their peak, almost 340,000 mortgages were approved. Estimates would suggest that the total number of outstanding mortgages in the country at this time is approximately 800,000. During this period the Irish economy was experiencing significant improvements in living standards and, hence, the general ability within the economy to sustain such mortgages was quite high. However, the severe decline in the performance of the Irish property sector allied to the post 2007 global economic downturn has had a distinctly harsh impact on the Irish economy with unemployment rates, in particular, experiencing a swift increase from 4.5 percent in 2006 to over 13 percent by 2010. A significant degree of credit default within the Irish market is a possibility.

This paper assesses the concept of credit default in the Irish residential property market by examining the degree of correlation between negative equity and mortgage repayment distress across a representative sample of Irish households. The paper builds on existing research in McCarthy and McQuinn (2011), which explicitly examines the issue of potential delinquency in the Irish market. McCarthy and McQuinn (2011) use information from the Irish component of the 2007 EU-wide Survey on Income and Living Conditions (SILC) to examine the financial sustainability of mortgage repayments amongst Irish households. Using information in the survey they calculate a mortgage-repayment-to-income ratio (MRTI) for mortgaged Irish households, which measures the cost of mortgage payment (including principal and interest) as a share of household income.

In this paper, using the 2009 version of the Irish SILC, we match the information on mortgage repayment distress with an estimate of mortgage solvency for our sample of mortgaged households. This is possible since questions in the SILC also provide information which allows for the calculation of the value of the original mortgage outstanding at a point in time, as well as an estimate of the value of the mortgaged property. As a result, we are able to compile distributions for both repayment distress and mortgage solvency across the sample. Using copula modelling, we model the dependence structure across the distributions of both variables and, in particular, the dependence across the tails of these distributions. Therefore, for those households classified as distressed vis-

à-vis their mortgage-repayment-to-income ratio, for example, we estimate the probability of such a household being in negative equity. As a sensitivity analysis, we also examine the implications for these probabilities of potential changes in income levels faced by these households. This is especially appropriate given the decidedly uncertain macroeconomic outlook for the Irish economy.[1]

We believe that the methodology proposed and the empirical estimates provided in the paper arrive at a particularly important juncture in policy terms. In the case of Ireland, the precarious position of households confronted by the dual problem of mortgage repayment distress and negative equity raises fundamental policy issues. Namely, what are the expected losses for mortgaged homeowners and, in particular, owner occupiers likely to be? The difficulties experienced in global financial markets since mid-2007 impacted the Irish financial sector in a particularly acute manner. Given the very high exposure of Irish banks to commercial and residential property lending, the substantial declines in these asset prices reported since 2007 has had significant implications for the balance sheets and, hence, required capital levels of these institutions. Heightened levels of credit default in the Irish mortgage market will obviously compound this already fragile situation. Examining the potential interaction of both delinquency and solvency enables a more complete picture of the situation confronting owner-occupiers in the Irish mortgage market.

The structure of the remainder of the paper is as follows: in the next section we provide a brief introduction to the SILC. We follow with a review of work examining the delinquency problem amongst Irish households. We then present our empirical estimates of insolvency in the Irish mortgage market before examining the dependency between both distributions. A final section offers some concluding comments.

2 The Survey on Income and Living Conditions

The data used in this paper to assess credit default in the Irish mortgage market are from the Survey on Income and Living Conditions (SILC). The SILC is a voluntary household survey which is conducted under European legislation. In Ireland, the survey is conducted on an annual basis by the Central Statistics Office (CSO). The survey is designed to produce a nationally representative sample of Irish households (see CSO (2009) for further details), and in 2009, this resulted in a sample of 5,183 households and 12,641 individuals. Of the 5,183 households surveyed, about 80 percent own their own homes, while mortgaged households represent about one quarter of the total sample of households.

While the SILC is primarily aimed at collecting information on the income and living conditions of different types of households, as discussed in McCarthy and McQuinn (2011), it also provides the perfect landscape for micro level analysis of mortgage related topics. In the context of the current study, the SILC collects information which allows for the calculation of mortgage burdens facing

[1] On the 28th of November 2010, the Irish Government announced details of a joint EU - IMF Programme for Ireland. The programme consists of financial support of a potential 85 billion euros from the IMF, the European Financial Stability Facility (EFSF) and the European Financial Stability Mechanism. In parallel with this, a four year recovery plan of austerity measures aimed at returning the Irish exchequer deficit to 3 percent of GDP by 2014 was also outlined.

surveyed households, the amount of the mortgage outstanding at a point in time and the value of the house for which the mortgage exists; each of these is a vital ingredient in the analysis of credit default among our sample of households, as discussed in later sections. There are, however, a number of caveats which apply to the use of the SILC in the current analysis. Firstly, it is important to note that the mortgage information in the SILC relates specifically to owner-occupied premises and does not take account of investment properties or second homes. Furthermore, the mortgage amount captured in the SILC reflects the original mortgage amount and does not take account of re-mortgagings / equity release or loans for home improvement. The SILC also does not collect information on other debts held by households so that the mortgage repayment burdens calculated in the next section do not capture the full debt exposure of households. Similarly, it is not possible to take account of savings and other assets held by households. Despite these issues, the SILC provides important policy relevant insights into mortgage related issues facing households in Ireland today. These insights cannot be obtained from any other existing nationally representative sample of households in Ireland.

3 Delinquency

Delinquency in a loan contract typically arises when a borrower is unable to make a payment by a certain date because of liquidity failure. In a corporate sense, one of the main reasons for liquidity failure is negative cash flow i.e. liquidity failure mainly occurs when there is insufficient income from a business, which is being operated at a loss. In this case, liquidity failure is chiefly a function of negative cash flow.

From the perspective of the household, an analogous concept is the ratio of the actual mortgage repayment to the disposable income of the household (MRTI). McCarthy and McQuinn (2011) calculate this ratio for a representative sample of Irish households in the 2007 SILC. They define the ratio as annual mortgage repayments (capital plus interest payments) as a share of annual household net disposable income for households who purchased their home either with a mortgage or under a tenant purchase scheme. Income is defined as the sum of direct income and social transfers, less taxes and social insurance. Direct income includes employee income, gross cash benefits or losses from self-employment, rental income, pension income, interest and dividend payments.

From a theoretical perspective, Sy (2007), in discussing this issue, defines the similar idea of a *loan serviceability ratio*. This is household income net of other debt repayments and the cost of living divided by the mortgage repayment. In selecting such a metric for delinquency, Sy (2007) argues that the ratio has the advantage of being a nonlinear function of both micro- and macro-economic causal variables. Thus, relevant risk factors are combined in a single causal variable in a parsimonious expression. Mortgage-repayment-to-income ratios also feature prominently in other studies on household financial distress such as Haughwout, Okah and Tracy (2009) or Georgarakos, Lojschova and Ward-Warmedinger (2010), for example.

McCarthy and McQuinn (2011) find a considerable dispersion in the MRTI ratio for Irish house-

holds in the 2007 SILC, with some households facing mortgage repayments which consume less than 1 percent of their annual net disposable income; for other households the MRTI ratio is substantially higher. To get a better idea of the proportion and types of households facing high mortgage burdens, McCarthy and McQuinn (2011) divide the sample of mortgaged households into deciles ranked according to their MRTI, and examine key household and mortgage characteristics among these groups. We replicate this exercise here using the 2009 data and find the same patterns as for the 2007 data. Specifically, as shown in Table 1, we again see a wide dispersion in the MRTI ratio across mortgaged households.[2] Table 2 demonstrates that heads of households tend to be younger in more highly leveraged households in the sample - a pattern which also emerges in the 2007 dataset; for the 50 percent of households in the 2009 sample facing the lowest mortgage repayment burden (of between 0.53 percent and 13.96 percent of their annual net disposable income), the average age of the head of household is 48 years as compared to an average age of 43 years for the 10 percent of households facing the highest mortgage repayment burden (of more than about 33 percent of average annual net disposable income).

From Table 3, it is apparent that a larger proportion of highly leveraged households obtained their mortgage from a bank, rather than a building society, relative to households with lower mortgage repayment burdens. It is also clear that more highly leveraged households tend to have taken their mortgages out in recent years (particularly in the 2000s) and they also tend to opt for longer mortgage terms than households with relatively lower MRTI ratios. These findings are also in line with the results from the 2007 survey.

4 Solvency

In the case of property, insolvency occurs when the value of the house is worth less than the outstanding mortgage. The household is, as a result, in negative equity. Clearly, from a credit default perspective, negative equity is a *necessary* but not a *sufficient* condition. Many property markets, such as Hong Kong and the United Kingdom in the 1990s, have experienced periods of negative equity without significant default as households were able to service their mortgage repayments.

Of course, in some markets, the delinquency and solvency issue are not necessarily mutually exclusive. In the United States, there are a number of empirical studies which suggest that negative equity is becoming a primary driver of default risk.[3] This situation arises as, with the prevalence of non-recourse mortgages in the US, financial institutions cannot go after the borrower's income or other assets. In this case, households in negative equity are relatively free to walk away from their mortgage debt. Given the presence of negative equity these households have a clear incentive to do

[2]There is some evidence of slightly higher MRTIs among the most highly burdened households in the 2009 sample, which is as expected given the deterioration in macroeconomic circumstances between 2007 and 2009. For example, in the 2009 sample, the top decile shows that 10 percent of households in 2009 face mortgage repayments which consume over 33 percent of their household net disposable income. For the 2007 data, the MRTI ratio of this group was 31 percent and higher.

[3]See, for example, Bhutta, Dokko and Shan (2010).

so.

Quite apart from being a necessary condition for mortgage default, negative equity can have a depressing effect on economic activity. Housing investment tends to be adversely affected in a period of falling house prices while negative equity can act as a drag on consumption since households that are in negative equity can be credit constrained and may also seek to increase their precautionary savings (Hellebrandt et al, 2009). Negative equity has also been shown to dampen household mobility since households may prefer to wait for house prices to recover rather than realise a loss by selling up and moving (Ferreira et al, 2010). This can result in higher region specific unemployment rates and can have an adverse effect on productivity (Henley, 1998).

Given the persistent decline in house prices since early 2007, there has been much discussion about negative equity in the Irish housing market. This is coupled with the fact that a substantial number of homeowners took mortgages out when house prices were close to their peak. Using aggregate data on average mortgage size, average mortgage terms and average loan-to-value ratios, Duffy (2010) has estimated the number of Irish mortgage holders in negative equity. By the end of 2010, Duffy estimates that almost 30 percent of mortgaged households in Ireland could be in negative equity. However, while negative equity estimates from aggregate data are informative and useful, in the absence of corresponding household information, the broader issue of credit default cannot be readily assessed.

In this section, we, therefore, examine the issue of negative equity in the housing market using micro level data available from the Irish SILC, and link these estimates of solvency with existing delinquency information for the same households. To estimate whether a household is in negative equity, information is required both for the mortgage outstanding at a point in time and the current price of the property. This information is available in the SILC and the calculations involved in obtaining the estimates are discussed in some detail below.

4.1 Mortgage Outstanding

Respondents to the SILC are asked to provide information on their original mortgage amount (for their principal private residence only), the mortgage term (in years) and the year that the mortgage was taken out.[4] Using a simple annuity formula, this information is combined to calculate the amount of the mortgage outstanding for each household at a point in time. This is an iterative exercise, where capital repayments are calculated annually, deducted from the mortgage outstanding at the end of the previous year and mortgage repayments for the following year are then based on this new outstanding mortgage amount. Specifically, the following annuity formula is used to calculate the annual mortgage repayment (capital plus interest) for each household, while the second formula is used to produce estimates of the amount of capital repaid each year:

$$A_t = M_t / \left(\frac{1 - (1 + R_t)^{-\tau}}{R_t} \right). \tag{1}$$

[4]Households that purchased their home either with a mortgage or under a tenant purchase scheme are included.

$$K_t = A_t/(1 + R_t)^{\tau}. \tag{2}$$

where A_t is the annual repayment (capital plus interest), M_t is the actual mortgage level, R_t is the variable interest rate, τ is the duration of the mortgage and K_t is the annual capital repayment.[5][6]

4.2 House Price

The SILC also asks respondents to estimate the current market value of their house. Since the survey was undertaken in 2009, we adjust the reported values down by 15 percent in order to arrive at an estimate of the value of each respondent's home in 2010. The house price reduction is chosen on the basis of information from the permanent tsb/ESRI house price index, which shows that national average house prices fell by approximately 15 percent in 2010, on an annual basis. In a later section, we assess the sensitivity of our negative equity estimates to alternative house price paths.

4.3 Estimates of Negative Equity

For a given point in time, the number of households in negative equity in the sample is estimated as follows:

$$P_t > M_t : PE_t \tag{3}$$

$$P_t < M_t : NE_t \tag{4}$$

where P_t is the house price, PE_t is positive equity and NE_t is negative equity. The results of this exercise, which are presented in Table 4, show that 11.2 percent of all mortgaged households in the sample were in negative equity by the end of 2010.

However, if we focus instead only on those households which took their mortgage out since 2000, we find that almost 19 percent of those households were in negative equity by the end of 2010. Finally, focussing on households that took their mortgage out since 2004, we find that almost 29 percent would be in negative equity by the end of 2010, according to our methodology.

As a next step we assess a household's proximity to negative equity - the results are shown in Table 5. We find that a number of households that purchased their home in recent years could be in danger of falling into negative equity. For households that purchased their home since 2004, for example, a further 10 percent reduction in house prices (over and above the already assumed 15 percent reduction in 2010) could push an additional 13 percent of these households into negative equity. Overall, however, the results suggest that many households still hold significant buffers of

[5]The interest rate is set as the average variable interest rate prevailing in each year of the mortgage.
[6]τ is reduced by one year for each iterative step of the calculation.

housing equity, with a significant portion of households that purchased their home since 2004 having at least 25 percent positive equity in their home.

4.3.1 Sensitivity of Negative Equity Estimates to Reported House Prices

While household surveys such as the SILC are a good source of the information required for negative equity calculations, research suggests that survey respondents tend to over-estimate the value of their homes, particularly if respondents purchased their home many years before the survey takes place (see Hellebrandt et al (2009) for example). In their study of household survey respondents in the U.S., Benitez-Silva et al (2008) find that homeowners tend to over-estimate the value of their home by between 5 and 10 percent. We therefore re-estimate negative equity among our respondents adjusting the reported house prices down by 7.5 percent - the half way point in the Benitez-Silva study. The results, which are presented in Table 6, show that 13.1 percent of mortgaged households in our sample are estimated to be in negative equity by the end of 2010 after the house price adjustment is taken into account. This figure increases to 21.6 percent if we focus only on households that took their mortgage out since 2000 and it increases further to 33.3 percent if we restrict our sample to mortgages taken out since 2004.

Given that we now have estimates of potential delinquency and solvency for each household, we wish to address the issue of correlation across the distributions of both variables. In the next section, we propose a method for addressing this issue in a rigorous manner.

5 Correlation of negative equity and mortgage repayment distress

Our main objective is to quantify the joint probability of a household experiencing negative equity and mortgage repayment distress. Simply, if the probability of a household experiencing mortgage repayment distress and negative equity were independent of one another, then the joint probability of both occurrences, would, of course, be the sum of the individual probabilities. However, particularly in the case of the Irish mortgage market, it is evident that such an assumption would be quite unrealistic. As noted previously, a considerable number of mortgages in the Irish market were taken out between 2004 and 2007, when house prices were particularly high. Since mid-2007, house prices have been falling and by the end of 2010, prices had fallen, in nominal terms, by almost 40 percent. At the same time unemployment in the Irish economy has risen sharply. Thus, *a priori*, there are good reasons for believing that incidences of mortgage repayment distress may be correlated with that of negative equity.

Therefore, in addressing the issue of the joint probability, one must model the dependence structure between the two variables. The most common way of measuring dependence is the correlation co-efficient. However, this assumes that each variable follows an i.i.d. process and that the joint distribution of the variables is elliptical. In practice, very few variables satisfy these conditions. It

is more appropriate to, instead, work with the entire joint distribution of both variables.

Given that the incidence of repayment distress and negative equity tend to reside in the tails of the respective distributions, standard parametric approaches (such as logit/ probit modelling) are not always likely to yield robust estimates of the relationship between the two concepts. Recently, the financial engineering literature, in particular credit risk modelling, has favoured the use of copulas to address this issue. The specific advantage of a copula is that it allows the isolation of the dependence structure from the structure of the marginals. This allows one to specify two different distributions for the marginals and additionally an independent dependence structure in the form of a copula. This is highly desirable in the case of house equity and repayment distress, as inspection of Figure 1 reveals, both variables have noticeably different distributions. Note that for the distributional analysis, we take the inverse of the MRTI - IMRTI as the "distressed" parts of both the negative equity and repayment burden estimates are now on the left hand side of each distribution.[7]

The ability to separate out the distributions was recognised first by Sklar (1959) and the bi-variate case is given as: for any joint distribution $F(x_1, x_2)$ there is a unique copula function $C : [0, 1] \times [0, 1] \rightarrow [0, 1]$ such that:

$$F(x_1, x_2) = C\left(F_1(x_1), F_2(x_2)\right) \tag{5}$$

Conversely, if C is a copula and $F_1(x_1)$ and $F_2(x_2)$ are distributional functions, then equation 5 defines a bi-variate distribution function with marginal distributions $F_1(x_1)$ and $F_2(x_2)$.

Due to their versatility, a broad range of copulas have been developed but can be broken down into two main categories: (i) elliptical copula's such as the Guassian and the student 't' and (ii) Archimedian copulas such as the Gumbel, Frank and Clayton. The former are constructed using a standard multivariate distribution leading to symmetry in the tails. The latter are one parameter copulas derived directly in terms of their cumulative distribution functions.

Figure 2 represents a scatter plot with histograms of the IMRTI and equity variables. From the graph, it is clear that there is clustering of observations in the bottom left quadrant with a positive relationship as both variables increase. The selection of copula type is determined by goodness-of-fit tests based on maximisation of the log likelihood function, namely Schwarz Bayesian (SIC), Akaike (AIC) and Hannan-Quinn Information Criterion (HQIC). Table 7 shows, for all measures, the Frank copula is found to best represent the data. In terms of estimation, a kernall smoothing filter is applied to the empirical cumulative probability distributions. The fit parameter for the Frank copula, tau, is estimated through maximum likelihood. This method has the advantage of not forcing the fit of a known distribution on the cdf's of the IMRTI and equity variables. Figure 3 presents the probability density function of the estimated copula. The above modelling of the dependence structure allows estimation of the joint probability of payment distress and a household

[7] We define the "distressed" part of the MRTI distribution as the range above 26 percent. This cut-off reflects the average MRTI of households that reported being in arrears on mortgage repayments at some point during the previous twelve months.

experiencing negative equity. Taking the whole sample (1,090 observations), there is a modest 6.06 percent probability that both occur together.

5.1 An uncertain outlook

More than most western countries, the Irish economy has been particularly affected by the recent financial crisis. The culmination of continued uncertainty surrounding the financial system and the deteriorating state of the public finances resulted in Ireland seeking an IMF-EU fiscal support programme in November 2010. One of the requirements of the programme was the need to bridge the significant exchequer deficit, which, in 2010, was estimated to be 12 percent of GDP.[8] A significant austerity programme was intensified in November 2010 aimed at raising 15 billion euros in budgetary measures between 2011 and 2014. As a first tranche, 6 billion euros was to be achieved in 2011. The scale of the associated public expenditure cutbacks and taxation increases has inevitably raised the concern that these measures may exacerbate the situation amongst distressed mortgage owners. Additionally, Irish house prices have, as of 2010 quarter 4, been declining for 3 consecutive years. A concern, in this regard, is that prices could continue to fall, thereby resulting in greater degrees of negative equity.

Given the degree of importance of these macroeconomic considerations, in addition to generating estimates of the joint probability for 2010, we also forecast what the probability is likely to be at the end of 2011. In doing so, we explicitly allow for the initial phase of austerity measures and the possibility of continued house price declines into 2011. For all of our calculations, house prices are assumed to record a 50 percent fall from peak (early 2007) to trough (end of 2011). Actual data shows that prices have fallen by nearly 40 percent by end-2010. Therefore, we assume the remainder of the peak to trough fall will occur through 2011. As the underlying SILC data are for 2009, the household income figures were reduced by 3.4 per cent to reflect aggregate changes in disposable income between 2009 and 2010. This is incorporated within the estimate for the 2010 joint probability.

As of early 2011, internal Central Bank forecasts suggest that aggregate disposable income is set to decline by a further 2.1 percent in 2011 - household income is adjusted accordingly. From Table 8, it can be seen that, given the forecast developments in 2011, the joint probability increases to 10.94 per cent. It is also evident from the table that it is the expected changes in house prices which exert a much stronger effect vis-à-vis that of income.

6 Conclusions

The close association between the Irish sovereign and its financial institutions, as crystallised by the Government guarantee of September 2008, has undermined the ability of the Irish economy

[8]This followed a deficit of 14.6 percent of GDP in 2009. Also if certain measures to do with capitalisation of the banking sector were included (as required by Eurostat), the Irish deficit, officially for 2010 would be in the region of 30 percent of GDP.

to emerge from the recent financial crisis. Arguably, the single greatest issue confronting Irish credit institutions is the potential distressed nature of their residential mortgage book. A relatively large portion of the total stock of Irish mortgages was issued when house prices were considerably overvalued and when the general public was well placed to service the resulting high mortgage amounts. The subsequent crash in Irish property prices since 2007 and the rapid increase in general unemployment has given rise to a potentially sizeable credit default problem.

In this paper, building on existing research into mortgage repayment distress, we examine the potential for credit impairment, where this is defined as the potential combination of delinquency (heightened levels of mortgage distress which could lead to arrears) and insolvency (negative equity). Across a representative sample of Irish households, we generate distributions of both delinquency and solvency concepts. We then, using copula modelling, examine the dependence across these distributions. As a result, we are able to calculate the probability of a household experiencing repayment distress also experiencing negative equity. Our results point to a 6.1 percent joint probability in 2010.

Given the highly uncertain future of Irish economic growth, we also conduct a scenario analysis to examine the sensitivity of the joint probabilities to changes in income levels and house price decreases. Our results suggest that further house price and income falls could result in heightened financial distress among mortgaged households in Ireland and an increase in the number of households in negative equity.

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Table 1: Distribution of Mortgage Repayment to Income Ratio (MRTI) by Household Deciles (weighted results)

Decile	MRTI Range %	Average Income (000 euros)	Average Mortgage Repayment (000 euros)	No. of Households
Bottom	0.53 - 4.05	75.2	2.0	123
2nd	4.06 - 5.95	69.6	3.4	123
3rd	5.96 - 8.32	71.0	5.0	123
4th	8.33 - 11.09	58.7	5.7	123
5th	11.10 - 13.96	69.0	8.8	122
6th	13.97 - 17.22	57.8	8.9	123
7th	17.23 - 21.34	57.9	11.3	123
8th	21.35 - 26.16	56.8	13.5	123
9th	26.17 - 33.70	52.7	15.2	123
Top	33.71+	55.4	26.4	122
Total		62.6	9.8	1,228

Figure 1
Non−parametric Fitting of Distributions

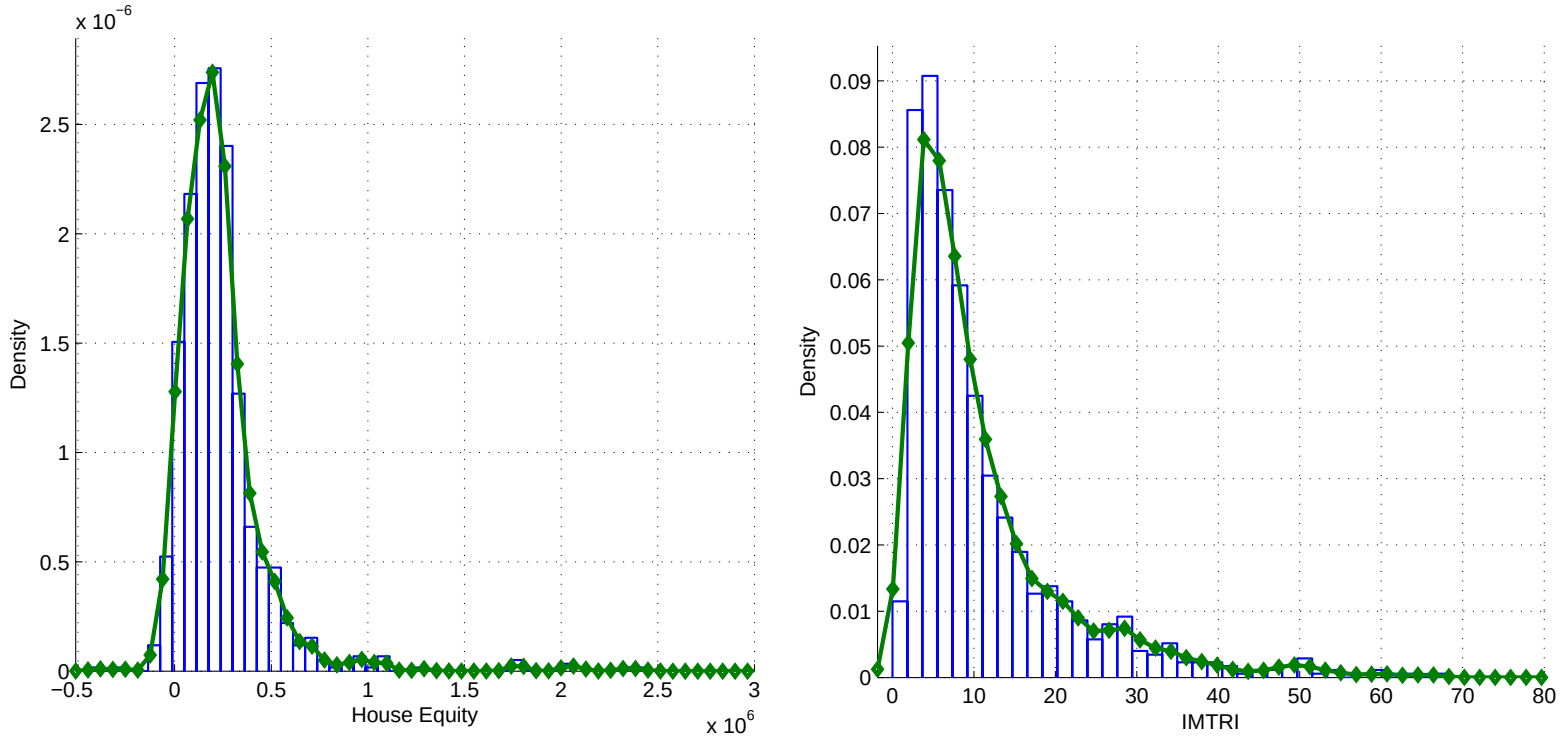

Figure 2
Scatter Plot with Histograms

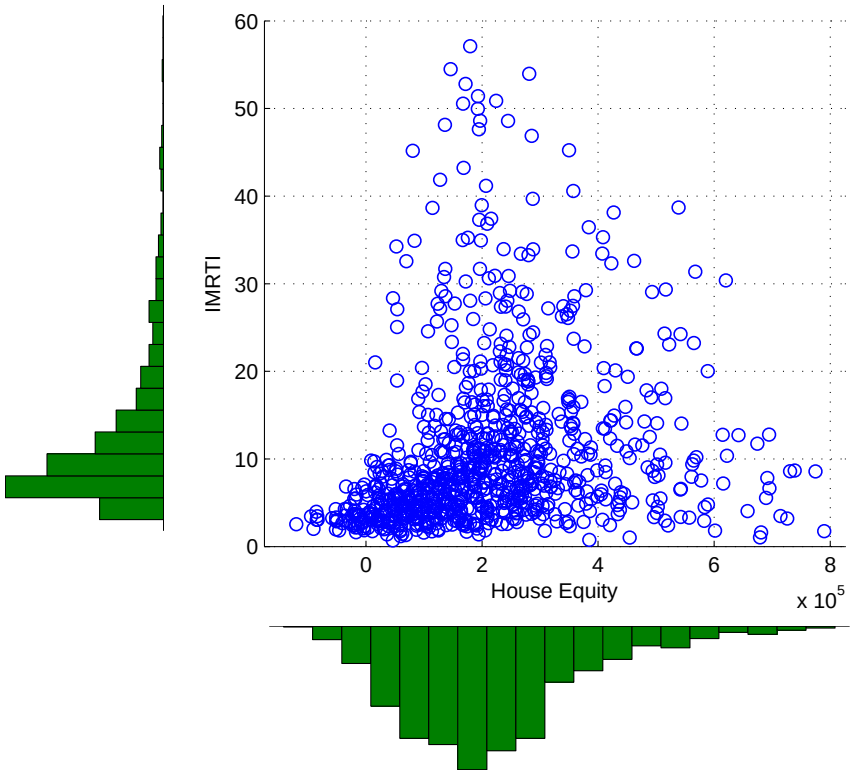

Figure 3
Archimedean 'Frank' Copula CDP

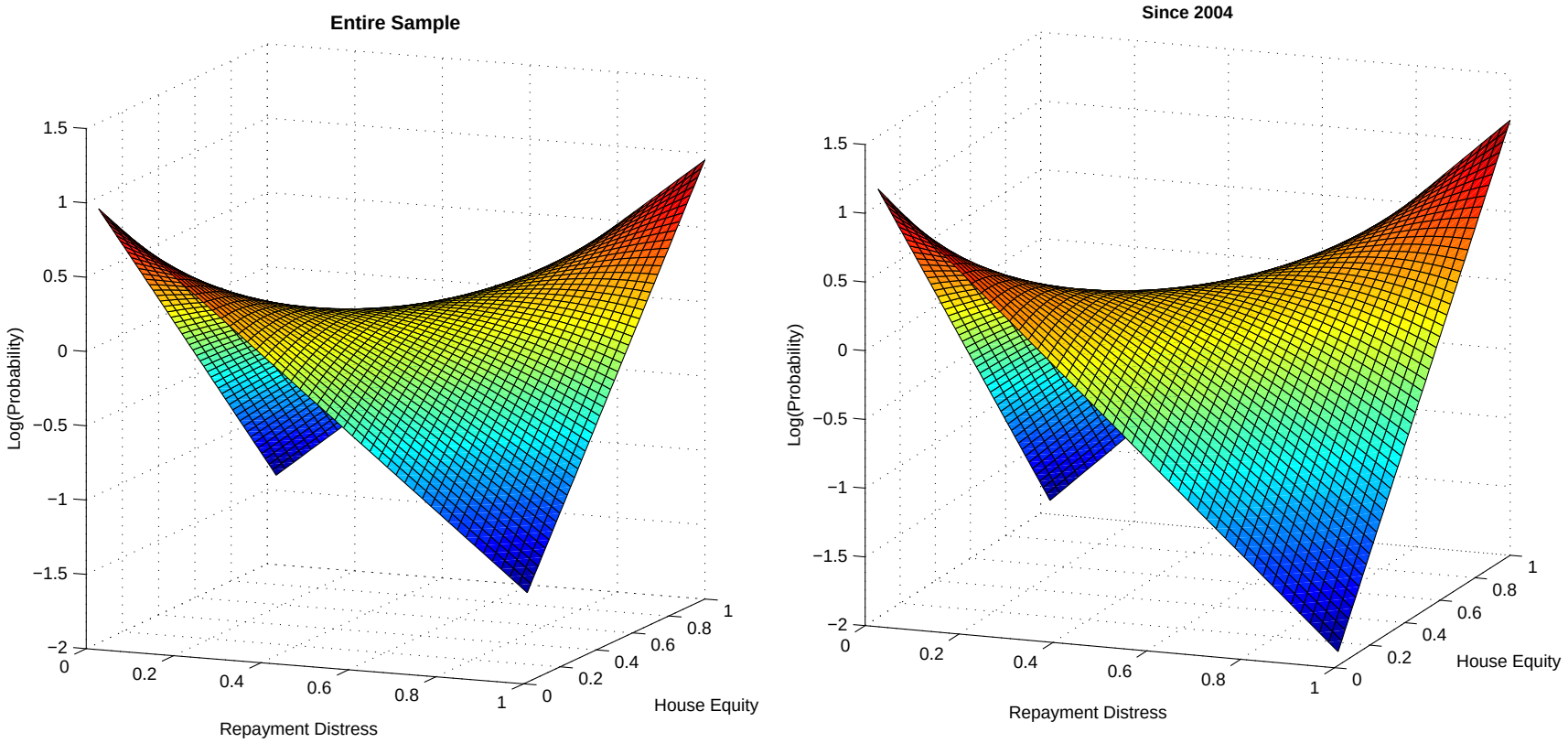

Table 2: Household Summary Statistics, according to Mortgage Repayment to Income (MRTI) ratio (%)

MRTI (%)		0.53 to 13.96	13.97 to 17.22	17.23 to 21.34	21.35 to 26.16	26.17 to 33.70	33.71+	Total
Head of Household	Mean Age (yrs)	48	44	39	38	37	43	44
	(%) Male	66.7	58.4	70.0	53.6	61.2	65.5	64.2
	(%) Urban	65.0	64.6	74.1	67.1	78.3	71.1	67.8
Marital Status (HOH)	Single	8.9	29.7	18.1	29.6	44.1	27.1	18.8
	Married	80.2	60.0	74.2	58.9	48.0	59.6	70.6
	W/D/S	11.0	10.3	7.7	11.5	7.9	13.3	10.6
Work Status (HOH)	Employed	77.1	80.4	86.8	79.5	77.1	75.5	78.5
	Unemployed/Inactive	22.9	19.6	13.2	20.5	22.9	24.5	21.5
Education Status (HOH)	Lower	33.7	29.4	19.2	9.3	14.1	26.1	26.7
	Upper 2nd	53.8	49.1	64.8	69.6	70.5	52.7	57.5
	3rd Level Degree+	12.5	21.6	15.8	21.2	15.5	20.7	15.7
	Other	0.1	0.0	0.2	0.0	0.0	0.6	0.1
Household Composition	1 Adult, with or without children < 18	5.8	11.8	6.9	12.8	26.3	25.6	10.9
	2 Adults, no child < 18	16.8	28.4	34.2	19.2	19.4	21.6	20.6
	3+ Adults, no child < 18	20.3	7.4	3.6	4.9	10.6	6.0	13.5
	2 Adults, 1-3 child < 18	32.6	41.2	50.5	55.3	35.4	31.3	37.8
	Other households with children < 18	24.5	11.3	4.7	7.9	8.4	15.5	17.2
N		614	123	123	123	123	122	1,228

Note: N = number of households in sample. Results are weighted.

Table 3: Mortgage Characteristics, according to Mortgage Repayment to Income (MRTI) ratio (%)

MRTI (%)		0.53 to 13.96	13.97 to 17.22	17.23 to 21.34	21.35 to 26.16	26.17 to 33.70	33.71+	Total
Source of Mortgage	Building Society	44.0	34.8	41.4	47.8	27.9	36.4	41.1
	Bank	39.6	53.1	51.4	44.6	67.3	57.1	46.7
	Other	16.5	12.1	7.2	7.6	4.8	6.5	12.2
Mortgage Type	Endowment	12.9	13.2	9.2	8.8	12.8	8.2	11.6
	Annuity	79.3	75.1	72.6	81.8	75.9	67.7	77.1
	Interest Only	3.4	3.6	11.3	4.5	4.6	22.3	6.2
	Don't Know	4.4	8.1	6.8	4.9	6.7	1.9	5.0
Interest Rate	Fixed	29.6	24.7	23.3	28.4	28.7	24.5	27.8
	Variable	70.1	74.3	76.8	69.9	71.1	75.1	71.7
	Don't Know	0.4	1.0	0.0	1.7	0.2	0.4	0.5
Year Mortgage Taken Out	1970s/1980s	20.4	5.4	0.2	0.3	0.0	0.0	11.0
	1990s	47.2	21.5	23.9	4.9	7.2	9.0	30.7
	2000s	32.4	73.2	75.9	94.8	92.8	91.0	58.2
Mortgage Term	0-20 years	48.7	34.2	31.7	23.0	22.1	44.3	40.1
	21-30 years	47.0	58.1	52.7	53.9	54.6	41.6	49.6
	31-40 years	4.3	7.8	15.7	23.1	23.2	14.1	10.4
N		614	123	123	123	123	122	1,228

Note: N = number of households in sample. Results are weighted.

Table 4: Households in Negative Equity, % of Mortgaged Households

	End-2010	
	%	Total N
All Mortgages	11.2	1,156
Mortgages Since 2000	18.9	699
Mortgages Since 2004	28.8	435

Note: % of households in negative equity represents weighted results. N = number of households in sample.

Table 5: Households in Danger of Negative Equity, % of Mortgaged Households

% of Home Value in Positive Equity (PE)	All Mortgages	Mortgages Since 2000	Mortgages Since 2004
0<PE<=10	3.9	7.1	12.6
10<PE<=25	5.6	10.2	16.5
PE>25	90.5	82.7	70.9

Note: Results are weighted.

Table 6: Households in Negative Equity, % of Mortgaged Households
Adjusting Reporting House Prices Down by 7.5%

	End-2010	
	%	Total N
All Mortgages	13.1	1,156
Mortgages Since 2000	21.6	669
Mortgages Since 2004	33.3	435

Note: % of households in negative equity represents weighted results. N = number of households in sample.

Table 7: Copula Goodness-of-Fit Tests

	Baseline			**2011 Scenario**		
	-SIC	-AIC	-HQIC	-SIC	-AIC	-HQIC
All Sample						
Normal	139.89	144.72	142.87	172.06	176.91	175.06
T	145.75	156.44	152.75	181.08	190.77	187.08
Gumbel	160.44	170.13	166.44	193.99	203.68	200.00
Frank	170.17***	179.86***	176.17***	211.14***	220.83***	217.14***
Clayton	160.21	169.90	166.21	186.88	196.57	192.88

Note: The copula which best fits the data is based on three selection criterion: (i) Schwarz Information Criterion (SIC), (ii) Akaike Information Criterion (AIC) and (iii) Hannan-Quinn Information Criterion (HQIC). *** denotes the best copula fit.

Table 8: Joint Probability (%) for a Household of Negative Equity and Stressed Repayment

			Marginal Response to Individual 2011 Scenario Components	
	Baseline	**2011 Scenario**	**Income**	**House Prices**
All Sample	6.06	10.94	6.24	10.5

Note: The most stressed repayment reflects an MRTI above the mean MRTI of households reported to be in arrears. The 2011 scenario explicitly allows for two factors; (i) initial phase of the austerity measures, i.e. effect of a 6 billion euro fiscal contraction on disposable income and (ii) continued house price declines. The SILC dataset ends December 2009, therefore adjustments must be made before joint probability estimates for 2010 and 2011 can be produced. House prices are assumed to record a 50 percent fall from peak to trough with over 30 percent taking place by end-2010 and the remainder in 2011. A reduction of 3.4 percent to disposable income is applied for 2010 and a downward adjustment of 2.1 percent for 2011. All scenario calculations are based on Central Bank of Ireland internal estimates. The joint probabilities are estimated using a Frank Copula.