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Repayment capacity, debt service ratios and mortgage default: An exploration in crisis and non-crisis periods

Conor O'Toole[a,b] and Rachel Slaymaker[a,b]

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Corresponding authors: conor.otoole@esri.ie
rachel.slaymaker@esri.ie

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JEL Classification: D14, G21, R31

a Economic and Social Research Institute.
b Department of Economics, Trinity College Dublin.

Repayment Capacity, Debt Service Ratios and Mortgage Default: An Exploration in Crisis and Non-Crisis Periods

Conor O'Toole[a,b] & Rachel Slaymaker[a,b] *

[a] *Economic Analysis Division*, Economic and Social Research Institute.

[b] *Department of Economics*, Trinity College Dublin.

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*Email: Conor.OToole@esri.ie or Rachel.Slaymaker@esri.ie. The views presented in this paper are those of the authors alone and do not represent the official views of the Economic and Social Research Institute. Results presented in this paper are based on analysis of strictly controlled Research Microdata Files provided by the Central Statistics Office (CSO). The CSO does not take any responsibility for the views expressed or the outputs generated from this research. Any remaining errors are our own.

1 Introduction

Assessing the drivers of mortgage default has long been of interest to both academics and policy makers alike. In recent theoretical models, default is explained by the influence of two channels: a) house price shocks which move the household into negative equity and b) shocks to their ability to maintain repayments through the labour market or through rises in the cost of finance (Campbell and Cocco, 2015; Aron and Muellbauer, 2016). These channels are predicted to interact through a "double trigger" where households suffering from a combination of both negative equity and affordability shocks are more likely to default (Foote et al., 2008).

Empirically this research has increased in saliency in recent years due to the link between mortgage delinquency and the global financial crisis, and the increasing importance being placed on financial stability of both households and mortgage banks more broadly (Duca et al., 2010; Mayer et al., 2009). The research has mainly focused on determining the relative importance of equity shocks which change the value of the property relative to the outstanding debt, and shocks to loan affordability from adverse labour market outcomes such as job loss or reductions in take home pay (Gerardi et al., 2008; Elul et al., 2010; Haughwout et al., 2008; Fuster and Willen, 2017; Kelly and O'Malley, 2016; Lydon and McCarthy, 2013; Connor and Flavin, 2015).

In the existing research, Mocetti and Viviano (2017) note there has been a disproportionate focus on the housing equity channel. One explanation for this is that a large number of these papers are based on the US, where the institutional setting is more favourable to strategic default, due to the non-recourse legislation present in certain states. This is compared to the European market where mortgage debt is not discharged with the sale of the property, and therefore the consequences of default are more severe in terms of future access to the credit market.

A second explanation is the challenge from a data perspective in obtaining a suitable measure for both equity and affordability at the micro level. While most studies in the existing literature have loan level measures of the current loan-to-value ratio, few studies have up-to-date information on household income in order to properly account for affordability shocks. Indeed, the greater focus on the housing equity channel potentially arises due to the use of bank loan level data which do not contain borrower characteristics, or at best, only contain limited information from the time of loan origination. Consequently these datasets lack crucial information on current income and labour market status. This has led to the frequent use of aggregate, regional level unemployment rates as an approximation for individual level affordability shocks. Gyourko and Tracy (2014) show that using local level unemployment rates as a proxy for unobserved household level employment status leads to severe attenuation bias and underestimates the true effect of unemployment on default by as much as a factor of 100.

The lack of adequate measures of current repayment capacity or affordability shocks in most datasets means that to date relatively few studies have used data on current income

to test affordability channels, with Gerardi et al. (2017), Mocetti and Viviano (2017) and Slaymaker et al. (2019) notable exceptions. This lack of current income information with which to measure directly the repayment capacity of the household, in particular for a sample that spans a broad period of tranquil and turbulent economic times, has left a number of questions unanswered in the literature: does the relationship between repayment capacity and default differ depending on the magnitude of any shock or the level of indebtedness of the household? Does the relationship between repayment capacity and default vary over time depending in broader economic conditions for example in crisis and non-crisis periods? Can any differences be explained by the presence of negative equity (to drive the double trigger) or liquidity constraints?

To address these gaps in the literature, this paper examines the impact of repayment capacity on mortgage default using Irish household survey data over the period 2004-2017, a period which bookends a systemic financial crisis with periods of strong economic growth. The contribution of this paper is threefold. First, we build on the work by Slaymaker et al. (2019) to explore the link between mortgage repayment capacity and default by testing the direct relationship between changes in the debt-service ratio and flows into default. Using the change in the current debt service ratio provides us with a direct measure of affordability shocks that come from both the labour market as well as interest rate changes and provides a direct measure of repayment capacity. These data allow us to deploy a methodology that addresses two biases common in studies on mortgage default; the omitted variables relating to current household-level circumstances and the measurement error from using aggregate employment information. We also have household level information on the current loan-to-value ratio and a range of other household controls.

Second, we test whether changes in the repayment capacity are non-linear (depending on the magnitude of the shock) and have a different impact on mortgage default depending on the level of household absorptive capacity (or indebtedness measured by the level of the DSR in period t-1).

Third, and a particular novelty of our paper, we then exploit the length of time our data covers to explore whether the impact of changes in the debt service ratio on default differs in periods of systemic crisis compared to times of relative macroeconomic stability. The reach of our samples across turbulent and stable periods allows us to split our sample and test the impact of shocks to the debt service ratio in both periods. Differences could be expected in theory if, for example, the level of negative equity or liquidity constraints differs in these contexts. We examine both of these channels in terms of how affordability shocks may be exacerbated by negative equity or liquidity constraints. To our knowledge, this has not been tested to date in the literature.

A number of recent papers using survey or administrative data to link mortgage performance to current income are close to our work. Mocetti and Viviano (2017) use administrative data on income and credit registry data for Italy to explore the impact of income shocks on mortgage delinquencies in a panel setting. They find a large effect of income shocks on default. However, they do not explicitly link the debt service ratio to

default which means they are omitting as an influence any changes that are relating to the repayment through interest rate adjustments. They also do not take into account the level of indebtedness of the households which would capture how much spare capacity each has to absorb shocks.

Aller and Grant (2018) and McCarthy (2014) also use panel and cross sectional survey data respectively containing current income to explain mortgage defaults. We build on these papers by explicitly linking the household's current debt service ratio to transitions into default, ensuring that we take account of potential changes to both incomes and mortgage instalments, as well as additional employment and health information for all household members. These studies don't explicitly link the current debt-service ratio to default, rather, they use income and employment data separately. The latter is also reliant on cross-sectional data.

In one recent study which does link the current repayment capacity through the DSR to default, Gerardi et al. (2017) use the US Panel Study of Income Dynamics (PSID) data, containing current income information, to quantify the relative importance of negative equity versus affordability concerns for the US. They find evidence that changes in the ability to pay, for example due to job loss, have large effects on the probability of default. The authors also find evidence of strategic default, estimating that more than one third of households who did default could have continued to pay their monthly mortgage instalments without needing to reduce their consumption. One limitation of their dataset is its biannual frequency which prevents modelling default using a survival approach. They also do not look at non-linear effects and test for differences in periods of systemic crises and economic tranquillity, which is also a contribution of our paper relative to Aller and Grant (2018), Mocetti and Viviano (2017), Slaymaker et al. (2019) and McCarthy (2014).

A number of findings emerge. We find both the level of, and shocks to, the current debt service ratio to be key determinants of households transitioning into mortgage loan delinquency. Changes in the debt service ratio appear to have the largest effect highlighting the saliency of the affordability shocks channel. Examining the importance of a household's capacity to absorb shocks, we show that the direction of the affordability shock (positive or negative) matters and is dependent on the level of indebtedness. A deterioration in the debt service ratio increases the likelihood of delinquency regardless of the level of debt, but with double the magnitude of effect for highly indebted households.

With regards to how the relationship between changes in the debt servicing capacity and default differs over time, we show that the sensitivity of default to a one per cent rise in the DSR is greater during periods of systemic crisis relative to more macroeconomically stable, non-crisis times. Further examination of the channels driving variation in this relationship over time reveals that both negative equity and liquidity constraints help to explain the differing effects during crisis and non-crisis periods. More specifically, two points are important to highlight. First, the magnitude of the coefficient on the change in the debt service ratio (for those households experiencing an increase in the DSR) was much higher for those households in negative equity. This finding supports the double trigger

hypothesis, as well as documenting the importance of repayment capacity in driving default. Second, the magnitude of the coefficient was also considerably higher for those households who faced tighter liquidity in crisis periods, indicated by households who were previously unable to save regularly. This finding holds for both households with and without negative equity which demonstrates a separate liquidity channel during crisis periods.

These findings are important as they highlight how the effects of repayment capacity shocks vary according to the broader economic situation, the degree of housing equity and household liquidity. These findings should be taken into account by policymakers in designing macroprudential policy measures as well as those designing effective interventions during crises to ameliorate heightened loan default (such as the various mortgage modification programmes in the US and Europe).

The remainder of this paper is structured as follows. Section 2 outlines the data and empirical model used in the analysis. Section 3 presents the baseline empirical results, while Section 4 explores how the relationship between the debt service ratio and default differs during periods of systemic crisis. Section 5 presents some robustness checks and Section 6 concludes.

2 Data and Empirical Model

2.1 Data and Summary Statistics

In this section we present the data used in the analysis. The data come from the 2004-2017 Irish waves of the EU Survey of Income and Living Conditions (SILC) which is coordinated by Eurostat and undertaken by the national statistical agencies. SILC is a household panel survey containing information on topics ranging from housing to poverty, deprivation and social exclusion, in addition to standard socio-demographic characteristics and current income data. Critically for our purposes, the Irish SILC contains information for each household on home ownership, current dwelling value, originating mortgage conditions (loan size and term), outstanding loan balance, current interest rate type, monthly mortgage instalments and whether a household is in default on their mortgage payments. A common issue with the use of survey data in this field is that surveys typically do not collect data on mortgage default on a regular basis (Mocetti and Viviano, 2017). Using Irish SILC data overcomes this issue; a measure of missed mortgage payments is captured in the dataset in a four year rotating panel structure (households are surveyed annually for a maximum of four years).

One of the major challenges in the existing literature, from a data perspective, is obtaining a suitable measure of the affordability, or ability to pay channel at the household level (Gerardi et al., 2017). The majority of existing studies use administrative loan-level data, which either do not contain borrower characteristics, or at best, only contain limited information from the time of loan origination. Consequently, few studies have up-to-date information on household income and the employment status of household members, in

addition to mortgage loan information, in order to properly account for repayment capacity shocks. Researchers therefore typically use aggregate regional measures of unemployment as a proxy for household level income shocks (Elul et al., 2010; Kelly and O'Malley, 2016; Bhutta et al., 2017). However, Gyourko and Tracy (2014) show that using local level unemployment rates as a proxy for unobserved household level income and employment shocks leads to severe attenuation bias and underestimates the true effect of unemployment on default.

As discussed in Slaymaker et al. (2019), one of the main motivations for using SILC data to examine the determinants of mortgage default is that it enables us to combine information on mortgage payment default with timely data on the household's economic status. This ensures that two biases common in existing studies are avoided; the omitted variable bias relating to the lack of current household income and the measurement error from using aggregate employment information. The importance of using timely data is underlined by the fact that economic conditions can deteriorate quickly, as was the case in Ireland where the unemployment rate increased sharply from just over 5 per cent in early 2008 to nearly 16 per cent by mid 2010. We are able to exploit up-to-date information on current net household income and monthly mortgage payments to directly link both changes in repayment capacity (through reductions in income or increased payments) as well as the level of indebtedness to loan delinquency. Moreover, in addition to the household questionnaire, all household members also complete an individual level survey component containing responses to key socio-economic factors such as employment and health status; potential trigger events for default. Utilising these individual level responses allows us to obtain a more accurate picture of the employment and health situations of the entire household, rather than simply relying on information for the individual household member who completed the household questionnaire. Specifically, we observe whether the number of unemployed adults in the household has risen in the previous year and whether one or more household members suffered a chronic health shock in the last 12 months.

In addition to enabling us to better measure the repayment capacity channel, with regards to the equity channel, another advantage of using SILC is that it contains information on the current dwelling value, which enables us to calculate a current loan to value ratio. Typically in the existing literature this is done by updating the house price at origination using the growth in house prices in a local area (Elul et al., 2010).

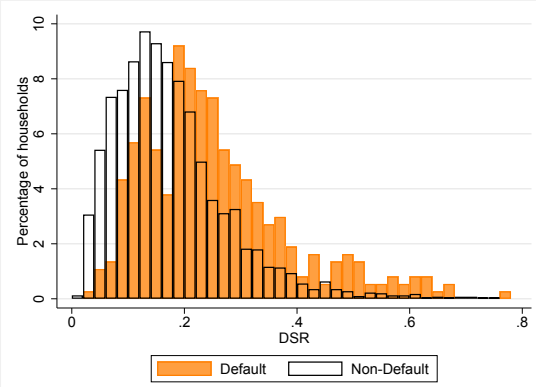
Several potential concerns remain over the use of survey data to examine the determinants of mortgage loan delinquency. Mocetti and Viviano (2017) argue that sample sizes are typically small due to mortgage delinquency being a low probability event, casting doubt over the reliability of empirical estimates. In addition, they express sample selection concerns, arguing that certain households may be less willing to answer survey questions and that this is likely correlated with them having repayment difficulties, leading to under-representation of mortgage default in surveys. In previous work using SILC Slaymaker et al. (2019) have shown that for the period 2009-2016[1], there is a 0.88 correlation between

[1]Central Bank of Ireland loan level data are only available from 2009 onwards.

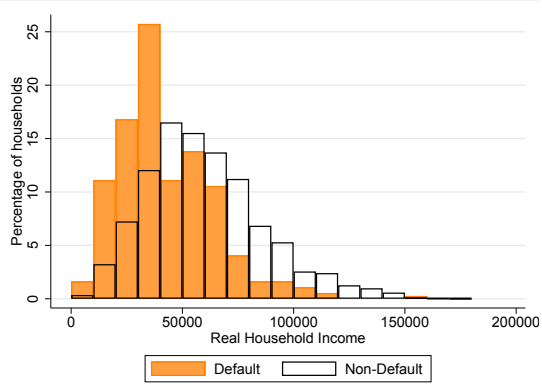
the percentage of principal dwelling home (PDH) loans in default of any length in the official Central Bank of Ireland mortgage arrears statistics and the percentage of households in mortgage default in SILC (see Figure 2 Slaymaker et al. (2019)). Furthermore, Slaymaker et al. (2019) build a household stress testing model which predicts a 2.7% rate of transitions into mortgage default in 2016. Using Central Bank of Ireland loan-level data, McCann (2017) shows that the actual six monthly flow was approximately 1.5%, indicating that the model based on these SILC data is a very close fit with the actual observed loan-level data. We therefore contend that SILC is a suitable dataset with which to undertake analysis of the determinants of mortgage default.

Figure 1: Debt Service Ratio and Income Distributions by Default Status

(a) DSR



(b) Income



In Figure 1a we plot the distributions of the current debt service ratio (DSR), the ratio of monthly mortgage payment to net monthly income, for households in and not in mortgage default respectively. The DSR distribution for households in default is clearly shifted to the right indicating a higher proportion of these households pay a greater proportion of their income to service their mortgage payments relative to households who are not in default. Similarly, Figure 1b shows that households in default are more highly concentrated towards the lower end of the income distribution compared to those not in default. Both of these charts highlight the correlation between repayment capacity constraints and mortgage default that we will test empirically in Section 3.

Our final sample consists of all mortgaged households who are surveyed in at least two consecutive years and have full information on mortgage default, monthly mortgage instalments, outstanding mortgage balance, current dwelling value and disposable income. For households in mortgage default, we restrict the sample to contain households only in the year they transition into default, i.e. we remove those who had already defaulted in a previous survey year. We present descriptive statistics for our final sample in Table 1. 3.5 per cent of the final sample transitioned into mortgage default. In terms of mortgage loan characteristics, from Table 1 we see that households who transitioned into default in our sample had similar monthly mortgage instalments to those not in default, but that their disposable income levels were €12,000 lower than households not in default.

Table 1: Decsriptive Statistics by Default Status

	(1) No Arrears	(2) Arrears
Original Loan (€)	156418.70	162690.10
Outstanding Principal (€)	131523.80	137583.20
Monthly Payment (€)	853.62	855.58
Mortgage Term (Years)	25	26
Debt Service Ratio	0.18	0.22
Change in DSR	-0.003	0.015
Current Loan to Value Ratio	0.51	0.66
Negative Equity	0.12	0.25
Real Disposable Income (€)	62680.82	50300.88
Rise in no. Unemployed in HH	0.04	0.25
HH member health shock	0.09	0.20
No. Obs	4178	152

Consequently, they also had higher debt service ratios, paying on average 22 per cent of their income compared to only 18 per cent for households not in default. Interestingly, while households not in default on average saw a slight fall in their debt service ratio, those who transitioned into default saw a rise. In addition, approximately one quarter of households who transitioned into default saw a rise in the number of unemployed household members, while one fifth contained a household member who suffered a major health shock in the preceding year. We will test these channels empirically in Section 2.2.

2.2 Empirical Model

Our empirical approach uses a standard survival model of transitions into default. Let

$$Default_{it} = \begin{cases} 1 & Default^*_{it} \geq 0; \\ 0 & otherwise \end{cases}$$

where $Default^*_{it}$ represents the underlying latent propensity of falling into default and $Default_{it}$ is the observed indicator variable for whether household i falls into default in year t[2]. Our model is estimated using a discrete time logit survival specification which models the probability that a household transitions into delinquency as a function of affordability and equity shocks, as well as the underlying socio-economic characteristics of the borrower:

[2]In SILC respondents are asked whether "In the last 12 months, did it happen that the household was unable to make a mortgage repayment for the main dwelling on time, due to financial difficulties?". Our definition of default therefore differs from the commonly used Basel III 90 days past due definition.

$$Pr(Default_{it} = 1) = f(\Delta DSR_{it}, DSR_{it-1}, lnY_{it-1}, \mathbf{\Delta S_{it}}, CLTV_{it-1}, \Delta CLTV_{it}, \mathbf{X_{it}}, \phi_i, \gamma_t) \quad (1)$$

Our principal loan repayment capacity measure is the DSR, the proportion of current net monthly income spent on mortgage repayments. We include both the lagged level (DSR_{it-1}) and the change in the debt service ratio (ΔDSR_{it}) in our specification to account for both the level of repayment capacity, as well as any affordability shocks. The inclusion of lagged net income, lnY_{it-1} , in addition to the debt service ratio enables us to capture the impacts of differing DSR levels and DSR shocks for a given income level.

$\mathbf{\Delta S_{it}}$ is a vector of household variables that could be considered potential trigger events for loan delinquency, specifically whether the household has suffered either an employment or a health shock during the previous year. Exploiting the individual survey component of the SILC data, we create two indicator variables for whether the number of household members in unemployment has risen and if one or more household members suffered a chronic health shock in the last year. Including these indicator variables ensures that borrowers who faced a catastrophic event which may have triggered mortgage delinquency are separately controlled for, over and above the repayment capacity challenges captured by the debt service ratio. The DSR therefore picks up the effects of smaller falls in income which may be due to wage cuts or a reduction in working hours, as well as an increase in mortgage payments, that are not necessarily caused by these trigger events.

To control for the housing equity channel, we include both the lagged level ($CLTV_{it-1}$) and the change in the household's current loan-to-value ratio ($\Delta CLTV_{it}$). $\mathbf{X_{it}}$ is a vector of household borrower characteristics which include the age, education level and marital status of the household head, as well as the household composition. We also include NUTS3 region, ϕ_i, and year, γ_t fixed effects to control for both regional macroeconomic variation and business cycle fluctuations.

As discussed in Kelly et al. (2015), the choice of the functional form for time is an important consideration in discrete time survival models. The latent exposure to default risk varies across both households and time. To account for this, we follow Kelly et al. (2015) in modelling the functional form for time as a polynomial of loan vintage, years since loan origination. We append this measure to the model shown in equation 1.

3 Empirical Results

3.1 Baseline Results

In Table 2 we present the results from estimating the discrete time survival model of transitions into mortgage default outlined in Section 2.2. We report average marginal effects from logit estimations with standard errors in parentheses. All specifications include loan vintage, year and NUTS3 region dummy variables. In Column 1 we first focus purely

Table 2: Baseline Results

	(1)	(2)	(3)	(4)	(5)
Household Characteristics					
Age					
36-50	-0.0241**	-0.0205*	-0.0206**	-0.0195*	-0.0199*
	(0.0108)	(0.0105)	(0.0105)	(0.0104)	(0.0105)
>50	-0.00783	-0.00172	-0.00191	-0.00296	-0.00353
	(0.0168)	(0.0177)	(0.0177)	(0.0170)	(0.0171)
Marital Status					
Single	0.0138	0.0121	0.0126	0.0135	0.0150
	(0.0154)	(0.0151)	(0.0151)	(0.0154)	(0.0156)
Widowed/Separated/Divorced	-0.000868	-0.000873	-0.000204	-0.000412	0.00100
	(0.0133)	(0.0134)	(0.0137)	(0.0133)	(0.0137)
Secondary	0.00369	0.00464	0.00408	0.00427	0.00301
	(0.0208)	(0.0205)	(0.0208)	(0.0200)	(0.0204)
Tertiary	-0.00793	-0.00687	-0.00765	-0.00640	-0.00779
	(0.0214)	(0.0212)	(0.0214)	(0.0206)	(0.0210)
Household Composition					
1 adult, 1+ children	0.0371	0.0358	0.0344	0.0357	0.0326
	(0.0254)	(0.0249)	(0.0246)	(0.0235)	(0.0220)
2+ adults, no children	0.0129	0.0123	0.0127	0.0158*	0.0173**
	(0.00850)	(0.00866)	(0.00865)	(0.00830)	(0.00827)
2+ adults, 1+ children	0.0326***	0.0315***	0.0316***	0.0356***	0.0364***
	(0.0111)	(0.0112)	(0.0112)	(0.0108)	(0.0107)
Household Shocks					
HH member health shock	0.0290***	0.0289***	0.0293***	0.0266***	0.0273***
	(0.0102)	(0.0101)	(0.0101)	(0.00935)	(0.00939)
Rise in no. Unemployed in HH	0.0652***	0.0646***	0.0648***	0.0615***	0.0611***
	(0.0121)	(0.0122)	(0.0122)	(0.0119)	(0.0120)
L.Log Real HH Income	-0.0133	-0.0139	-0.0104	-0.0194**	-0.0126
	(0.00856)	(0.00883)	(0.00962)	(0.00896)	(0.00937)
LTV Channel					
L.CLTV		0.0107	0.00880	0.0123	0.00815
		(0.00925)	(0.00945)	(0.00888)	(0.00932)
ΔCLTV		0.00333	0.00220	0.00302	0.000167
		(0.0117)	(0.0121)	(0.0115)	(0.0122)
Affordability Channel					
L.DSR			0.0289		0.0669
			(0.0465)		(0.0452)
ΔDSR				0.110*	0.127**
				(0.0656)	(0.0618)
Loan Vintage	Y	Y	Y	Y	Y
Year Dummies	Y	Y	Y	Y	Y
NUTS 3 Region Dummies	Y	Y	Y	Y	Y
Observations	4,330	4,330	4,330	4,330	4,330

Loan vintage is defined as years since mortgage origination. Standard errors reported in parentheses and significance level displayed as * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$..

on borrower characteristics. Households in the middle age group of 36-50 years of age are less likely to default relative to younger households. Regarding household composition, households containing a couple and at least one child are more likely to default relative to the base group of single adult households. Unsurprisingly, higher disposable income levels are associated with a lower likelihood of falling into loan delinquency. Finally, we observe that both a rise in the number of unemployed adults in the household and a household member having suffered a chronic health shock in the previous 12 months are statistically significant determinants of a household transitioning into default. These results are consistent with previous findings by Duygan-Bump and Grant (2009).

In Column 2, in order to account for the housing equity channel, we include both a one period lag of the current-loan-to-value ratio, CLTV, and ΔCLTV; neither are statistically significant. While it may appear surprising that we do not find a direct effect of the equity channel, it must be remembered that equity shocks normally materialise into default when borrowers pass the negative equity threshold. Given the sample period we include, which covers a large number of years with rising house prices and high housing equity, it is not unsurprising that the average effect of LTV is insignificant. We return to the issue of negative equity thresholds later in the paper.

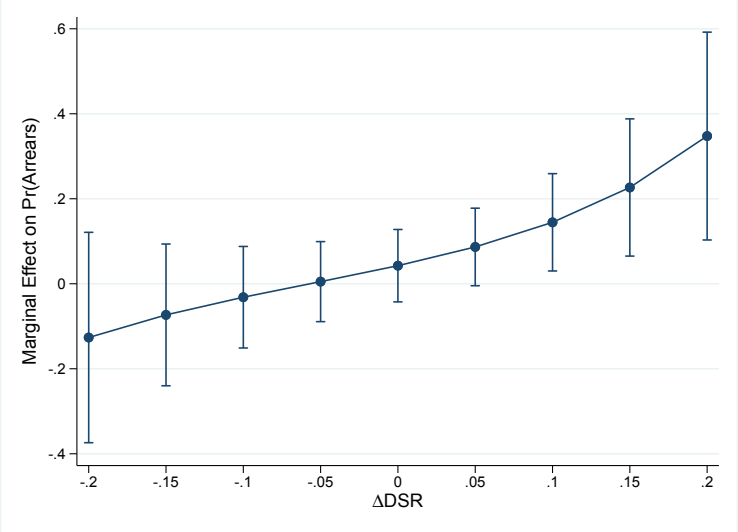
In Columns 3-5 we add our key measures of household repayment capacity, the household's lagged debt service ratio (Column 3) and the change in the DSR (Column 4) separately and then together (Column 5). Including both the lagged level and the change in the household's debt service ratio accounts for both the level of repayment capacity and any shocks the household may face. From column 5 we see that shocks to debt servicing capacity is an important determinant of falling into delinquency. In addition, the magnitude and significance of the impact of health and unemployment shocks on mortgage delinquency remains unchanged. The lagged level of the debt servicing capacity is not statistically significant in this specification. Our evidence therefore indicates that the actual level of the debt service to income is not a significant driver of default, rather defaults are driven by changes in the debt service ratio i.e. shocks to affordability matter. However, effects may be evident across the distribution that are not captured by this specification which is at the mean. We will examine this further in the remainder of section 3.

3.2 Are the Effects Non-Linear?

To pick up on our previous analysis, we now delve into possible non-linearity in the effects of the relationship between a household's repayment capacity and loan delinquency. We might expect the impact of a shock to the debt service ratio to vary depending on the magnitude of the shock, as households are more likely to be able to absorb a smaller increase in their debt service ratio. In Figure 1a we show that the DSR distribution for those households in default was shifted to the right of those not in default, meaning that households in default typically pay a larger fraction of their income on their mortgage instalments. It therefore seems likely that the severity of any shock may be non-linear, i.e.

a DSR shock may have a greater impact on default as it becomes more severe.

Figure 2: The Impact of Shocks to the Debt Service Ratio on Mortgage Default



In Table 2 we established that there is a positive relationship between ΔDSR and the likelihood that a household falls into delinquency. In order to explore potential non-linearities in the relationship between repayment capacity and mortgage default we begin by simply adding ΔDSR^2 to the baseline model. In Figure 2 we present the marginal effects of ΔDSR on default at discrete values of the repayment capacity shock, ΔDSR from this specification.

The estimated coefficients presented in Figure 2 suggest that larger deteriorations ($\Delta DSR>0$) in a household's repayment capacity have a greater effect on the likelihood of that household falling into default. However, it must be noted that the effects of larger DSR deteriorations are not statistically significantly different from the effects of smaller deteriorations. The large error bars likely indicate that this is due to relatively small sample sizes for the extreme shocks. What is evident from Figure 2 is that there is a asymmetry in the effect of ΔDSR on falling into default. A deterioration, or increase in ΔDSR leads to a statistically significant increase in households falling into default, whereas an improvement in the DSR, from a positive income shock for example, has no impact on the likelihood that a household transitions into delinquency.

3.3 Does the Level of Indebtedness Matter?

In Figure 2 we found no effect of an improvement in the DSR, $\Delta DSR<0$, on the likelihood that a household falls into delinquency, but that a worsening in the DSR, $\Delta DSR>0$, is associated with an increased likelihood of falling into default. We next examine whether shocks of the same magnitude may have differing effects depending on the households' ability to absorb such a shock or the level of the starting DSR. Recall for the first specifications, we did not find any impact of the level of the DSR. However, it may be the

case that the level of indebtedness interacts with the shock to amplify the effects i.e. we might expect that households with a lower initial DSR may be better able to absorb a shock of the same magnitude than a household already paying a higher proportion of their income on their mortgage instalments. For instance, a household facing an increase in their mortgage repayments from 15 to 20 per cent of net income may be able to continue to make their repayments, whereas a similar 5 percentage point increase from 30 to 35 per cent may leave a household unable to make these repayments.

To examine this we separate households according to the value of their initial DSR, classifying a household as lowly indebted if they pay less than 25 per cent of their income on mortgage payments and highly indebted if they pay 25 per cent or more of their income on monthly instalments. The choice of a 25 per cent threshold is somewhat arbitrary, but it classifies approximately 25 per cent of our sample as highly indebted.

In Table 3 we present the marginal effects of a one per cent fall, ΔDSR<0, and a one per cent rise, ΔDSR>0 for both low and high initial DSR levels. As in Figure 2, a deterioration in the DSR, ΔDSR>0, is associated with an increased likelihood of falling into default for both households with a low and high initial DSR. However, the magnitude of the effect is double for those households with a high DSR, indicating that these households have less capacity to absorb a shock to their repayment burden. Regarding an improvement in the DSR, ΔDSR<0, is associated with a negative coefficient, indicating a fall in the likelihood of falling into default, although these coefficients are not statistically significant.

Table 3: The Impact of ΔDSR on Default by Absorptive Capacity

	(1)
Δ DSR<0, low DSR	-0.151
	(0.121)
Δ DSR<0, high DSR	-0.100
	(0.095)
Δ DSR>0, low DSR	0.158***
	(0.0388)
Δ DSR>0, high DSR	0.332**
	(0.154)
Observations	4,330

Marginal effects of a one per cent rise and decrease in ΔDSR on default for high and low initial levels of DSR. High DSR>0.25; low DSR<0.25. Standard errors reported in parentheses and significance level displayed as * p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01.

One important caveat to note here is that we only consider the debt service ratio related to the mortgage loan. SILC does not contain any information about the monetary value of any other loan commitments the household may have. SILC does however contain binary indicators for whether a household has consumer loans and whether they have fallen into default on their repayments, providing an indication of broader financial distress. We address this as a robustness check in Section 5.

4 Does the Relationship Between Repayment Capacity and Default Change During a Systemic Crisis?

Much of the recent literature examining the determinants of mortgage default centres around the time of the 2008 financial crisis, aided by the increasing availability of detailed loan-level data. These papers provide invaluable insights into the key factors which drive mortgage loan delinquencies during a systemic crisis. One question which naturally arises is whether the drivers of loan delinquency change over time. Households who fall into default during periods of relative macroeconomic stability may be those who suffer so called trigger events such as ill health, relationship breakdowns and unemployment. However, in a systemic crisis, labour market shocks, both in terms of unemployment and income cuts for those who remain employed, may also permeate to groups in the economy that would not be affected in normal times. In addition, the prevalence of negative equity may exacerbate the impact of labour market shocks; the so called double trigger model of mortgage default. Previous descriptive work by Fahy et al. (2018) using Irish SILC data provides suggestive evidence that the relative importance of the various channels of default may vary over time. They show that during pre-crisis years households that suffered health, employment and marital shocks saw higher mortgage default rates[3], but that during the systemic crisis typically lower risk groups such as the employed and healthy saw the largest increases in incidence of default.

Our specific focus in this paper is on how the relationship between our key measure of repayment capacity, the debt service ratio, and mortgage default changes during a systemic crisis period relative to more macroeconomically stable periods. The double trigger theory of default suggests that the presence of negative equity during a systemic crisis should exacerbate affordability shocks, leading the DSR to have a greater impact on default during crisis times, relative to non-crisis periods when house prices are rising. To think further about why this may be the case, it is useful to consider the simple two period theoretical model of mortgage default introduced by Foote et al. (2008) which provides a theoretical rationale for why the double trigger of negative equity and affordability shocks leads households to default on their mortgage. Traditional frictionless models of default such as in Kau et al. (1994) posit that borrowers should continue to stay current on their mortgage repayments as long as the present value of the house is greater than the mortgage owing i.e. taking expected future house price appreciation into consideration in their default decision. These models operate under the assumption that all borrowers are free to borrow at the same price. Foote et al. (2008) note that empirically borrower-specific affordability shocks such as unemployment also play a role in the default decision. They therefore introduce heterogeneity across borrowers with respect to the cost of funds

[3]This work refers to the stock of households in mortgage default at a point in time rather than households who transition into default during a particular period.

into their model in order to capture the differing levels of credit constraints faced. They show that the value placed on both the house and the mortgage varies according to each household due to this heterogeneity in the price of credit. Consequently, a household that is credit constrained will have a high discount rate, where this present bias means they place a lower weight on the potential for future house price appreciation, thus increasing the likelihood of default.

Linking this back to the relationship between the DSR and default, we contend that households are more likely to be liquidity constrained during crisis periods and therefore repayment capacity shocks are likely to have a greater impact on default during a systemic crisis. Furthermore, our findings in Table 3 suggest that when leverage is high, the effects of shocks to the debt service ratio have a greater impact on the likelihood of default. Therefore, in a crash following a credit boom, we may expect to find a different pass through of shocks to default relative to more stable economic times.

This provides a number of simple testable hypotheses that can be linked back to our empirical model. These can be summarised as follows:

H1: $\beta_{\Delta DSR-Crisis} > \beta_{\Delta DSR-Non-Crisis}$

H2: $\beta_{\Delta DSR-NegativeEquity} > \beta_{\Delta DSR-PositiveEquity}$

H3: $\beta_{\Delta DSR-LiquidityConstrained} > \beta_{\Delta DSR-Unconstrained}$

where $\beta_{\Delta DSR}$ is the coefficient estimated in our model for the change in the debt service ratio. The groups indicated after the coefficient relate to estimating the model for different sub-samples or groups of households. We test each of these hypotheses in the subsections below.

Figure 3: Percentage of Mortgaged Households:

(a) in Negative Equity (b) Able to Save Regularly

Figure 3 provides a simple descriptive picture of two of the potential explanations for why we may expect the relationship between the DSR and default to differ during a systemic crisis: negative equity and liquidity. From Figure 3a we observe the scale of

negative equity faced by Irish mortgage holders during the financial crisis, rising rapidly from and peaking at more than 30 per cent of mortgaged households in 2013. Figure 3b shows that between 2008 and 2011 there was a 20 percentage point fall in the share of households able to save regularly among the households in our sample. In the absence of wealth data in SILC, we use this measure as a proxy for liquidity constraints. In the remainder of this section we formally test how the relationship between the debt service ratio and mortgage delinquency differs during crisis and non-crisis periods and attempt to investigate the channels through which this occurs.

4.1 Testing Across Crisis and Non-Crisis Periods

We begin by simply splitting the sample between crisis and non-crisis periods. We define the systemic crisis period as 2009-2013, with data from all remaining years classed as non-crisis. Although large numbers of households remained in longer-term mortgage default in Ireland in 2014, we classify this as a non-crisis period because our model examines the determinants of first time transitions into default and house prices were rising in 2014 with falling unemployment and increases in incomes. We present the results from these split sample regressions in Table 4. During the crisis period, ΔDSR has a positive, statistically significant effect on the flow of households falling into default, but in non-crisis times this coefficient is much smaller in magnitude and no longer statistically significant. This is perhaps unsurprising in that during non-crisis times we also see that health shocks and an increase in the number of unemployed household members appear to be the major determinants of households falling into default. These tend to be relatively uncommon events and are typically associated with a substantial loss of income rather than a smaller fall in incomes, or a reduction in hours that are more widespread during a systemic crisis and likely to be picked up by the change in the DSR. In contrast to the baseline results in Table 2, from column 1 of Table 4 we see that during the crisis period, the level of the debt service ratio is associated with a statistically significant increase in default flows.

One concern that arises with the findings presented in Table 4 is whether it is simply the case that there are insufficient cases of households transitioning into default outside of the crisis period, or similarly, is there too little variation in ΔDSR, to statistically identify an effect on mortgage delinquency. With regards to the incidence of default, in Table 10 in the Appendix we show that 2.3 per cent of the sample transitioned into delinquency during non-crisis years relative to 6.2 per cent during the crisis. While, as expected this represents a smaller proportion of that sample, the statistical significance associated with affordability trigger events of unemployment and health shocks in Table 4, suggests that there are not insufficient cases of default to estimate the model separately on the respective samples.

In Figure 4 we present the distribution of ΔDSR for both crisis and non-crisis years. The distributions of debt service ratio shocks are in fact fairly similar during both periods, with a median ΔDSR close to 0 and households facing a range of both positive and negative

Table 4: Determinants of Mortgage Default in Crisis versus Non-Crisis Periods

	(1) Crisis	(2) Non-Crisis
HH member health shock	0.0247	0.0226***
	(0.0203)	(0.00767)
Rise in no. Unemployed in HH	0.0966***	0.0413***
	(0.0247)	(0.0108)
L.Log Real HH Income	-0.00112	-0.0197**
	(0.0205)	(0.00829)
L.CLTV	0.0270	-0.00343
	(0.0221)	(0.00917)
ΔCLTV	0.00684	-0.0127
	(0.0251)	(0.0122)
L.DSR	0.286***	-0.0467
	(0.0980)	(0.0340)
ΔDSR	0.254**	0.0485
	(0.103)	(0.0590)
Observations	1,389	2,941

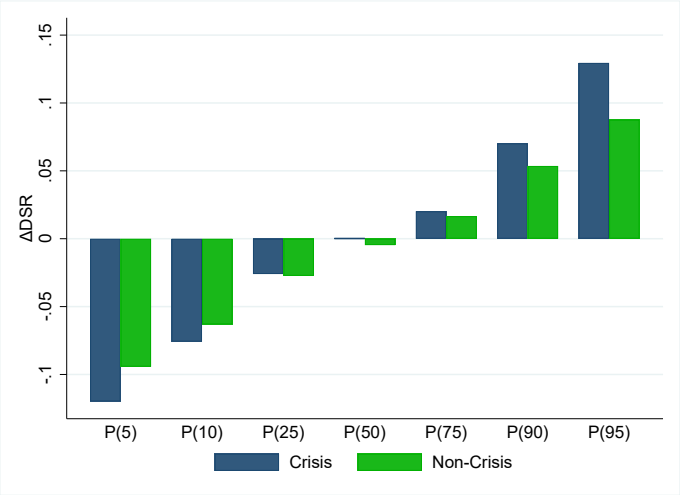
Regressions reported are marginal effects as in the baseline model from the 5th column of Table 2 split out by crisis and non-crisis period sub-samples. Crisis period covers 2009-2013. Standard errors reported in parentheses and significance level displayed as * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

affordability shocks. The standard deviation is higher during the crisis years showing more variability in debt service ratio shocks, with both larger increases and falls relative to non-crisis times. Regarding negative affordability shocks, or rather a decrease in the proportion of income spent on mortgage repayments, this is perhaps unsurprising. During non-crisis periods where incomes are typically rising, this rise in income will lower the debt service ratio. On the other hand, during the crisis those who maintained their income may have seen interest rate cuts, leading to a reduction in their debt service ratio. This is a pertinent point in the Irish context given the high proportion of mortgage holders on variable rate contracts (in particular tracker borrowers whose mortgage type had an automatic pass through of the policy rate to arrears) and therefore affected by changes in interest rates (Fahy et al., 2019). In particular, Byrne et al. (2017) find that the pass through of monetary policy rate changes to borrowers in Ireland following the crisis substantially lowered default rates for borrowers with tracker mortgages (these made up nearly 50 per cent of outstanding mortgages during this period).

What is also clear from Figure 4, and somewhat surprising, is that it is not the case that households only suffered a deterioration in their debt servicing capacity during the crisis years. This implies that the differing relationship between ΔDSR and mortgage delinquency is not due to a lack of shocks to the DSR outside of crisis times, but rather due to the broader economic circumstances combining with and exacerbating the impact of these DSR shocks during the period of systemic crisis.

The presence of both positive and negative DSR shocks has implications for our estimation. Indeed, taking a closer look at the impact of ΔDSR on the likelihood of falling into

Figure 4: Distribution of ΔDSR Shocks in Crisis versus Non-Crisis Periods



default, in Table 11 in the Appendix, using coefficients from our logit estimation, we show that the sign of the coefficient on the effect that ΔDSR has on default differs according to whether the change in the DSR is positive or negative. More specifically it shows that if ΔDSR<0, i.e. there is an improvement in the household's capacity to service its mortgage payments, this is associated with a fall in the likelihood of the household falling into default. Whereas an increase in ΔDSR, or a worsening of the household's DSR is associated with a rise in their likelihood of falling into default. This has important implications for our analysis of the effects of ΔDSR on the likelihood of falling into default during crisis and non-crisis periods.

Consequently, in columns 1&2 of Table 5 we examine the impact that a one per cent increase in ΔDSR has on default during both crisis and non crisis periods, conditional on ΔDSR>0. In column 1 we see that as expected, a one per cent increase in ΔDSR leads to an increase in the likelihood of households falling into default during a crisis, with a larger coefficient than in column 1 of Table 4. In column 2 we see that when we condition ΔDSR to be positive, even during non-crisis times, a 1 per cent increase in ΔDSR is associated with a 0.085 percentage point increase in default flow rate. Similarly in columns 3&4 we examine the impact that a one per cent decline in ΔDSR has on default during both crisis and non crisis periods, conditional on ΔDSR<0. We see that during non-crisis times this improvement in a household's debt servicing capacity leads to a fall in the likelihood of them falling into default, but that no such effect is evident during the crisis period.

Table 5 clearly establishes that the sensitivity of default to a one per cent rise in ΔDSR is greater during crisis periods relative to non-crisis periods. In the following two subsections we examine two potential explanations for these findings: a negative equity channel and a liquidity constraints channel.

Table 5: Testing the Sensitivity of Default to ΔDSR Shocks in Crisis versus Non-Crisis Periods

	(1)	(2)	(3)	(4)
	ΔDSR>0		ΔDSR<0	
	Crisis	Non-Crisis	Crisis	Non-Crisis
Δ DSR	0.359***	0.0850***	-0.0158	-0.139**
	(0.0948)	(0.0294)	(0.158)	(0.0556)
Observations	1389	2941	1389	2941

Marginal effects of a one per cent increase and decrease in ΔDSR on default estimated on crisis and non-crisis period sub-samples. Crisis period covers 2009-2013. Standard errors reported in parentheses and significance level displayed as * p < 0.1, ** p < 0.05, *** p < 0.01.

4.2 Does Negative Equity Affect Affordability Shocks?

The first potential explanation for observing a stronger relationship between a one per cent rise in ΔDSR and default during crisis times that we consider is the prevalence of negative equity during systemic crisis periods. When a borrower with positive equity has insufficient liquid financial resources to continue making their mortgage payments, they are able to realise the value of the housing asset and pay off the outstanding mortgage debt. Conversely, when a borrower with insufficient resources to make their mortgage payments also finds themselves in negative equity, the value of the asset does not cover the value of the outstanding mortgage debt. According to the double-trigger theory of mortgage default, it is this combination of negative equity and repayment capacity shocks that lead borrowers to default on their mortgage repayments.

Table 6: Testing the Negative Equity Channel

	(1)	(2)
	ΔDSR>0	
	Neg eq.	Non Neg eq.
Δ DSR	0.599*	0.198***
	(0.338)	(0.0746)
Observations	182	1188

Takes columns 1&3 (crisis period only) of Table 5 and splits out by the one period lag of their negative equity status. Specification slightly altered by removing marital status, education and age groups and replacing with continuous age to overcome issue of perfect predictors. Standard errors reported in parentheses and significance level displayed as * p < 0.1, ** p < 0.05, *** p < 0.01.

In order to examine this channel, in Table 6 we re-estimate columns 1&3 of Table 5, this time splitting the crisis sample out by whether a household was in negative equity or not, holding all other variables at means. We use a one period lag of negative equity status in order to avoid simultaneity concerns. From columns 1&2 we see that the impact of a one per cent increase in ΔDSR on default conditional on ΔDSR>0 during the crisis period is three times as large when the household was in negative equity in the previous period (column 1) compared to when they were not (column 2), albeit the coefficient for households

in negative equity is only statistically significant at the 10 per cent level. We therefore find evidence to support the double-trigger theory of mortgage default. However, the positive, statistically significant effect for those who were not in negative equity indicates that the increased sensitivity of default to a one per cent rise in ΔDSR during the crisis period cannot solely explained by this housing equity channel.

It is worth noting that in our baseline findings presented in Table 2, we found no statistically significant impact of either the current Loan-to-Value ratio or ΔCLTV on the likelihood of a household falling into default. This highlights the importance of examining the various different determinants of mortgage default in both crisis and non-crisis periods.

4.3 Do Liquidity Constraints Exacerbate Affordability Shocks?

The second potential explanation for the differences in the sensitivity of mortgage default to a shock to the debt service ratio between crisis and non-crisis periods is liquidity constraints i.e. households having insufficient financial buffers to withstand shocks during crisis times.

We contend that households hit by a shock during a crisis period are likely to have fewer liquid financial assets for a number of reasons. First, their incomes may be falling faster than prices, lessening the household's ability to hold or accumulate assets. Second, borrowers are likely to face greater liquidity constraints. This is consistent with the model put forward by Foote et al. (2008) which proposes credit constraints as an explanation for why the dual trigger of negative equity and affordability shocks leads to default. Borrowers are likely to face greater liquidity constraints during a systemic crisis as financially constrained banks reduce their lending during crisis periods, reducing the household's ability to borrow from financial institutions in order to offset their affordability challenges. Furthermore, households are also likely to face non-bank lending cutbacks, such as it becoming more difficult to borrow from friends and family members as many of these households also may be facing liquidity constraints. Thirdly, households who face unemployment shocks are likely to take longer to re-enter the workforce during a crisis due to fewer re-employment possibilities. Consequently they are likely to run down any savings, leaving them with insufficient buffers to withstand further or prolonged shocks.

Ideally in order to test this channel we would use information on household wealth, but SILC does not contain any information on household assets, the value of savings, or overall wealth. Instead, we therefore utilise information in the SILC survey on whether or not households were able to regularly save some of their income prior to falling into default on their mortgage payments. This enables us to separate our sample into those households who were and were not regular savers. We use this as a proxy for the liquidity situation of the household.

A priori we would expect a deterioration in the debt servicing capacity to have a stronger impact on the likelihood of falling into mortgage default for those borrowers who were not regular savers, as these households are likely to have fewer savings resulting in fewer liquid assets and buffers to withstand shocks. Furthermore, it is likely that these

borrowers will be the most liquidity constrained in terms of what they are able to borrow from banks and other financial institutions due to having fewer financial assets. As employment shocks, falling incomes and liquidity constraints are all more common during crisis times, we would expect to see stronger effects during crisis periods. In addition, non-savers are likely to have greater re-employment probabilities in non-crisis times enabling them to get back into work more quickly, reducing the likelihood of them falling into default. Conversely, we would not expect a deterioration in the debt servicing capacity of regular savers to lead to mortgage default in either crisis or non-crisis periods. The fact that these households are able to regularly save some of their income would suggest that they have some financial buffer against potential shocks, at least in the short term. It also seems plausible that these households are less likely to be liquidity constrained in terms of their ability to borrow from banks and other financial institutions.

We separate households by the one period lag of their ability to regularly save some of their income. We do so in order to avoid any simultaneity concerns as households who have fallen into default are likely to have been forced to stop their regular savings. In Table 6 we showed that DSR shocks had a greater impact on default for those households in negative equity. We would expect that many of these households would simultaneously suffer from liquidity constraints. However, here we are specifically interested in whether liquidity constraints can help to explain why we observe, positive, statistically significant effects of ΔDSR on mortgage delinquency for households not in negative equity. We therefore estimate the model over the whole sample in order to hold all other variables at their means for the whole sample. We do so in an attempt to disentangle the effects of liquidity constraints from other factors such as negative equity whose means differ substantially over the different periods.

Table 7: Testing for Liquidity Constraints

	(1) Savers	(2) Non-Savers	(3) Non-Savers Positive Equity
Non-crisis	-0.153	0.0882**	0.0804*
	(0.173)	(0.0310)	(0.0375)
Crisis	-0.340	0.570***	0.464**
	(0.280)	(0.185)	(0.194)
Observations	4,327	4,327	4,327

Marginal effects of a one per cent increase in ΔDSR on default for savers and non-savers during crisis and non-crisis periods. Saver status determined by one period lag of response to whether able to regularly save income. Crisis period covers 2009-2013. Standard errors reported in parentheses and significance level displayed as * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

In Table 7 we report the marginal effects of a one per cent increase in ΔDSR for savers and non-savers during crisis and non-crisis times respectively. From columns 1&2 of Table 7 we observe that the positive, statistically significant effects of debt service ratio shocks on mortgage delinquency are indeed completely driven by those borrowers without a prior regular savings habit i.e. those most likely to be liquidity constrained when hit by a DSR

shock. To further disentangle these liquidity effects from potential negative equity effects, in column 3 we focus solely on those households in positive equity. The results remain very similar indicating the existence of liquidity constraints, over and above any effects due to negative equity. Comparing the results from column 3 to those presented in columns 1&2 of Table 5, we see that the magnitude of the effect of DSR shocks is greater for non-savers than for the sample as a whole during crisis years (0.46 v 0.33), whereas this is not the case for non-savers during non-crisis years (0.08 v 0.085). This provides further indication of the role that liquidity constraints play in exacerbating the effects of debt service ratio shocks during periods of systemic crisis.

5 Robustness Checks

In this section we perform several checks to ensure that our findings are robust. One issue we have with Table 5 is that we estimate separately on sub-samples during crisis (2009-2013) and non-crisis years. However, in addition to the difference in coefficients on ΔDSR, the means for other variables during this period, such as the proportion of households in negative equity, are likely to be quite different. In order to capture the different effects of ΔDSR on default during crisis and non-crisis times, in Table 8 we estimate the model over the entire sample; this holds negative equity at means for the whole sample. This helps us to get at whether the findings from Table 5 are driven solely by negative equity concerns or also by liquidity/solvency concerns. The coefficients in columns 1&2 of Table 8 are similar to those in Table 5. When estimating over the full sample we now no longer find any statistically significant effect of a one per cent decrease in ΔDSR, conditional on ΔDSR$<$0, on default in the non-crisis period.

Table 8: Robustness Check: The Sensitivity of Default to ΔDSR Shocks in Crisis versus Non-Crisis Periods Estimated over Full Sample

	(1)	(2)	(3)	(4)
	ΔDSR$>$0		ΔDSR$<$0	
	Crisis	Non-Crisis	Crisis	Non-Crisis
Δ DSR	0.274***	0.131***	-0.120	-0.0572
	(0.0655)	(0.0297)	(0.0981)	(0.0477)
Observations	4,330	4,330	4,330	4,330

Marginal effects of a one per cent increase and decrease in ΔDSR on default estimated on the full sample. This is comparable with Table 5 but estimated over the full sample rather than separately on sub-samples. Crisis period covers 2009-2013. Standard errors reported in parentheses and significance level displayed as * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Our primary focus in this paper is on the impact that affordability or repayment capacity shocks have on mortgage default. One limitation with the SILC data is that they do not contain any information about the monetary value of any other loan commitments the household may have. Rather, our debt service ratio measure only reflects the proportion of net income that a household spends on mortgage instalments. In practice, it is likely that any other loan commitments will also impact on whether they stay current on their

mortgage payments. SILC does contain a binary indicator for whether a household has fallen into default on their repayments of any consumer loans or hire purchase agreements they may have i.e. any debt outside of their mortgage. This measure provides an indication of broader financial distress.

In Table 9 we re-estimate the specification used in Table 5, this time adding the binary indicator for whether a household is in default on any other loans. We use a one period lag to avoid simultaneity concerns. The estimates reported in Table 9 are virtually identical to those in Table 5. Controlling for whether a household was in other loan default at $t-1$, or more generally broader financial distress, does not reduce the impact of shocks to the debt service ratio suffered between $t-1$ and t on mortgage loan delinquency.

Table 9: Robustness Check: Accounting for Broader Financial Distress

	(1)	(2)	(3)	(4)
	ΔDSR>0		ΔDSR<0	
	Crisis	Non-Crisis	Crisis	Non-Crisis
Δ DSR	0.363***	0.0810***	-0.0609	-0.157***
	(0.0882)	(0.0278)	(0.144)	(0.0549)
Observations	1,389	2,941	1,389	2,941

Replication of Table 5 with the addition of a binary indicator for whether a household is in default on any other loans (using a one period lag). Standard errors reported in parentheses and significance level displayed as * p < 0.1, ** p < 0.05, *** p < 0.01.

6 Conclusions

Since the onset of the global financial crisis there has been renewed interest in research examining the drivers of mortgage default. The majority of these studies focus on determining the relative importance of equity and affordability shocks. A major challenge in this literature is to adequately measure affordability, or repayment capacity shocks. One of the underlying reasons for this is that the majority of empirical papers are based on loan-level data. These datasets contain a wealth of information on loan characteristics, but lack up-to-date information on the current economic position of the household.

In this paper we use Irish household survey data to examine the importance of affordability or repayment capacity shocks as a driver of mortgage delinquency. Utilising information on current household income, in addition to the employment and health status of all household members, provides us with a more precise measure of household repayment capacity, the debt service ratio, with which to examine the impact of affordability shocks on transitions into mortgage default. We estimate a discrete-time logit survival model which directly links both changes in, and the level of, the debt service ratio to mortgage default. We find that shocks to the debt service ratio are a clear driver of mortgage delinquency.

We then allow an interaction effect between the level of indebtedness as well as the size of the shock to identify how shock absorption depends on the starting point debt burden. We show that a deterioration in the debt service ratio increases the likelihood of

delinquency regardless of the initial debt burden, although the effect is twice as large for those with a higher initial debt burden.

Finally, we show that while households do suffer from deteriorations in their debt servicing capacity during both crisis and non-crisis times, the sensitivity of mortgage delinquency to a rise in ΔDSR is greater during periods of systemic crisis relative to more macroeconomically stable, non-crisis times. Examining potential channels for why this relationship may vary over time reveals that it is due to the combination of DSR shocks with both negative equity, i.e. the double trigger, and with liquidity constraints which leave households with insufficient buffers with which to withstand affordability shocks during a systemic crisis. These findings highlight the importance of examining how parameters vary over time. The effects of repayment capacity shocks vary according to the broader economic situation and we therefore need to take this into account when examining the drivers of mortgage loan delinquency.

Our findings have important implications for financial stability policy, bank stress testing and the link between macroeconomic developments and the financial sector. First, we clearly find that shocks to repayment capacity are critical for determining the level of mortgage default. This finding would suggest that targeted borrower-based macroprudential instruments which limit the repayment capacity (such as debt-service to income limits or loan-to-income restrictions) should play a critical role in building up buffers for borrowers. Second, for bank stress testing purposes, models which determine the income channel solely with aggregate unemployment indicators may underestimate the role of income shocks in determining default. Consideration to expanding the scope of models in this context would be useful. Finally, the interaction between negative equity, liquidity constraints and affordability shocks during crisis periods highlights the feedback loops that can develop during crisis periods. Our research would further support moves to ensure both equity and affordability buffers are built into macro-financial stability policy.

Appendix

Table 10: Summary Statistics for Crisis versus Non-Crisis Periods

	(1) Crisis	(2) Non-Crisis
Default	0.062	0.023
DSR	0.181	0.179
ΔDSR	-0.001	-0.004
HH member health shock	0.099	0.102
Rise in no. Unemployed in HH	0.066	0.034
CLTV	0.595	0.47
ΔCLTV	0.048	-0.059
Negative Equity	0.192	0.089
Real Disposable Income (€)	61067.31	62873.13
Observations	1,389	2,941

Crisis period covers 2009-2013.

Table 11: Logit Coefficient on ΔDSR when ΔDSR is Positive and Negative

	(1)
ΔDSR if ΔDSR<0	-7.290
	(6.450)
ΔDSR if ΔDSR>0	6.248***
	(1.768)
Observations	4,330

Logit coefficients on ΔDSR when ΔDSR>0 and ΔDSR<0 for the model estimated in Table 3.

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