02/RT/15

Páipéar Taighde Teicniúil
Research Technical Paper

Designing Macro-prudential Policy in Mortgage Lending:
Do First Time Buyers Default Less?

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February 2015

Abstract

Macro-prudential policy is designed to address risk at a systemwide level, an example of which is mortgage default following a period of excessive residential property lending. Policy tools to address this risk, such as caps on loan-to-value (LTV) and loan-to-income (LTI) ratios should by design reflect the risk profile of lending. This research considers the heterogeneity of default risk between first time buyers and second and subsequent buyers and finds that first time buyers have lower default rates having controlled for borrower and loan characteristics. The potential implications for the macro prudential policy setting are empirically analysed: the default-differential between the two groups linearly increases with LTI and a non-linear difference is found to be maximised at 80-85 per cent for LTV. In addition, the role for a rule designed on house valuation is examined, with results showing a diminishing default-differential as valuations increase. This research is consistent with differential regulatory treatment of first time buyers with default risk remaining comparable to the remainder of mortgage lending.

Keywords:Macro Prudential, Credit Risk, Mortgages, Ireland
JEL Classification:E32, E51, F30, G21, G28

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Non Technical Summary

The financial crisis has brought to the fore a focus on policies that can mitigate risks in the financial sector. In particular, there has been a movement towards the introduction of macro-prudential policies which are designed to address risk at a systemwide level. Of particular importance to restrain unsustainable lending in mortgage markets are limits on loan-to-value (LTV) and loan-to-income (LTI) ratios for borrowers. Such limits protect both banks and borrowers by providing a buffer against vulnerabilities such as house price and affordability shocks as well as by limiting lending and housing booms. The realisation of these risks is clearly evident through the role played by mortgage default in the recent financial crisis both in Ireland, other European countries and the US.

Globally, many countries have moved to introduce macro-prudential measures in the mortgage market with a view to building the future resilience of the banking sector. Within this context, there are many studies which focus on the impact of these measures. However, there has been much less research focusing on how these measures are calibrated and in particular how they are set across different groups of borrowers such as first time homebuyers (FTBs). As FTBs face the greatest difficulties in accumulating savings to purchase a home, they bear a disproportionate cost of the macro-prudential regulations which impose higher savings and income constraints. In fact there are many examples internationally where macro-prudential policies have been tailored to alleviate such concerns for FTBs. Allowing FTBs to access higher LTV or LTI loans can however create additional financial stability risks unless it can be shown that these borrowers have a lower tendency to default.

To inform these considerations, this research explores whether the default risk between FTBs and second and subsequent buyers (SSBs) differs and therefore whether looser regulatory treatment can be justified. We find that FTBs are less likely to default; FTBs are four percentage points or 30 per cent relatively less likely to default than SSBs. We find this difference changes with the level of LTV, LTI and house prices. Given the differential in default rates by borrower type at varying levels of LTI, LTV and house prices, policy makers who are calibrating macro-prudential measures could take stock of such evident differences in their country situation and attempt to incorporate this information into cap selection. This may better the selection of specific cap levels. Our research is consistent with differential regulatory treatment of first time buyers with default risk remaining comparable to the remainder of mortgage lending.

1 Introduction

One outcome of the 2007-2009 global financial crisis has been a re-evaluation of the scope and intensity of financial regulation (Borio and Drehmann, 2009; Hanson et al., 2011; Blanchard et al., 2010). There has been a recognition of the requirement for regulatory structures to incorporate macro-prudential measures to boost the resilience of the financial sector (IMF, 2013). Such policies use a range of instruments[1] to safeguard the stability of the financial sector against adverse movements in credit and property prices and have been shown to break the link between house price fluctuations, credit growth and banking sector stress (Arregui et al., 2013; Nabar and Ahuja, 2011; Gerlach and Peng, 2005; Vandenbussche et al., 2012).

Of particular importance to restrain unsustainable lending in mortgage markets are limits on loan-to-value (LTV) and loan-to-income (LTI) ratios for borrowers. Such limits have two effects a) protect both banks and borrowers by providing a buffer against vulnerabilities such as house price and affordability shocks and b) prevent crises from occuring ex-ante by preventing lending and housing booms. This research is focused on a) and at its core is the concern that a loosening of lending standards through an accumulation of higher LTI and LTV loans can create unacceptable financial sector risks. The realisation of these risks is clearly evident through the role played by mortgage default in the recent financial crisis both in European countries and the US. It is generally accepted that the period prior to the onset of the financial crisis was characterised by loosening lending standards and less strict underwriting criteria in mortgage lending (Duca et al., 2010, 2011). This led directly to increases in the rate of foreclosures and default through "double trigger" equity and employment channels (Barakova et al., 2014; Anderson et al., 2011; Elul et al., 2010). Tighter conditions on LTI and LTV ratios may have reduced such mortgage delinquencies.

There is a developing literature which evaluates the impact of macro-prudential measures on credit growth, house prices and indicators of banking sector resilience using a macroeconomic focus.[2] There has been much less focus on a) micro-econometric studies evaluating the impact of macro-prudential measures and b) micro research on the specific design and calibration of such measures. Where micro-econometric approaches have been followed, some have mainly been conducted using data at the bank level (Claessens et al., 2013; Aiyar et al., 2014a,b) or have a focus on

[1] See Claessens et al. (2013); Grace et al. (2015); Kashyap et al. (2011) for an overview of the instruments of macro-prudential policies.

[2] See IMF (2013), Galati and Moessner (2013) and Galati and Moessner (2014) for reviews.

dynamic provisioning or reserve requirements using matched firm-bank data (Jimenez et al., 2013; Dassatti Camors and Peydro, 2014). Much less work has been done on evaluating the impact of macro-prudential limits on mortgage lending using household data. Two notable exceptions are Igan and Kang (2011) who find that loan-to-value and debt-to-income limits are associated with a decline in house price appreciation and transaction activity using survey data for Korea and Fuster and Zafar (2014) who evaluate borrower willingness to pay based on different loan-to-value ratios.

On the detailed calibration of LTI and LTV ratios using micro-econometric studies, research is much more scarce. This is particularly the case in relation to the exemption or tailoring of the measures to take into account specific borrower groups such as First Time Buyers (FTBs)[3]. This is all the more surprising given there are numerous examples of countries providing for differential regulatory treatment and exemptions from macro-prudential mortgage regulations for FTBs.[4] FTBs are the marginal borrower and thus most sensitive to financing conditions and the LTI/LTV limits at which they can borrow. From an regulatory perspective, governments and policy-makers have to balance financial stability risk concerns with the management of access to homeownership for FTBs.

The obvious benefits of the stability/homeownership trade-off have lead to widespread usage of differential regulatory treatment for first time buyers in the design of macro-prudential policy globally, but Jacome and Mitra (2015) show such calibrations have mainly been completed on a more ad-hoc basis with little empirical justification. This research attempts to bridge this gap in the existing literature by testing if the different regulatory treatment can be motivated from a credit risk perspective. Using loan-level data on 291,000 loans across four Irish banks, we test whether FTBs have a different default risk to second and subsequent buyers (SSBs)[5] which could support the calibration of LTV and LTI rules by FTB status.

We find that FTBs have a lower probability of default relative to SSBs: the mean difference in default rates is 4 percentage points or a 30 per cent lower default rate between SSBs and FTBs.

[3] A First Time Buyer loan is defined as the case when all named borrowers on a loan are first-time residential property purchasers.

[4] While a more detailed overview is provided in section 2, some examples are: Romania provides an exemption from LTV and DTI limits for FTBs; Poland provides a government subsidy for downpayment to FTBs in order to meet the LTV limits. Israel provided different LTV caps for first time buyers in 2012. Ireland introduced limits on LTV and LTI in January 2015 in which FTBs were provided with a differential regulatory ceiling.

[5] SSBs are defined conversely to FTBs i.e. the case where any named borrower on a loan is not a first time buyer.

The result is statistically significant and holds when subjected to a range of robustness checks. To provide support in a non-Irish context for this finding, we cite research by Jiang et al. (2013, 2014). While their focus was on loan documentation and brokerage channels, they include a control for FTBs which is negative and significant for a sample of US loans. From a macro-prudential policy perspective, this result provides empirical support for the differential treatment of FTBs. While any loosening of regulatory caps will reduce default risk buffers, our findings suggest that the aforementioned concerns relating to FTB downpayment and homeownership constraints could be addressed with a lower risk cost compared to lowering regulatory ceilings for all borrowers.

To further explore the implications of this finding for macro-prudential policy, we estimate a default model which is non-linear in LTV and LTI to assess potential threshold effects for rule setting. Secondly, we test if the FTB finding differs with originating LTI and LTV levels. We find that the default risk increases in a monotonically non-linear fashion with higher LTV levels, with a sharp increase in slope above 85 per cent. The FTB/SSB differential is maximised for LTVs of 80-85 per cent; with the FTB default rate being 45 per cent lower. The result for LTI is more linear and the difference between the default rate of FTBs and SSBs grows constantly. Therefore, if cap differentials based on FTB status are to be provided in mortgage measures, the specific level of the caps must be taken into account during calibration.

This paper is structured as follows: section 2 considers why FTBs might be different and explores cases where macro-prudential regulations have provided differential treatment. Section 3 outlines the data and empirical model. Section 4 presents the main results. Section 5 draws out the implications for policy and section 6 discusses the intuition around our results. Section 7 concludes.

2 First Time Buyers and Macro-prudential Policy

To support our assessment of the credit risk of FTBs in a macro-prudential context, it is informative to place our assessment in the context of two questions: 1) is there economic rationale as to why FTBs could be different? and 2) are there international examples of where macro-prudential policies have taken into account FTB status?

Considering the economic rationale as to why FTBs might be different, there are a number of potential explanations. Firstly, there is a well developed literature which discusses the credit conditions available to FTBs and their relationship with house prices (Engelhardt, 1994; Engelhardt and Mayer,

1998; Duca et al., 2010, 2011) and homeownership rates (Linneman and Wachter, 1989; Linneman et al., 1997; Quercia et al., 2003). This literature posits that without a current property to build up equity through amortisation and house price increases, first time buyers are the marginal borrower i.e. most sensitive to the bank lending conditions and subject to binding financing (downpayment) constraints. Linneman and Wachter (1989) and Linneman et al. (1997) find that both wealth and income constraints set by financial institutions through underwriting criteria have a considerable impact on homeownership rates in the US. Quercia et al. (2003) test how changes in affordable lending efforts impact on homeownership rates for underserved household groups. They find that households are more sensitive to changes in downpayment constraints relative to changes in interest rates but the impacts are different depending on the household type (mover, city centre household).

Downpayments are in the main accumulated through savings by such borrowers and changes to the percentage of downpayment required has a considerable impact on their ability to purchase a house. Previous research finds that saving for a downpayment is both a major goal of most young renter households and the largest barrier to home ownership (Engelhardt, 1994). For some cases, it may be possible that such financing constraints can be alleviated by family support or other financial transfers. Engelhardt (1994) states that in the US approximately 20 per cent of all FTBs receive at least some help from relatives in financing the downpayment. However, in the absence of family support or windfall financial transfers, they must accumulate the downpayment entirely. This leaves FTBs highly sensitive to credit availability through what LTV and LTI levels the banks underwriting criteria, or regulatory restrictions, allow lending to take place.

The second reason why FTBs may be different is the lack of a credit history that a second or subsequent borrower has built up. If banks take credit history into account, then this may add to financing constraints faced by FTBs. As financial institutions have increasingly moved to a process of credit scoring in capital allocation, the credit score based constraints have become more important. Barakova et al. (2003) distinguish between wealth, income and credit constraints in determining homeownership. While they find that wealth effects are the most predominant, their research finds a role for credit scores and credit history in determining homeownership. Calem et al. (2010) provide more insight into this aspect of barriers to homeownership. They link homeownership directly to the "thickness" of an individual's credit file based on their history of debt use, or lack thereof. As FTBs, do not have established mortgage credit history, this is a potential barrier to their access to finance for homeownership.

Thirdly, FTBs are, in a majority of cases, a different demographic profile relative to second and subsequent time buyers. They are usually younger and therefore are earlier in the income lifecycle: their future income growth prospects are potentially higher (Attanasio et al., 1999; Guvenen et al., 2015). If a mortgage is serviceable early in the income lifecycle, then future income growth should give additional scope to meet obligations over time. If debt is nominal and interest rates stable, then even moderate real earnings growth should provide capacity to service debt once the borrower does not take on additional borrowings.

To date, there are many examples of policy makers making specific design provisions in macro-prudential measures to account for first time buyer groups. Table 1 provides some specific examples of cases where regulatory measures to limit loan-to-income or loan-to-value ratios on residential mortgage lending have provided differential treatment for first time buyers. This table is not meant to be exhaustive but instead to provide some tangible examples of the design of macro-prudential policies which treat first time buyers differently.

The majority of the examples considered use a looser cap on LTV ratios for FTBs. This may be justified in the context of the above debate on downpayment constraints, savings and home-ownership which indicate the sensitivity of FTBs to credit conditions. However, from a financial stability perspective, providing such differentiated treatment would potentially create additional risk and heighten overall systemic vulerabilities. Such vulnerabilities could however be mitigated if structural differences in default risk between groups exist.

As noted above, despite the widespread usage of differential regulatory treatment for first time buyers in the design of macro-prudential policy globally, and the aforementioned economic rationale for why first time buyers may be different to other borrowers, there is no empirical evidence that explicitly tests the difference between these borrower groups in a macro-prudential policy context. This research attempts to bridge this gap in the existing literature by assessing whether first time buyers are a differential default risk.

Table 1: Summary of International Residential Macro Prudential Measures

Country	Exemption/Regulatory Difference
Direct Measures for First Time Buyers	
China	Differential LTV caps between first home buyers and second home buyers (April 2012).
Finland	95 per cent cap for FTBs, 90 per cent otherwise
Ireland	90 per cent LTV cap for FTBs up to €220,000, 80 percent above. 80 per cent LTV flat rate for other residential non-investment mortgages
Israel	FTB LTV cap of 75 per cent. 70 per cent all other residential non-investment mortgages Nov 2012
Italy	Apr 1995, By the Interministerial Credit Committee Resolution of 22 April 1995, the maximum LTV ratio was raised to 80% from 75% for first-time home buyers and from 50% for repeat buyers. The maximum LTV ratio could be raised to 100% if additional guarantees were provided.
Poland	Government subsidy for downpayment to First Time Buyers in order to meet the LTV limits
Romania	FTBs exempt from LTI and LTV limits
Singapore	LTV Cap of 80 per cent for 1st time borrowers lower caps for other borrower groups
Indirect Measures for First Time Buyers	
Canada	Introduced mortgage insurance to complement LTV caps for First Time Buyers
Hong Kong (SAR)	Differential caps by property value and mortgage insurance for FTBs
Rep. of Korea	LTV/LTI Cap Differential on Property Type in different areas to discourage speculators and which facilitates purchase by FTBs

Source: Jacome and Mitra (2015); Igan and Kang (2011) Grace et al. (2015)
Shim et al. (2013) IMF (2013).

3 Data and Empirical Model

3.1 Data

This research uses loan-level data from four major banking institutions in Ireland: Allied Irish Banks (AIB, including EBS Building Society), Bank of Ireland (BoI), and Permanent TSB (PTSB). These institutions account for approximately *66* percent of the Irish residential mortgage market. These data were collected by the Central Bank of Ireland as part of the Financial Measures Programme (FMP) which assessed bank restructuring, recapitalisation and conducted stress testing following the recent systemic banking crisis. The loan-level data (LLD) contain full information on the originating characteristics of each mortgage at these institutions, e.g. the balance drawn-down, LTV & LTI ratio, mortgage term and interest rate type; a range of borrower-specific information such as borrower age,

income at origination, marital status and whether they were joint or single-assessed; and data on the dwelling the loan is used to acquire, such as the county of location, purchase price and whether the property is an apartment or house. Data is also available on the employment status of the borrower at origination (employed, self-employed, other) and up to date information on collateral valuations. There is also detailed information on the current non-performing status of each loan. Further details regarding the data can be found in Kennedy and McIndoe Calder (2011).

Our analysis takes a snapshot of loans which were on the banks' books in December 2013 and uses these to conduct our evaluation. This cross-sectional analysis provides a point in time evaluation of the drivers of default at this date. Given our focus on designing macro-prudential measures for non-investment residential mortgage lending, the sample is limited to only principal dwellings and primary loans[6] therefore mainly focusing on the borrowers' primary home. In total the sample contains 291,000 loans.[7] Importantly for our analysis, the data provides information on the loan purpose type which facilitates the creation of an indicator for FTBs relative to SSBs.

To provide insight into the composition of the market across FTBs and SSBs, Figure 1 presents the per cent of total loan balance (Balance) and per cent of the number of loans (Number) accounted for by FTBs in the dataset. The X axis presents the year in which the loan was originated. We observe that FTBs accounted for less than 50 percent of the borrowers in our sample in the years before the financial crisis. Indeed, during the period 2004-2008 their share declined to less than 40 percent of both count and balance.[8] Since the crisis, FTBs have accounted for a larger share of the sample. Their percent of the number of loans issued is currently higher than their percent of balance indicating that FTBs are taking out more smaller loans than SSBs.

The key focus of our research is exploring the differential credit risk of FTBs relative to SSBs. Figure 2 presents the default rate on the count of loans for FTBs and SSBs in our sample.[9] The default rate is clearly lower for FTBs than SSBs and this difference exists for all the loans in our sample across the time period of origination (and were in default in December 2013). Across the sample, on average approximately 15 per cent of SSBs are currently in default; this rate is one-third less for FTBs. This includes loans from before the credit boom period in Ireland (pre 2004). The

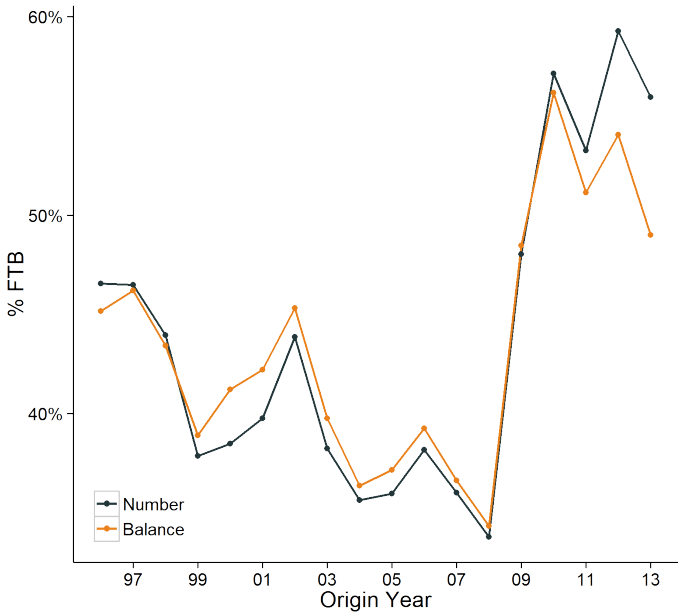
[6] A primary loan is defined as the original loan on the borrower's collateral.

[7] For details of how the final sample is derived, please see Table A.2

[8] If a loan was taken out during the period but then amortized before December 2013, we do not observe this loan in our data

[9] We follow the standard Basel definition of loan delinquency in defining defaulted loans as those with arrears in excess of 90 days.

Figure 1: Mortgage Market Segment by FTB Status



difference is eliminated in more recent years as typically loans do not become delinquent in the first years.[10]

As discussed and identified in the related literature, macro-prudential limits on mortgage lending place constraints on borrowers through the ceilings on LTI and LTV ratios at which they can borrow. As FTBs are the marginal borrowers, these should be more binding for this group and we should observe on average that FTBs borrower at higher LTI and LTV levels. To explore this in our data, Figure A.1 presents the LTV and LTI levels of loans originated over time for FTBs and SSBs. Panels A and B indicate that FTBs in Ireland have higher LTV and LTI limits than SSBs in all years in our sample. In general LTI and LTV levels increased up to 2006, which is in line with the easing of credit conditions in the banking sector during this period (see McCarthy and McQuinn (2013)). The data indicate that FTBs are more sensitive to LTV and LTI levels and thus can be expected to be more influenced by the introduction of regulatory ceilings. These dynamics are similar to those presented in the research by Duca et al. (2010) and Duca et al. (2011) who indicate a liberalising of the credit conditions for FTBs in the US in the period to the onset of the 2007 financial crisis.

[10]It must also be noted that the FTB figures are potentially an upper bound as all SSBs must have transitioned from performing FTB. This would therefore have the effect of reducing the denominator in the FTB calculation and increase the overall percentage.

Figure 2: Default (by count) by FTB Status and Year

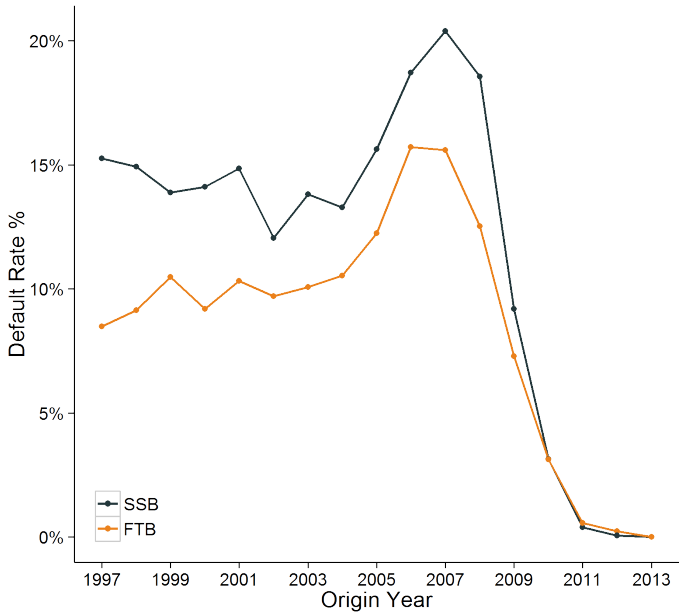


Table 2 presents summary statistics for key loan and borrower characteristics from the dataset depending on whether or not the borrower is a FTB. The difference between the mean values for each group is also presented with tests of statistical significance. As indicated in Figure 2, the default rate for FTBs is lower than that for SSBs: the default rate for FTBs is 10.3 percent which is 30.8 per cent lower than that for SSBs. The difference is statistically significant at the 1 per cent level.

While the average loan size is comparable across the two groups at approximately €182,000, there are large differences in the value of the property purchased. The average house price paid by FTBs is nearly €255,000 whereas SSBs paid €339,000 for their dwelling. This represents a statistically significant difference of circa €84,000, 24.8 per cent higher for SSBs. This reflects the higher LTV levels for FTBs than SSBs and the fact that FTBs do not bring equity from previous property sales: the mean original-loan-to-value (OLTV) for FTBs is 74 per cent relative to circa 56 per cent for SSBs: FTBS have an OLTV that is nearly 33 per cent higher than SSBs. The difference is statistically significant at the 1 per cent level. Incomes are also lower for FTBS at €56,000 relative to €69,000 for SSBs but FTB original-loan-to-income (OLTI) levels are higher (3.44 to 2.83). In our sample, FTBs have longer mortgage terms: on average FTB loan terms are 62 months longer than for SSBs. There is also a higher share of fixed rate and variable loans amongst FTBs with a higher share of tracker

Table 2: Summary Statistics by FTB Status

	FTB	SSB	Diff	% Diff from SSB
Default (%)	10.3	14.9	4.6	30.8***
Loan Size (€)	182,514	182,199	316	0.1
Purchase Price (€)	254,814	339,163	-84,349	24.8***
Current Value (€)[1]	182,414	237,963	-55,549	23.3***
Borrower Characteristics				
Income (€)	56,280	68,995	-12,714	18.4***
Age (yrs)	31.8	39.3	-7.6	19.3***
Employed (%)	77.1	68.4	8.7	12.7***
Self-Employed (%)	11.9	15.6	-3.7	23.7***
Single (%)	69.7	25.2	44.5	176.5***
Married (%)	27.4	66.2	-38.8	58.6***
Divorced (%)	2.1	7.5	-5.4	72.0***
Loan Characteristics				
OLTV	74.23	55.86	18.37	32.8***
OLTI	3.44	2.83	0.61	21.5***
Term (months)	348	286	62	21.6***
Vintage (months)	91	95	-4	4.2***
Dublin (%)	25.8	25.7	0.1	0.3
Fixed (%)	11.5	6.9	4.6	66.6***
SVR (%)	53.8	48.4	5.4	11.1***
Tracker (%)	34.7	44.7	-10.0	22.3***

Notes: Significant difference is based on t-tests on the equality of means.
$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$
[1] Current valuation as of December 2013.

loans amongst SSBs[11].

In relation to the borrower-specific characteristics, the average age of FTBs is lower than SSBs as is the share of self-employed persons. FTBs are on average 7.6 years younger than SSBs while the share of self-employed FTBs is 3.7 per cent lower. Both differences are statistically significant at the 1 per cent level. FTBs also have a greater share of single assessment mortgages (69 percent to 25 percent), and a lower per cent are married or divorced. There is no statistically significant difference in the per cent of FTBs and SSBs whose property was purchased in Dublin.

3.2 Empirical Model

From a macro-prudential perspective, if differential regulatory treatment is to be partially justified for FTBs on the basis of lower default risk (as evidenced in Figure 2 and Table 2), then it must be

[11]Tracker mortgages are variable rate mortgages with a fixed margin above the ECB rate.

ensured that any observed differential is not explained by other characteristics of the loans and borrowers.

To test whether this is the case, we model the default probability of loans in our dataset using a standard binary model approach which is common in the literature (Jiang et al., 2013, 2014; Haughwout et al., 2008). Let NP_i be the realisation of the underlying propensity for delinquency for loan i, NP_i^*, which takes the values:

$$NP_i = \begin{cases} 1 & NP_i^* \geq 0; \\ 0 & NP_i^* < 0. \end{cases}$$

In our baseline specification, the probability of the realised default indicator taking the value of 1 is modeled as a function of underlying characteristics of the borrower, loan terms and dwelling controls:

$$Pr(NP_i = 1) = \mathbf{F}\left(FTB, \mathbf{X_i}, \mathbf{Z_i}, \mathbf{C_i}\right) \tag{1}$$

where $\mathbf{X_i}$ is a vector of borrower-specific controls, $\mathbf{Z_i}$ a vector of loan terms at origination and $\mathbf{C}$ a vector of other controls. To test the main hypothesis of this research, the variable FTB is a binary indicator variable which captures whether the loan was issued to a FTB at origination. The coefficient on this variable indicates whether or not FTBs default less after controlling for other borrower and loan characteristics included in the model.

The borrower-specific controls, $\mathbf{X_i}$, include borrower age modeled as a quadratic term, indicators for marital status (married, single, separated/divorced, other) and the employment status of the borrower at loan origination (employed, self-employed, other status). Loan origination conditions, $\mathbf{Z_i}$, include loan size at origination (in logs), the LTI and LTV at origination, the loan vintage included as a polynomial (months since the loan was a taken out), the term length, whether the application had a single or joint borrower assessment at origination and the type of originally contracted interest rate (binary indicators for standard variable rate, tracker, fixed-rate). The interest rate type is particularly important in an Irish context as tracker loans have an automatic passthrough from changes to ECB policy rates. Since the onset of the crisis, non-tracker, standard variable rates have diverged from the policy rate as banks have attempted to re-build profitability, compensate for high mortgage default and to protect against loss making trackers (Goggin et al., 2012). This

has provided an affordability support to borrowers with tracker loans relative to those on normal standard variable rates. A control for whether or not the property is in Dublin is also included. This is important given the regional variation in economic conditions. A full overview of the variables in the model with descriptions can be found in table A.1.

Our assessment based on the value of LTI, LTV and other criteria at origination may not be identical to other papers in the literature. This is indeed the case in relation to papers which model the standard "double trigger hypothesis" of mortgage arrears which indicates the current loan-to-value position is an important driver of arrears (Foote et al., 2008; Haughwout et al., 2008; Lydon and McCarthy, 2013; Gerardi et al., 2013; Kelly et al., 2012). However, this choice is deliberate and, from a macro-prudential policy perspective, our interest lies in what information banks have available when making the credit decision and how this can best be used to support future financial stability. As banks underwriting criteria cannot be forward looking and control future affordability or house price shocks, a macro-prudential focus should be on credit risks that can be managed by prudent loan origination criteria. Hallissey et al. (2014) find a high correlation between LTI and LTV at origination and default. Including these variables at origination also provides important insight into how the credit allocation criteria set by banks at origination affects future default and is in line with Elul et al. (2010).[12]

The vector $\mathbf{C_i}$ includes a range of additional controls that may impact both the borrowers default risk as well as difference in default risk between FTBs and SSBs. These include controls for whether or not the borrower received an equity release or top-up loan in addition to their original mortgage[13]. Previous research has found a statistically significant impact of second loans on primary loan default (Gerardi et al., 2008; Demyanyk and Van Hemert, 2011; Eriksen et al., 2013; Kau et al., 2014). We therefore include two indicators to control for this influence. We include a binary indicator for whether or not the borrower took out an equity release at the same bank as the primary loan as well as the log of the value of additional balance of second loan. To further explore this channel, we also include a dummy for whether or not the borrow has a mortgage for a buy-to-let investment property. Lydon and McCarthy (2013) provide evidence of higher default rates amongst buy-to-let investors. Controlling for this channel is important to ensure our FTB

[12]We do however conduct a robustness check including current LTV levels and the results hold. These estimations are available on request from the authors.

[13]Our data allow us to identify this variable within bank only i.e. a second loan at a different bank would not be captured by this variable.

control is not capturing these risk differentials. Dummies for each of the banks in the sample are also included.

We also undertake a range of robustness checks to test whether the difference in default risk between FTBs and SSBs holds depending on a range of additional potential considerations not included in our baseline model. The results are presented in section 4.2. They include assessments of the impact of current negative equity, dwelling type (apartment/non-apartment), changes in LTV since origination, county variation, and checks of whether the effects hold across time periods (pre and post 2004.)

To further explore the implications of this finding for macro-prudential policy, we test for a) threshold effects of the impact of different LTI and LTV levels at origination on default risk and b) whether the difference in default rates between FTBs and SSBs differs with originating LTI and LTV levels. Dividing a continuous variable into groups or categories is popular method for testing if the slope is constant across a variable. For example, LTV could be grouped into intervals of 10 (e.g. 0-10, 10-20, 20-30,...,) allowing for each group to have a different relationship with default. While this approach is a valid, it assumes the effect is constant within each group and discrete jumps in the relationship occur across group boundaries. A spline approach can address these shortcomings by fitting a piecewise regression which takes a functional form between points, known as knots, of the continuous variable. The simplest approach is to fit a linear spline, whereby the relationship between knots has a constant slope. Following a number of applications in the medical literature (Desquilbet and Mariotti (2010), Marrie et al. (2009)), we allow for non-linear relationship between the knots using a restricted cubic spline (RCS). When using a RSC, one obtains a continuous smooth function that is linear before the first knot, a piecewise cubic polynomial between adjacent knots, and linear again after the last knot. In general, the logit RCS model, with restricted spline function $f(S)$, with k knots is given by,

$$Pr(NP_i = 1) = \mathbf{F}\left(FTB, \mathbf{X_i}, \mathbf{Z_i}, \mathbf{C_i}, f(S)\right)$$
$$\text{with } f(S) = \beta_0 + \beta_1 S_1 + \beta_2 S_2 + ... + \beta_{k-1} S_{k-1}$$

where $\mathbf{X_i}$,$\mathbf{Z_i}$ and $\mathbf{C_i}$ are defined as in Equation 1. S is the variable upon which the spline function is estimated, in our case LTV and LTI. In terms of number and location of the knots along the

distributions of LTV and LTI, we follow Harrell (2001) approach of 5 knots located at the 5, 27.5, 50, 72.5 and 95 percentiles of the distributions of LTV and LTI.

4 Empirical Results

4.1 Modeling Default Risk of First Time Buyers

This section presents the main results of our empirical analysis. The model is estimated using a standard logit framework with robust standard errors. Table 3 outlines the marginal effects calculated at the mean from our baseline logit specifications: column (1) contains the estimates of the baseline model, columns (2) to (4) include additional controls individually and column (5) controls for all factors simultaneously. For interest rate type controls, the omitted category is *fixed-rate* while for marital status, the omitted category is *married*.

The main variable of interest is FTB. In column (1), the coefficient on FTB is negative and statistically significant at the 0.1 per cent level. The point estimate indicates that FTBs are 4.1 percentage points less likely to default than SSBs. For context, summary statistics in table 2 indicate that raw default rate differential between the groups is 4.6 percentage points. Controlling for the factors included in the specification, the difference, as indicated by the coefficient on FTB, remains 4.1 percentage points and thus does not appear to be fully explained by controlling for loan or borrower-specific characteristics in an econometric framework. Moving across columns (2) to (5) where employment, equity release and buy-to-let controls are included sequentially and simultaneously, the finding remains: FTBs have a lower default probability than SSBs of approximately 4 percentage points. These findings are in line with Jiang et al. (2013, 2014) who find that FTBs in the US are also a lower default risk.

To understand how macro-prudential regulations on LTV and LTI levels support financial stability, it is important to evaluate how the level of LTI and LTV at origination can impact mortgage default. In our model, the OLTV and OLTI at origination both enter the model with a positive and statistically significant coefficient. For LTV, the magnitude of the marginal effect is 0.001 indicating that a 10 percentage point increase in the OLTV increases the probability of default by 1 percentage point. The marginal effect of OLTI is 0.006: a one unit increase in the level of OLTI increases the default probability by 0.6 percentage points. On this evidence, limits to both LTI and LTV at

origination through macro-prudential regulation would lower default risk.

Table 3: Marginal Effects of Logit Model

	(1) Basic	(2) Emp Status	(3) Equity Rel	(4) BTL	(5) Full
OLTV	0.001***	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
OLTI	0.006***	0.008***	0.008***	0.007***	0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ln(DBO)	0.022***	0.012***	0.016***	0.020***	0.005*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Term	0.001***	0.001***	0.000***	0.001***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Int Type, SVR	0.100***	0.094***	0.100***	0.099***	0.095***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Int Type, Tracker	0.062***	0.058***	0.063***	0.061***	0.059***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)
Single Assess	−0.008***	−0.006***	−0.009***	−0.009***	−0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Dublin, Yes	−0.037***	−0.033***	−0.035***	−0.037***	−0.031***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
Marital Status, Single	−0.004*	−0.005*	0.000	−0.004*	−0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Marital Status, S/D	0.036***	0.037***	0.038***	0.037***	0.039***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Marital Status, Other	0.022***	0.018*	0.023***	0.022***	0.018*
	(0.006)	(0.008)	(0.006)	(0.006)	(0.008)
FTB	−0.041***	−0.043***	−0.040***	−0.040***	−0.041***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Emp Status, Self-Employed		0.085***			0.085***
		(0.002)			(0.002)
Emp Status, Other		0.064***			0.064***
		(0.003)			(0.003)
Equity Release Dummy			−0.037*		−0.025
			(0.015)		(0.015)
ln(Additional DB)			0.009***		0.008***
			(0.001)		(0.001)
BTL Also				0.030***	0.020***
				(0.003)	(0.003)
N	291,345	263,430	291,345	291,345	263,430

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Controls for borrower age and loan age also included.

Bank dummies included in all regressions.

Focusing on the other control variables in column (1), we find that the log of loan size has a positive and statistically significant effect on the probability of default: default probability increases with loan size at origination. This finding holds in the full model in column (5). The loan term has a positive and statistically significant effect on the probability of default. In relation to the interest

rate types, we find that relative to fixed rates, borrowers on SVR rates and tracker rates are 9.5 percentage points and 6 percentage points more likely to default. It must be noted that the majority of mortgages in Ireland are either SVR or tracker rates.[14]

Regarding borrower-specific controls in the full model in column (5), there is no statistically significant difference in the default rates of married borrowers and single borrowers. Separated or divorced borrowers are more likely to default than married borrowers. Borrowers who have single assessment have a lower probability of default. Borrowers whose collateral is in Dublin are also less likely to default: the point estimate is negative and indicates a 3.1 percentage point lower default rate on loans against Dublin properties. One characteristic of the Irish economic crisis, and subsequent nascent recovery, has been considerable regional variation in economic performance (Morgenroth, 2014). With better employment prospects, Dublin-based borrowers have suffered less from employment and income shocks relative to borrowers from other regions. This would be partially captured with this control. Controls are included for borrower age and loan age (vintage) in all models non-linearly. In these cases, average marginal effects are not informative and the non-linear patterns are available on request from the authors.

In columns (2)-(4), the three additional controls are added sequentially and then simultaneously in column (5). Of importance is the inclusion of controls for employment status to capture the impact of income volatility on default. The omitted category is employed. In both column (2) and (5) the results indicate that self employed persons have an 8.5 percentage point higher probability of default relative to employed borrowers. Employment status other (which includes retired and unemployed persons) have a 6.5 percentage point higher probability of default relative to employed borrowers. The controls for equity release indicate that the likelihood of default increases with the volume of additional drawn balance of the loan. Borrowers who have a BTL loan are also more statistically likely to default.

4.2 Robustness Checks

To further assess the robustness of our finding on FTBs, we run a series of additional tests. The output is presented in table 4. In each robustness check, the underlying model is the Full model as in column (5) in table 3. For brevity we only present the coefficient on the FTB dummy as well as

[14]See Household Credit Market Report, Central Bank of Ireland for further information. The loan age or vintage is modeled as a polynomial and the effects are available on request from the authors.

the coefficient on any additional variables that are included.

The first robustness check splits the sample into loans originated in years before and after 2004. There is clear evidence that credit conditions in Ireland began to loosen considerably in the period post 2004. This is evident from previous research (McCarthy and McQuinn, 2013) as well as being clearly demonstrated in figure A.1. Estimating the effect of FTBs on a sample pre and post this period will ensure that the results are not driven by any structural change in lending conditions in the boom period in Ireland. The results are presented in columns (1) and (2). The dummy for FTBs is negative and statistically significant in both periods indicating that the finding is not solely related to loans originated post 2003.

The second robustness check removes the Dublin dummy and replaces it with a full range of county dummies. As noted above, there has been considerable variation in both the impact of the economic crisis and the subsequent recovery on regional economies in Ireland. This may have a considerable impact on the level of mortgage default across the country as unemployment shocks have been unevenly distributed. Including county dummies in the logit specification can provide a tighter control for local conditions on default outcomes. Indeed previous research in Ireland has included these dummies as controls or focused on county employment conditions in mortgage default models (Kelly, 2011; Lydon and McCarthy, 2013; Gaffney et al., 2014). The FTB coefficient in the model with county dummies is presented in column (5): it is negative and statistically significant as before.

Table 4: Robustness Checks of FTB Marginal Effect

	(1) Pre 2004	(2) Post 2004	(3) Apt	(4) Delta LTV	(5) Counties	(6) NE	(7) FTB*NE	(8) FTB*NE*HighLTI
main								
FTB	−0.027***	−0.048***	−0.037***	−0.026***	−0.039***	−0.033***		
	(0.003)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)		
APT			−0.020***					
			(0.003)					
Δ LTV				−0.003***				
				(0.000)				
FTB w/LTV<100							−0.017***	
							(0.002)	
FTB w/LTV>100							−0.070***	
							(0.003)	
FTB w/LTV<100 and LTI <p50								−0.005**
								(0.002)
FTB w/LTI >p50								−0.039***
								(0.002)
FTB w/LTV<100								−0.038***
								(0.006)
FTB w/LTV>100 and LTI>p50								−0.080***
								(0.004)

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The final set of controls deal with the issue of current loan-to-value ratios or negative equity. The effect of negative equity on mortgage default is well established in the literature as part of the standard options-based model of delinquency and through identification in empirical research (Foote et al., 2008; Elul et al., 2010; Kelly et al., 2012). While these effects are usually identified through the inclusion of current LTV in empirical models, we have chosen to include OLTV as a control due to the focus on macro-prudential policy. To therefore control for these factors, we run three robustness checks. First, we include the change in LTV since origination as well as the level of originating LTV which should capture the impact of changes in house prices since origination on default. The results are presented in column (4). While the magnitude of the FTB coefficient falls somewhat, it remains negative and statistically significant at circa three percentage points differential in default risk. In addition, we include a dummy for loans in negative equity as an alternative and the main finding holds. In fact, we interact the coefficient on FTBs with the negative equity dummy and find that, while the effect is negative and significant for both groups, the effect is actually greater for FTBs who are in negative equity.

While it appears be the case that FTBs react differently to negative equity, they may also react differently if they are stretched on the income side with high LTIs. Furthermore, when borrowers are stretched on both LTI and LTV channels, there could be even greater default risk. It is interesting to explore whether the FTB finding is robust to this double interaction. To test whether this is in fact the case, we interact both the FTB and negative equity results with a dummy for whether or not the borrowers LTI was in the top 50 per cent of the distribution at origination. The results of these triple interactions are presented in the final column in table **??** As was the case with negative equity, it appears that FTBs with higher LTI are even less likely to default. Interestingly, the marginal effect of FTB is even larger (in absolute terms) for high LTV, high LTI borrowers: FTBS with high LTV and LTI have a much lower propensity to default than SSBs.

While not presented in the paper, we also run the full model for each of the financial institutions in our dataset. This is to ensure that the findings are not driven by the lending practices of one bank in particular. We find a negative and statistically significant effect for the default risk of FTBs for each bank indicating our findings hold across financial institutions.[15]

[15]For confidentiality reasons the results have not been included in the draft. Anonymised versions of the estimates can be obtained from the authors on request.

5 Implications for Designing Macro-prudential Regulations

Section 4 above provides empirical support for a differential in risk of lending by FTB status. If macro prudential policy, through LTV and LTI caps, was to reflect this result, additional analysis on the interaction with the main policy tools, LTV and LTI is required. There are two extensions to the model required; (i) a model which explores non-linearities between default and LTV/LTI and (ii) test if the FTB result differs across originating LTI and LTV levels. The standard binary model outlined in Section 3 can be extended to include a non-linear specification of LTV and LTI, by estimating a logit model with LTI and LTV entered as a spline function.

The results are presented in figures 3 and 4. We find that while the default risk increases with LTV at origination, we identify the difference between FTBs and SSBs is greatest at LTV of 80-85 per cent; with FTB default rate 45 per cent lower. The result for LTI is more linear and the difference between the default rate of FTBs and SSBs grows constantly. Therefore, if cap differentials based on FTB status are to be provided in mortgage measures, the specific level of the caps must be taken into account during calibration.

Section 2 outlines the economic rationale as to why FTB might be different with a focus on their marginal borrower status and their sensitivity to lending conditions. It is also important to consider there is also wide distribution of borrowers within the FTB group facing different outcomes as a result of macro prudential measures in the house market. Take for example a higher LTV requirement, this will lead to one of three outcomes for a first time borrower; (i) elongates the the period of deposit accumulation resulting in the purchase of a similar property, (ii) adjustment of expectations with the purchase of a lower cost property or (iii) failure to purchase property, especially if house price growth exceeds the individual's savings rate. The third outcome is more likely to effect lower income households purchasing lower cost housing. The third group are the extreme case of a marginal borrower with high sensitivities to lending conditions with thus the potential to bear the largest costs to the new regulation. A potential policy response is to design a rule which reflects the relative cost of housing.

The credibility of such a response depends on the interaction of the FTB credit risk differential and the cost of housing. This can be tested by interacting FTB status with a variable created by

placing each loan into deciles of house prices by origination year and applying the RCS approach, similar to LTV and LTI above. Figure 3 shows a strong, almost linear relationship between relative house price and default, with a 44% lower default rate for highest compared to lowest cost housing. Figure 4 focuses on how this relationship interacts with a borrowers FTB status, showing a non-linear relationship maximised at house prices just below median levels, with a 34 % difference. Above the median, the FTB credit risk effect diminishes with house price level.

All macro prudential measures aimed at lowing LTV and LTI levels will increase resilience of the banking sector through reduced risk default risk. From an regulatory perspective, governments and policy-makers have to balance financial stability risk concerns with the management of access to homeownership for FTBs. The findings above provide empirical support from a credit risk perspective to calibrate such macro prudential policies to reflect FTB status and the relative housing cost. Designing macro prudential policy in this way, reduces the impact of the resilience building measures on households accessing affordable housing and becoming home owners for the first time.

Figure 3: Predicted Probabilities from RCS Models

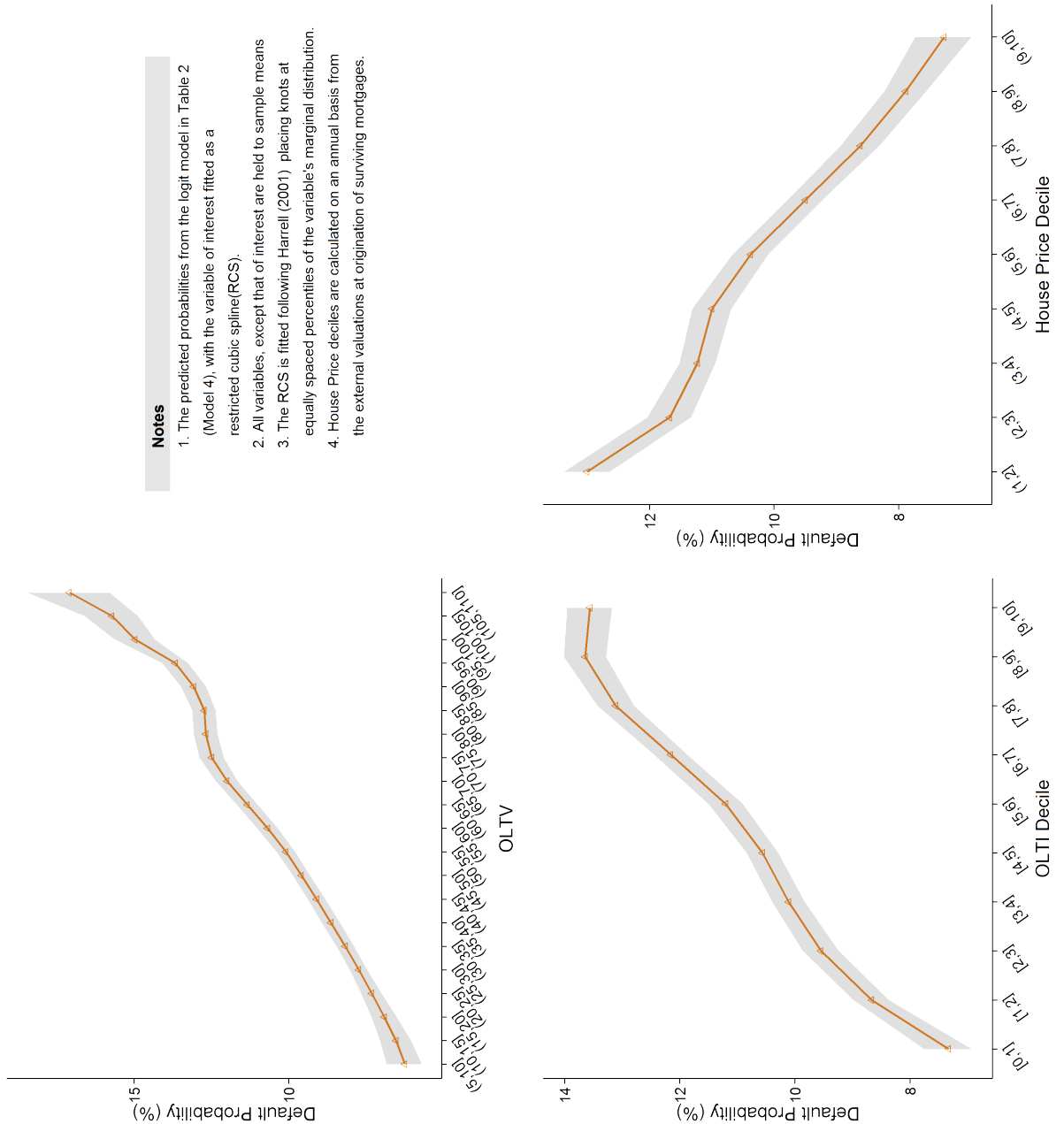
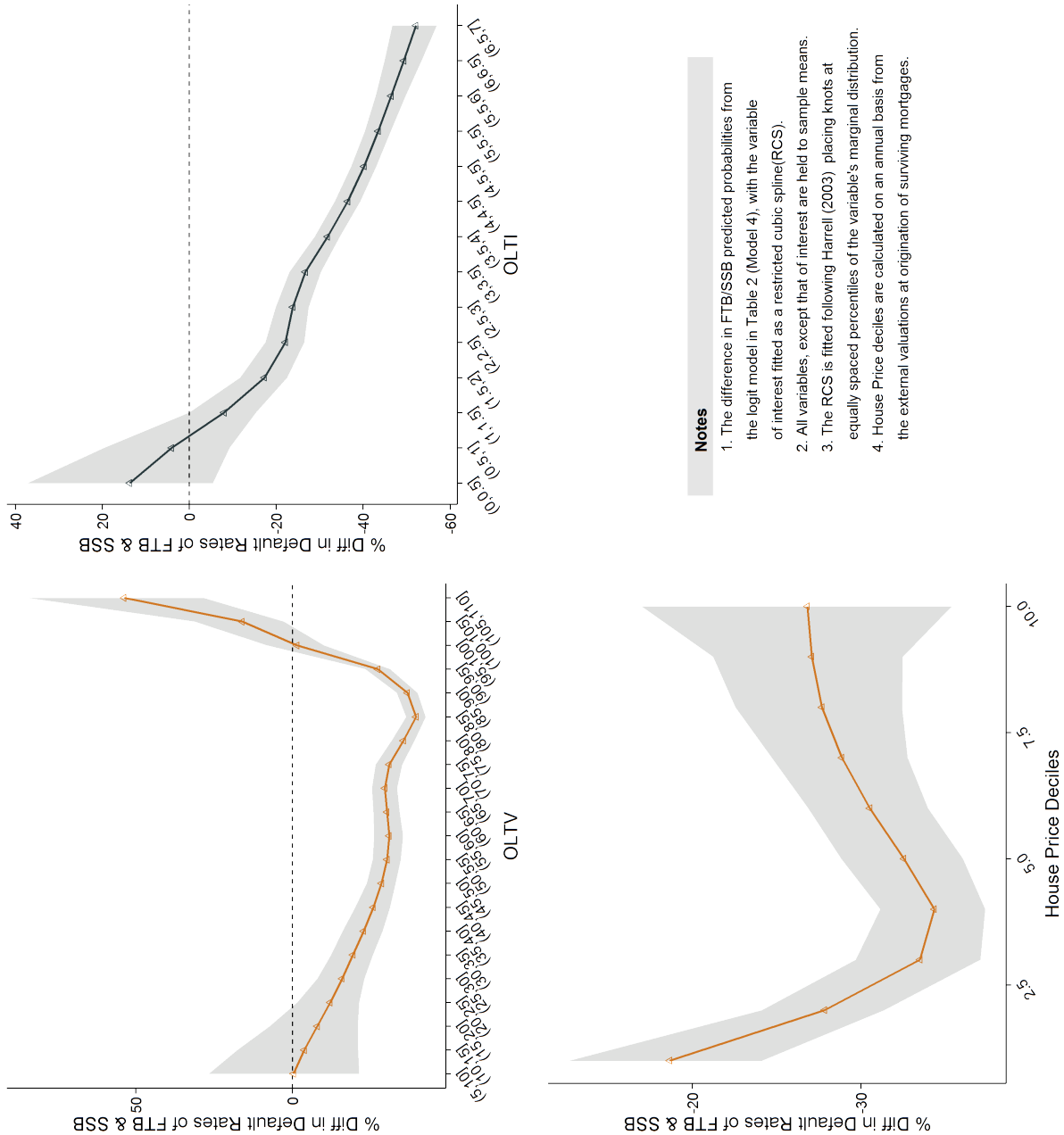


Figure 4: FTB & SSB Default Differential from RCS Models



6 Why Do FTBs Default Less? A Discussion

A key question is why FTBs might in fact be a lower credit risk. As our research is based on an indicator variable for FTBs, it is not possible to exactly identify what is driving this differential. In fact, there may be a number of reasons why FTBs and SSBs differ in unobservable ways that we cannot isolate in our data and thus could be driven by omitted factors. However, it is important to explore a number of potential hypotheses which could be the focus of future research. In this section, we present a discussion of potential channels through which the FTB default mechanism may operate. Our discussion will draw out potential explanations from a borrower perspective (demand side) and a bank perspective (supply side).

On the borrower side, there are a number of potential reasons why FTBs may default less. Firstly, as marginal borrowers, FTBS are more unlikely to have built up a credit history prior to purchase. While we may expect that borrowers with a repayment history are more likely to perform, it could also be the case that FTBs see their first purchase as a means to build up a payment history. If FTBs wish to move in the future and are concerned about the impact of default on their future credit access, they may be more active in trying to keep up with mortgage payments due to a larger reputational loss in default. For FTBs, the life-time costs of default are higher as exclusion from credit markets in the future, following a current default, has higher repercussions.

A second borrower explanation relates to risk appetite. Becoming an SSB may in fact reveal a higher tolerance for risk relative to borrowers who remain FTBs. For example, two borrowers of the same age, one chooses to be become an SSB and one remains an FTB. This decision may reveal the something about the borrowers underlying latent risk tolerance with SSBs comfortable to take more risk. This increased risk appetite may lead to a higher probability of default for SSBs. A related factor in this explanation could be loss aversion. If SSBs used capital gains to purchase the property, they are more likely to realise losses, rather than try to sit things out. FTBs on the other hand may have spent a lengthy period building up savings balances and are more unwilling to realise losses on these funds i.e. loss aversion is higher for FTBs than SSBs. Additionally, it could be the case that SSBs are more likely to be "property investors" in that conditional on the covariates included, they view their housing not only as a consumption good but also as an investment with which to realise future gains. If this is the case, then their attachment to a home is lower. Both of these suggest that FTBs "work harder" to protect against default.

A third borrower explanation is that FTBs could potentially be a lower risk as their income growth path for a give LTV is higher. While that may in fact be the case, as our regression framework controls for borrower age, we are essentially testing the difference in default rate for SSBs and FTBs of the same age. In this context, the lifecycle hypothesis is less likely to be the explanation. Indeed, as a further robustness check, we interact the FTB dummy with borrower age and the differential holds across age groups.[16] From a supply-side, bank perspective, there is one main reason why FTBs might be lower default. Firstly, it may be that, due to a lack of credit history, banks apply more thorough lending evaluations and stricter appraisal criteria to FTBs. This may lead to better credit allocation outcomes following a shock to house prices. It is also possible that during a house price boom, such as that experienced in Ireland, collateral could be a poor proxy for risk as shown in Dell'Ariccia and Marquez (2006). Within this context, while SSBs appear to have higher equity buffers, these buffers to not adequately capture actual risk due to the overreliance on collateral-based lending risk assessments during lending booms.

7 Conclusions and Policy Implications

The credit conditions of the FTB group are central to price setting in housing markets (Duca et al., 2011). They are the marginal borrower, devoid of potential equity gains from house price movements and therefore exhibit a high degree of sensitivity to changes in credit conditions. Any macro prudential policy aimed at addressing risks in residential property lending must take account of theses differences. This research empirically investigates whether the default risk of mortgage lending depends on a borrowers FTB status and therefore whether these findings support an adjustment in macro-prudential regulation to address the marginal status of FTBs. The results indicate that FTBs do default less, controlling for a range of borrower, loan and dwelling region factors. While these results relate to a cross section of loans for Ireland dated December 2013, the findings are comparable to Jiang et al. (2013, 2014) who find a negative effect of first time buyers on loan default using a large dataset of loans from a major financial institution in the US.

While this research is the first to explicitly highlight the fact that FTBs are a lower default risk in a macro-prudential context, a differentiation in regulatory treatment for first time buyers and non first time buyers has been applied internationally (See table 1). We find that the default risk

[16] Results are available on request from the authors.

increases in a monotonically non-linear fashion with higher LTV levels, with a sharp increase in slope above 85 per cent. The FTB/SSB differential is maximised for LTVs of 80-85 per cent, with the FTB default rate is 45 per cent lower. The result for LTI is more linear and the difference between the default rate of FTBs and SSBs grows constantly. Therefore, if cap differentials based on FTB status are to be provided in mortgage measures, the specific level of the caps must be taken into account during calibration.

The economic rationale for specialist treatment of FTB borrowers centres on their bearing a disproportionate cost of the macro-prudential regulation. With the FTB group, the cost, if measured through exclusion from the housing market is highest for the lower part of the house price distribution. We find a non-linear differential in credit risk between FTB and SSB borrowers across house prices, with diminishing credit risk gains for house prices above the median value.

In summary, our research finds differences in default risk between FTBs and SSBs. The higher risk associated with increased LTV is minimised in credit risk terms for FTB with LTVs between 80-85 and house valuations below the median. Given the differential in default rates by borrower type at varying levels of LTI, LTV and house prices, policy makers who are calibrating macro-prudential measures could take stock of such evident differences in their country situation and attempt to incorporate this information into cap selection. This may better the selection of specific cap levels.

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Table A.1: Variables Included in Analysis

	Variable	Description
Baseline Model		
Borrower Characteristics		
	Borrower Age	Borrower Age at origination (in months)
	Marital Status	Groups (Single, Married, Separated/Divorced, Other)
	Region	Groups (Dublin, Non-Dublin)
Loan Characteristics		
	Bank	Groups (AIB, BOI, PTSB)
	Vintage	Number of months since loan origination.
	Term	Loan term at origination (in months)
	Interest Rate Type	Type of interest rate at origination. Groups (Fixed, SVR, Tracker)
	DBO	Drawn Balance at Origination (in natural logs)
Marco Prudential Variables		
	LTV	Loan to value at origination.
	LTI	Loan to income at origination.
Additional Specifications		
	Employment Status	Type of employment at origination. Groups (Employed, Self-Employed, Other)
	Equity Release Dummy	Dummy variable for additional loans on same property.
	ADBO	Total Drawn Balance of Equity Release (in natural logs)
	Additional Property	Dummy capturing borrowers with Buy to Let/Holiday Homes

Figure A.1: Medians of LTV, LTI & House Prices by Year/FTB Status

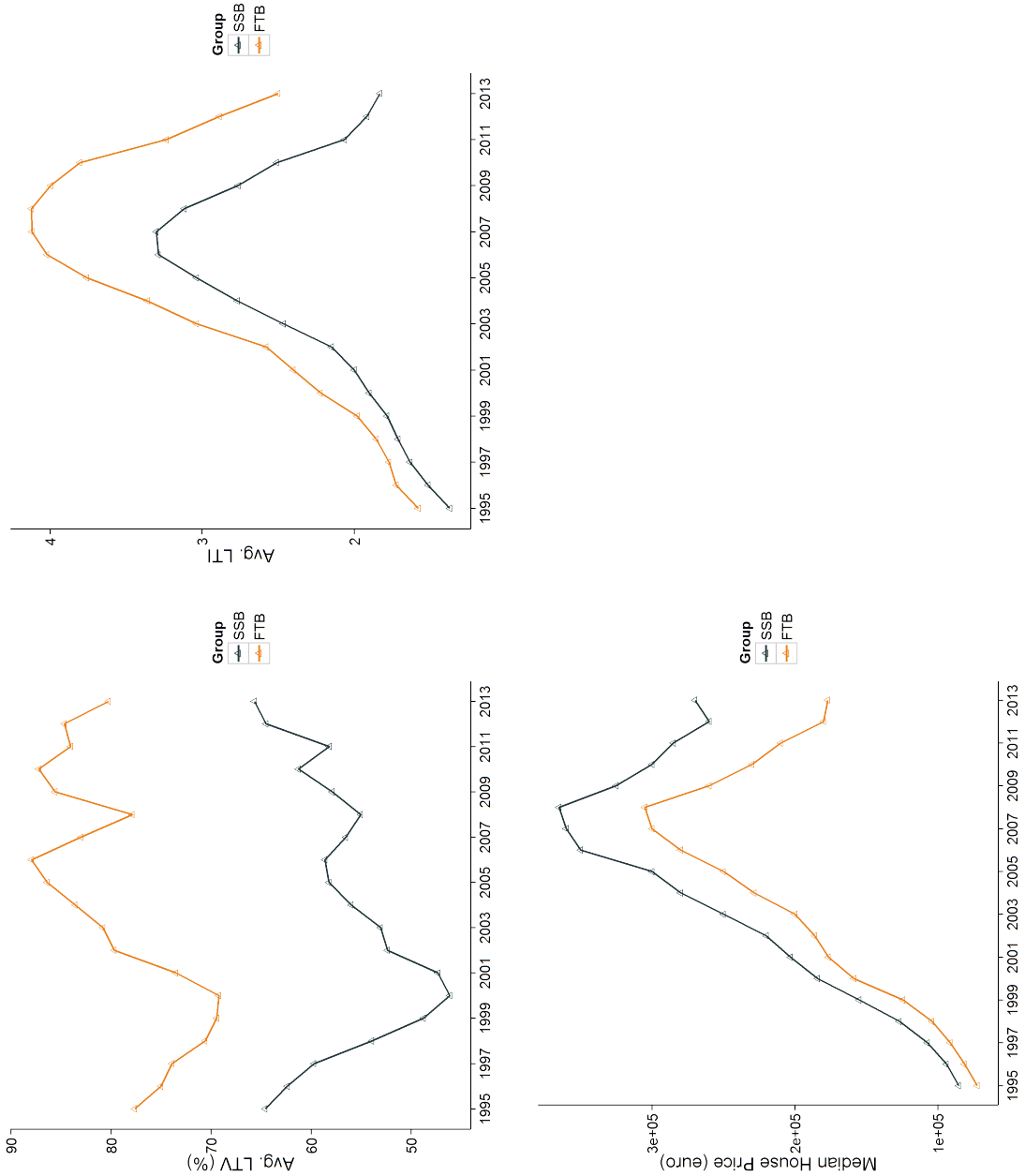

Table A.2: Sample-selection rules

Data-cleaning step	**N**	Obs Removed
Raw data	**616,895**	0
Remove loans that aren't valued	**607,281**	9,614
Remove buy-to-let loans	**516,616**	90,665
Remove non-primary mortgage loans	**411,551**	105,065
Remove NA and missing fields	**315,453**	96,098
Remove outliers from continuous variables	**291,345**	24,108