Working Paper No. 618

March 2019

Household savings constraints, uncertainty and macroprudential policy

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Abstract: Despite the increasingly wide-spread nature of macroprudential regulations, relatively few studies have assessed the implications of such policies on key household finance decisions. In this paper, we investigate the impact on Irish household perceived savings constraints of macroprudential policy measures introduced by the Central Bank of Ireland in early 2015. These measures, which require larger downpayments than previously was the case, constitute a significant new source of uncertainty for those seeking to engage in homeownership. Using a unique, nationally representative survey of households' savings decisions we find that the measures have had a significant impact on the degree to which Irish households feel constrained in their savings decisions. Credit constraints and consumer inattention are proposed as explanatory channels for this development. Heterogeneous effects across households indicate younger, private renting households, and those with relatively uncertain cash flows show the largest increase in perceived constraints following the introduction of the policy.

JEL classification: D14, G28

Keywords: Savings, Uncertainty, Macroprudential Policy

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1. Introduction

The adoption of macroprudential measures across a number of jurisdictions over the past ten years is an increasingly popular response to the credit-fuelled nature of the property bubbles which had emerged in the run up to 2007/08. The significant increase in mortgage credit which preceded the international, financial crisis resulted in the financial systems of a number of countries being especially vulnerable to disruptions in global financial markets experienced at that time. Limits on loan to value (LTV) and loan to income ratios (LTI) have been used for some time by authorities in Hong Kong, China, Korea, Singapore, and other emerging market economies as a counter-cyclical credit tool (Zhang and Zoli, 2016). More recently, regulatory authorities in Hungary, Norway, Sweden, Finland and Ireland have all adopted these types of macroprudential measures. These instruments are specifically aimed at curtailing the excess provision of credit and providing financial buffers for both households and credit institutions to mitigate the impacts of future downturns in housing markets.

While an increasing array of studies have examined the effectiveness of loan-to-value and loan-to-income restrictions from a financial stability perspective (Bruno et al., 2017; Cerutti et al., 2017; Claessens et al., 2013), few have examined the implications of such measures for household finance and in particular the savings decisions of households. However, as homeownership remains a strong preference among households in many economies, it is likely that the introduction, and possible subsequent variation in macroprudential requirements, will impact the determinants of households savings.

If macroprudential limits on leverage increase the downpayment required by households, then *ceteris paribus*, an increase in the households' savings rate is required. Alternatively, households would have to increase the length of time required to accumulate the deposit. In cases where households are unable to increase the savings rate, or can but must delay purchase, these households could be seen as savings constrained. As a consequence, a tightening of macroprudential policies could increase the share of households who appear constrained.

These mechanisms in a sense provide a proxy for liquidity constraints i.e. households which need to raise the savings rate to complete a planned purchase due to tighter credit requirements. Previous research has focused on liquidity constraints for house-

holds (Carroll and Kimball, 2001; Samwick, 2003; Zeldes, 1989), noting that when a liquidity constraint is added to the standard consumption problem, the resulting value function exhibits increased prudence around the level of wealth where the constraint becomes binding. Therefore, the extent to which households experience liquidity constraints can have a major impact on their savings decisions and in turn on investment and consumption. In general, however, due to the paucity of detailed information on households savings decisions, it is difficult to find empirical evidence of these features.

In this paper, we draw on a novel dataset of household savings which measures households perceptions as to whether their current savings behaviour is "optimal". One challenge of studying savings behaviour among households is the notion that each individual respondent may react different to a fixed level of savings. Factors such as variations in family circumstances, planning decisions and expectations of future economy circumstances can augment the satisfaction particular acts of saving may enable. This specific dataset, taken from the Economic and Social Research Institute's Economic Sentiment Monitor (ESM), allows us to define households as facing savings constraints if they indicate they are not content with their current savings behaviour. The survey also allows us to disentangle whether or not households have a demand for housing and whether their savings behaviour is linked to the need to acquire a downpayment for the house purchase. We couple this with a quasi-natural experiment through the unexpected introduction of macroprudential loan-to-value and loan-to-income measures in the Irish mortgage market to test how the increased downpayment requirement impacts households' savings constraints.

More specifically, using these unique, nationally representative survey data from Irish households, before and after the introduction of the new regulations, we exploit the variation across households in their exposure to downpayment constraints to test a) how macroprudential regulations impact household savings constraints and b) how uncertainty and precautionary behaviour shapes the distributional response to the policy across households.

In examining the impact of macroprudential policy on savings decisions our contribution builds on a new strand of the literature, which focusses on the role of uncertainty due to policy measures. As is well known, uncertainty is particularly important in the context of households' savings with Carroll and Kimball (2006) defining precau-

tionary saving as resulting from the knowledge that the future is uncertain; households adjust their savings to smooth consumption over their life cycle. Uncertainty, typically in the savings literature, has been examined in the context of shocks to labour income, however, a more recent literature has focussed on the role played by policy uncertainty (Giavazzi and McMahon (2012)) where political uncertainty in terms of labour market reform plays a critical role in determining the degree of precautionary behaviour. In the presence of macroprudential limits on mortgage lending and/or time varying bank lending standards, households will be uncertain as to the exact level of wealth required to meet downpayment constraints. Therefore, households with uncertain cash flows, would be expected, *a priori*, to increase their savings due to precautionary motives. In our setting, this would translate into a greater increase in savings constraints for households with uncertain future cash flows relative to others following the introduction of the macroprudential measures.

The Irish market is of particular interest in terms of identifying the uncertainty channel. As noted in McQuinn (2017), amongst OECD countries, the Irish residential sector experienced the largest increase in house prices over the period $1995 - 2007$ and conversely suffered the most significant decline in prices between $2008 - 2013$. Given the increases in both prices and activity levels, the housing market, had, by 2007, assumed a disproportionate importance vis-á-vis the overall economy with the Irish financial sector particularly vulnerable to the subsequent international financial downturn. Consequently, the variation in key housing market indicators had significant implications for Irish households.

In our analysis, we define two groups of savings constrained households: a) *Constrained Savers* - households who are currently saving for a home but feel the savings they are doing are not adequate and b) *Constrained Non-Savers* - households who intend to buy a house in the next 2 years but are not actively saving for house purchasing at present. Using these definitions, our identification strategy is threefold. First, we use a simple event window analysis which considers the change in constraints before and after the policy. Second, we take two groups who are suggested by research as being more exposed to housing downpayment constraints namely younger households, and those in the private rental sector, and use these groups to apply a quasi-experimental difference-in-difference method. Third, to test the impact of uncertainty, we follow Gi-

avazzi and McMahon (2012) and use the public sector/private sector split to distinguish between households with different cash flow uncertainty. We also use a survey based indicator for those households who have concerns about future incomes/affordability as a further means of identifying households with varying degrees of uncertain income.

Our results suggest an increase in the share of constrained households amongst non-savers following the increase in the policy. These findings are intuitive and indicate the impact of these regulations are borne most by those who intend to buy a house but are most constrained in their savings behaviour at present. From our quasi-experimental testing, we find that the effects are largest for younger households and those in the private rental market. Both are groups of households most likely to face downpayment constraints when entering the housing market. In terms of uncertainty we find private sector households are more affected as are those with explicit concerns around future income affordability. These findings would suggest that uncertainty exacerbates the constraint channel following a downpayment shock.

There is also another potential explanation that may exacerbate the effect we find over and above that of a credit constraints shock. We find active savers were unaffected and non-saving potential buyers were more constrained and this may relate to the parametrisation of the macroprudential regulations in Ireland combined with the attentiveness of market participants a la Reis (2006). When the regulations in Ireland were introduced, their calibration was very close to the market credit conditions at that time.[1] In this case, current active savers, who were attentive in terms of absorbing the information about the regulations would have realised that the payments shock was not significant. However, inattentive purchasers who would not have been as familiar with the additional financial constraints imposed by the policy perceive the shock to be much more significant.[2]

To test the robustness of our findings, we undertake two important tests. First, we include controls for the economic cycle that vary by time and region to ensure that our findings are not driven by any change in underlying economic trends. Second, we en-

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[1] Kinghan et al. (2019) found a marginal tightening of credit for high income first time buyers of between 1-2 percentage points of LTV.

[2] In the institutional and individual responses to the introduction of the regulations, considerable emphasis was on whether homeownership would ever be feasible for first time buyers. https://www.centralbank.ie/publication/consultation-papers/consultation-paper-detail/cp87-macro-prudential-policy-for-residential-mortgage-lending

sure that the two treatment groups that we use (younger households and those in the rental sector) were not themselves affected by the regulatory change by using a multinomial logit inverse probability weighting technique as presented by Stuart et al. (2014) and used by McCann and O'Toole (2019) to deal with a similar issue relating to macroprudential policy. In both cases, our baseline results are robust to the additional controls.

Our findings have important implications for the political economy acceptance of a mortgage-based macroprudential regime. In some cases, the introduction of loan-to-value and loan-to-income regulations can be perceived as impairing the ability of households to "own their own home"[3] even if the actual change brought about by the regulations may be somewhat less severe than expected. In the Irish case, the calibration of the rules closely to the market credit conditions meant that the actual shock was not extreme due in particular to the sliding scale rule for LTV and the system of proportionate allowances. Our findings suggest that savings constraints increased for younger, renting households exactly those households most expected to be affected based on existing research. From a policy perspective, clear communication of the impacts of the regulations on such borrowers may increase the political economy acceptance of the measures and ensure such frameworks are long lasting.

The paper is structured as follows. Section 2 briefly describes the role of uncertainty in household savings literature before clarifying Ireland's experience with macroprudential policy. Section 3 describes our methodology and dataset. Section 4 details the empirical findings of our approach while Section 5 deploys robustness checks in order to verify the validity of these results. The final section summarises our final conclusions and policy implications, based on these findings.

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[3]Clear evidence can be found for this from the response to consultations by the public, political parties, Ministries and government bodies to the proposed introduction of these measures by the Irish Central Bank which can be found here: https://www.centralbank.ie/publication/consultation-papers/consultation-paper-detail/cp87-macro-prudential-policy-for-residential-mortgage-lending.

2. Background and Context

2.1. Macroprudential Regulations As An Uncertain Downpayment Shock

The introduction of macroprudential policy measures after the financial crisis sought to safeguard the stability of the financial sector by breaking the link between house price fluctuations, credit growth and banking sector stress (Arregui et al., 2013; Nabar and Ahuja, 2011; Vandenbussche et al., 2015). A central component of the new policy measures introduced has been the deployment of borrower-based instruments in the mortgage market which limit underlying credit conditions at loan origination. The most frequently used instruments in this toolkit are loan-to-value and loan-to-income ratios which impose a regulatory downpayment constraint and income affordability limit respectively.[4] Loan-to-value ratios, in particular, require prospective homeowners to increase liquidity upfront at the time of purchase.

These measures therefore impose regulatory income and downpayment constraints for households looking to become mortgaged-homeowners. In the literature, there is a considerable focus on which households face binding downpayment constraints and the impact on homeownership (Barakova et al., 2014). Our paper is the first to bridge this traditional literature on downpayment constraints with the impact of macroprudential policy on household savings.

In 2015, given the strong pick-up in Irish house prices apparent since 2013, the Central Bank of Ireland announced the introduction of macro-prudential measures aimed at preventing the emergence of another credit bubble. A full outline of these regulations can be found in Keenan et al. (2016) however a short summary at this juncture is useful. The regulations limited the maximum loan-to-value ratio for first time buyers to 90 per cent for house purchases under 220,000 and to 80 per cent for every euro over 220,000. Kinghan et al. (2019) show this led to a LTV shock of approximately 2 percentage points overall. Second time buyers were subject to a maximum 80 per cent loan-to-value (LTV) ratios. A system of proportionate allowances was also introduced such that lenders could exempt 15 per cent of total lending from the regulations. In addition

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[4]Other measures can include specific limits on debt-service ratios or loan term restrictions. These macroprudential measures were adopted on a widespread basis in Asian economies following the onset of the financial crisis in 1997 (Zhang and Zoli, 2016).

to the LTV restrictions, a loan-to-income restriction of 3.5 times gross income was also implemented. Proportionate allowances to this rule allowed 20 per cent of total lending to be exempt from this measure. While welcome from a financial stability perspective, these policy measures do, for a number of reasons, increase the degree of uncertainty for prospective homeowners:

1. The measures, when introduced, were unanticipated and, as such, can be seen as an exogenous increase in credit constraints,

2. Uncertainty about the actual application of the measures; financial institutions may grant exemptions to a certain number of households, who would then not face any downpayment or income limits. However, it is unclear which households would be eligible,

3. The possibility that the regulations may change in the future.[5]

In all of these cases, the rules counted as an actual increase in credit constraints in the mortgage market in Ireland. It is also likely that borrowers with a greater degree of uncertainty in forecasting their cash flows would be more likely to feel a heightened uncertainty when the rules were introduced.

With these considerations, the heterogeneous impacts of these policies across households are likely to be significant; given differences in the distribution of income and wealth across the economy, it is unlikely that a uniform effect would be found. Two particular factors are likely to attenuate the impact for specific borrower groups: a) their relative demand for homeownership and degree of financing constraints and b) uncertainty. For the former group, it is likely younger borrowers and those in the private rental market looking to purchase homes would be most affected.

2.2. Precautionary Behaviour, Uncertainty and Household Savings

An important feature of our research is to examine the impact of uncertainty due to downpayment shocks. The literature on precautionary behaviour and savings is particularly important in that regard.

The role of uncertainty and, particularly, that of the precautionary motive in influencing savings has received considerable treatment from both a theoretical and em-

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[5]Subsequently, the Central Bank of Ireland announced an annual review of the measures, where certain changes have been made.

pirical perspective. Leland (1968) and Sandmo (1970) were amongst the first studies to provide an analytical framework illustrating how savings could be a positive function of future income uncertainty. Skinner (1988), Dynan (1993) and Banks et al. (2001) all analyse the magnitude of the precautionary effect using Euler equations, while Caballero (1991) and Deaton (1991) provide further theoretical justification for the presence of the precautionary motive - the latter focussing on the interaction between the precautionary effect and borrowing constraints.

From an empirical perspective, a significant number of studies at the micro-household level provide support for precautionary savings, these include Carroll (1997), Engen and Gruber (2001), Gourinchas and Parker (2002), Cagetti (2003), Kennickell and Lusardi (2004), and Deidda (2014).

More recently, the potential causes of uncertainty have been broadened out to include policy or political considerations; Giavazzi and McMahon (2012) examine the implications for German household savings due to potential labour market reforms, while Aaberge et al. (2017) find that an increase in political uncertainty resulted in significant temporary increases in savings amongst urban Chinese households in 1989.

Our contribution to this literature is to further shed light on the uncertainty-savings relationship and show that households with greater income uncertainty are more affected by downpayment constraints when trying to save for home purchase.

3. Data and Identification Strategy

3.1. Data and Measurement

Table 1: Overview of Savings Indicators

Variable	Definition
$Save_i^t$	Variable = 1 if household saves either regularly or occasionally,
	0 otherwise
$SaveHouse_i^t$	Variable = 1 if household is saving to purchase a house,
	0 otherwise
$PotentialBuyer_i^t$	Variable = 1 if non-saving household intends to purchase a home
	within two years,
	0 otherwise
$ConHouse_i^t$	Variable = 1 if saving for a house or a potential buyer
	& is not satisfied with its current level of saving
	0 otherwise
$ConSaveHouse_i^t$	Variable = 1 if household saving to buy a house
	& is not satisfied with its current level of saving
	0 otherwise
$ConPotentialBuyer_i^t$	Variable = 1 if household intends to buy a home within two years
	& is not satisfied with its current level of saving
	0 otherwise

The first set of dependent variables takes into account different forms of savings behaviour, distinguishing between savers and their motivations. $Save_{it}$ draws from a survey question of "Do you save regularly, occasionally or not at all these days?" The variable is set as a dummy where, irrespective of saving frequency, any form of saving sets 'Save' equal to one. $SaveHouse_{it}$ identifies "What are you saving for?", where the selection of choices includes 'To buy or renovate a home', 'To make a large purchase', 'For a holiday', 'For a special event', 'For education', 'In case my income falls in the future' and 'To have something put by for unexpected expenses'. Whether or not individuals are saving for buying/renovating their homes acts as our second dependent dummy variable, wherein respondents with a value equal to one are saving for a home. Our third dependent variable, $PotentialBuyer_{it}$ is equal to one when an individual who does not save indicates they intend to purchase a home within two years.

The second set of dependent variables focuses on those interested in the housing market and identifies savings constrained individuals within this subset of the sample. This takes into account whether or not respondents are satisfied with their current level of savings, inclusive of savers and non-savers. $ConSaveHouse_{it}$ acts as a subset of $SaveHouse_{it}$, focusing on savers experiencing a savings constraint. $ConPotentialBuyer_{it}$ is a subset of $PotentialBuyer_{it}$, identifying those unsatisfied with their status as non-savers within the group. $ConHouse_{it}$ combines both of these dummy variables, identifying savings constrained individuals saving for a home as well as non-savers expressing a constraint while simultaneously signalling their intent to purchase a home within 2 years.

These six dummy variables will feature as dependent variables in the models of the identification strategy. When identifying heterogeneous effects, the empirical section will highlight differences among the set of three constrained dummy variables.

Figure 1 displays a flow chart of dependent variable groups. After households are classified between saving and not saving, further classifications indicate whether the household is "interested" in the housing market either through specifically saving for a house or through indications of being a potential buyer within the next two years. For both types of housing market participants we examine the likelihood of experiencing savings constraints.

Our main hypothesis under examination is that the share of constrained households (with some demand for housing) increases following the introduction of the measures. In the graphic this would be identified by an increase of the share of households indicating they are constrained *within* the groups House Saver and Potential Buyer.

3.2. Identification Strategy

Our research question involves testing whether the introduction of macroprudential policy measures led to an increase in the degree to which Irish households perceived savings constraints to be binding. Given the cross-sectional nature of our data, our approach to identification is twofold. To estimate the average effect of the policy change, we a) undertake a simple event study and b) use specific groups suggested by theory and existing literature as quasi-natural control groups.

3.2.1. Event study analysis

As presented in Table 1, the saving indicator in all four cases is binary and therefore requires the use of a probability model. Before identifying heterogeneities between different focus groups, we establish a baseline model to capture the average policy effect whilst controlling for key variables. We use a standard logit model with pooled cross-sectional data which tests the effects of the introduction of the policy in the Irish mortgage market.

$$Pr(SC = 1)_i^t = \alpha + \beta_1 Post + \omega \mathbf{X_i^t} + \theta_t + \theta_r + \epsilon_i^t \tag{1}$$

Where i identifies the individual respondents and t date based on the specific month and year each observation was collected. The vector X_i^t controls for individual aspects of individuals reported through the survey. Baseline controls include fixed effects for the month (θ_t) and region (θ_r) as well as a host of borrower controls based on demographic details. These include fixed effects for respondent gender, education status, marital status, housing tenure, number of children, occupation, and working status. We also include the age in years of the household head (respondent). A full listing of these variables can be found in appendix 1. Additionally, we include controls for the personal financial positions of individuals, their future expectations of their personal finances, and expectations towards the labour market.

The critical variable for our identification strategy is the dummy, $Post$. This indicator variable takes a value of 1 for any response captured after the 9th of February 2015 when the macroprudential regulations were introduced and a 0 otherwise. As per our main hypotheses, we would expect that, if the regulations have increased household perceptions of savings contraints, then $\beta_1 > 0$. The time window that we explore is 18 months either side of the introduction of the measures.

3.2.2. Quasi-Natural Difference-in-Difference

Once a series of baseline estimates are achieved, the model is then used in order to evaluate how different focus groups, represented by the dummy term Z, were affected by the introduction of macroprudential policy measures, relative to their counterparts.

As part of the identification strategy, we will explore heterogeneities occurring across age and private renters. Indeed, younger households and those with no current wealth built up in a property (wealth constrained) have been found in the existing literature to have been most affected by downpayment constraints (Acolin et al., 2016; Haurin et al., 1998; Barakova et al., 2014).

Using these characteristics, we split our data into two groups: Young $(< 43)^6$ vs Old; Renter vs Homeowner. We then use these two groups in a quasi difference-in-difference the explore their relative exposure to the policy treatment.

This approach imposes quasi difference-in-difference estimator method upon the standard logit model:

$$Pr(SC = 1)^t_i = \alpha + \beta_1 Post + \beta_2 Z + \beta_3 Post \times Z + \omega \mathbf{X^t_i} + \theta_t + \theta_r + \epsilon_{it} \qquad (2)$$

where Z relates to household age or rental market status.

The Economic Sentiment Monitor also captures useful proxies for income uncertainty. Other information in the survey reveals an individual's employment status and sector of employment. From this information, we are able to distinguish between public and private sector employees. This can be a useful proxy for income uncertainty as in Giavazzi and McMahon (2012), as private sector workers generally cannot predict their future incomes as accurately as employees. Public servants are assumed to benefit from greater job security relative to those employed in the private sector. We therefore run a similar model to above using the public/private split to identify whether private sector workers are more affected by the policy.

One benefit from using the public/private split in terms of identifying the policy impacts are that the risk of endogeneity between the policy and employment status is low i.e. it is unlikely that many households changed their sector of employment as a response to the policy. If this were to happen, it would bias the estimated effect on constraints by shifting the group composition.

Finally, as a robustness check, we develop an alternative indicator of uncertainty which draws on a self reported risk identifier in the survey. We flag households as fac-

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[6]Age 43 is the age which represents the bottom 25 per cent of our data.

ing income uncertainty if they report that affordability/income issues are the main risk they face at present. This metric is more likely to be affected by the policy so the public/private split is our prefered model.

3.3. Summary Statistics

In evaluating the effects of the macroprudential policy measures, it is first important to review the distribution of market participant groups across the sample. Table 2 presents an overview of the distributions under pre- and post-policy conditions on the basis of the different dependent variables. Pre- and post-policy time windows capture observations between August 2013 and July 2016 resulting in an 18 month time window in the pre- and post-policy periods.

Table 2: Summary Statistics for Saver Data

	Pre-Policy	Post-Policy
$Save_i^t$	0.596	0.646
	(0.491)	(0.478)
$SaveHouse_i^t$	0.059	0.066
	(0.299)	(0.302)
$PotentialBuyer_i^t$	0.102	0.094
	(0.434)	(0.442)
$ConHouse_i^t$	0.094	0.090
	(0.492)	(0.496)
$ConSaveHouse_i^t$	0.025	0.024
	(0.494)	(0.481)
$ConPotentialBuyer_i^t$	0.070	0.066
	(0.464)	(0.457)
Observations	5,191	5,565

Among savers and non-savers, the majority of the sample (59.6 per cent) has reported either regular or occasional acts of saving before policy implementation. After the introduction of macroprudential policy however, the number of saving households

increased to 64.6 per cent of the population. Prior to the introduction of these measures, individuals saving to buy a house accounted for 5.9 per cent of the sample. This share rose to 6.6 per cent for the post-policy sample.

While the share of individuals interested in saving increases, it does appear fewer people who are non-saving felt the housing market was affordable following the introduction of the macroprudential policy measures. An average of 10.2 per cent of respondents indicated an interest in purchasing a home within two years, however, when revisiting this 18-month average following policy introduction, the share of potential buyers fell to 9 per cent. This may suggest that following a restriction in lending standards, a specific portion of individuals abandoned plans to purchase a home. Although the ratio of savings constrained savers to non-savers remained relatively stable between the two time periods, the general improvement in macroeconomic conditions appears to have slightly eased savings constraint among respondents.

Table 3 presents summary statistics for the regression sample. Overall, there were 10,756 individual household responses over the three year timespan of the analysis. Roughly half of the sample is female, with 42.8 per cent of respondents maintaining a third level education. While Dublin captured the largest share of respondents, the overall distribution of households closely mirrors percentage shares implied by Census 2016.[7] Approximately 70 per cent of respondents are married, averaging 53 years of age, most of which are homeowners. Regarding job roles, the majority of households reported professional or technical occupations as opposed to being employed in manual labour. 13 per cent of households reported themselves as entrepreneurs while 41.2 per cent acted as employees for various companies. Finally, 19.2 per cent of respondents reported expecting financial difficulties over the next twelve months whereas the remainder reported either a general ease in their financial conditions or as having a neutral perspective on the matter.

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[7]The Central Statistics Office prepared 'Census 2016 - Part 1', which provides details on overall population change, age, marital status, households and families, nationalities, foreign languages, the Irish language, religion and housing.

Table 3: Summary Statistics for Controls

Variable	Mean	Variable	Mean
Female=1	50.9%	HH no. of adults at work (over 18)	
Third level Educ.=1	42.8%	0	29.2%
		1	29.7%
Border	10.6%	2+	41.1%
Dublin	28.8%		
Mideast	11.2%	Children	31.7%
Midland	5.5%	No Children	68.3%
Midwest	7.6%		
Southeast	10.6%	Occupation	
Southwest	16.2%	Professional/Technical	57.1%
West	9.7%	Manual	42.9%
Married/Partner	69.6%	Employee	41.2%
Single	17.6%	Self-Employed	13.0%
Widowed/Divorced/Separated	12.8%	Other	45.8%
Age	53	Expected Financial Position in 1YR	
		Difficulty	19.2%
Homeowner	92.7%	Neither	68.1%
Private Renter	7.3%	Ease	12.7%
		Observations	10,756

Figure 1: Flow Chart of Respondent Choices
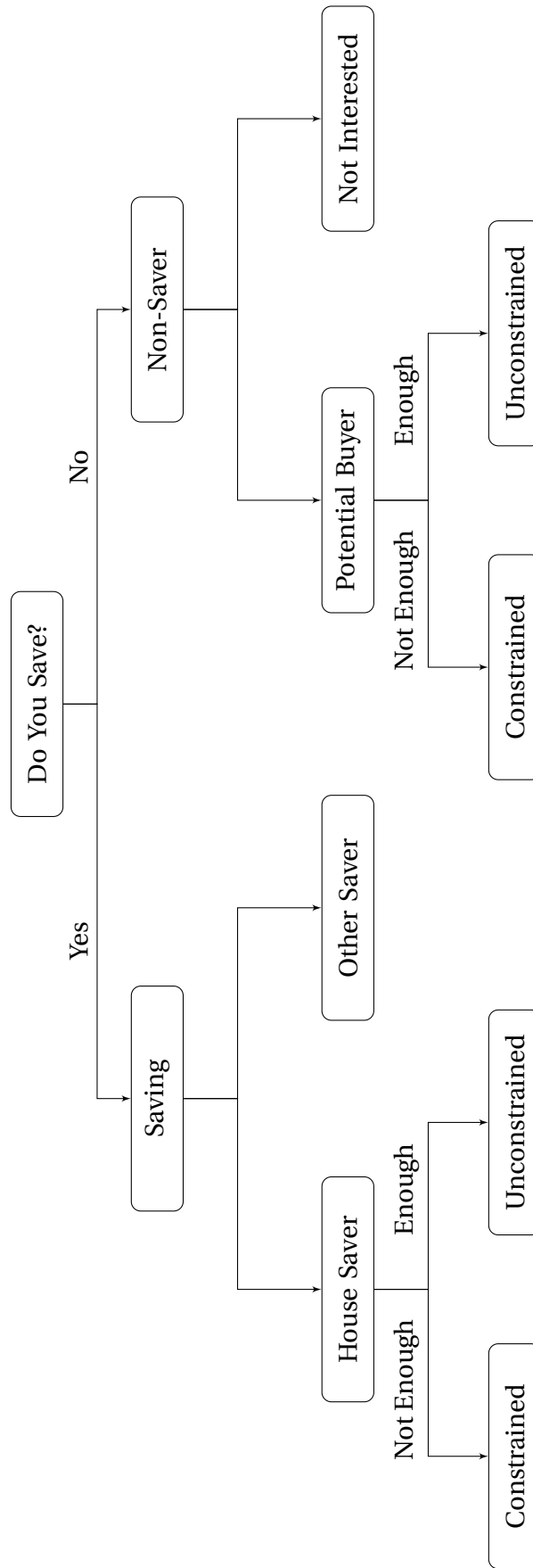
4. Empirical Findings

In the following section, we present the main findings from the estimation of equations (1) and (2). In equation (1), the baseline model of this paper, we capture the overall effect of the introduction of macroprudential policy on the net change in the likelihoods of households actively saving. For savers, we also explore how households specifically saving for a house were affected. Among those households who are non-savers, we examine how those intending to purchase a home within two years were affected.

We then investigate the heterogeneous effects across age and ownership status to explore how these constraints were distributed. We use several proxies for different types of income uncertainties. In particular, we compare savings behaviour across employment status and different sectors of employment. In the estimates presented in this section, we narrow in on specific subgroups of the main population in particular regressions. This explains why the number of observations reported in different specifications changes. All probability models are estimated using a logit model with robust standard errors.

4.1. Baseline Model

Table 4 presents the estimates of our main specifications for the event window study. In column (1), we present the coefficient on the Post for the model where the dependent variable is the share of constrained households who are saving for a house. In column (2) we present the coefficient on Post with the dependent variable for constrained potential buyers. In column (3) we present the estimate for the pooled sample with both home savers and potential buyers. In each of these samples, the dependent variable takes the value of 1 if the household is constrained and 0 otherwise. All models are estimated with the vector of household controls, month fixed effects, region fixed effects and sentiment controls.

The results in Table 4 suggests the introduction of macroprudential measures have resulted in a greater perceptions of savings constraints. Though there is a 5p.p. increase in the likelihood of savings constraints across both groups, the effect appears to be driven by an increase in savings constraints for potential buyers. The post-policy like-

lihood of experiencing savings constraints as a potential buyer increased by 10.3p.p.. Given that 7 per cent of respondents were constrained potential buyers prior to the policy, this suggests that, ceteris paribus, macroprudential policy measures resulted in an X per cent increase in savings constraints pressures on average for potential buyers.

Table 4: Policy Volume Effect - Savings-Constrained Behaviour

	(1)	(2)	(3)
	House Saver (Con)	Potential Buyer (Con)	Constrained
Policy=1	-0.0065	0.1032**	0.0496*
	(0.047)	(0.033)	(0.029)
Observations	662	1,013	1,675
Sentiment Controls	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes
Household Controls	Yes	Yes	Yes

Robust standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.2. Exploring Heterogeneous Effects

4.2.1. How Were Younger Households Affected?

The permanent income hypothesis indicates that, as an individual ages, they shift from acting as an intertemporal borrower from their future self towards assuming the role of the intertemporal lender to their past self (Friedman, 1957). Consumption and the remaining portion of savings, are intended to remain smooth over time, with expenditure levels rationally based on the even distribution of lifetime wealth an individual expects to generate rather than the current income they earn. Therefore, the increased down-payment burden introduced by macroprudential policy is expected to be particularly constraining on younger age groups.

Results in Table 5 capture a clear disparity emerging regarding the likelihood of savings constraints among younger and older sections of society. The findings present the average effect of the treatment for both the treated and control groups of young and old. Those below the age of 42 appear to be 14.1p.p. more likely to experience savings constraints following the introduction of macroprudential policy measures. We do not find any effect on older households. The fact that constraints are heightened for younger households following the introduction of a macroprudential shock to downpayments is in line our expectations as well as the existing literature (Acolin et al., 2016; Haurin et al., 1998).

Table 5: Differences Across Age for the Savings-Constrained

| | (1) | (2) | (3) |
	House Saver (Con)	Potential Buyer (Con)	Constrained
Age (< 42)=0	-0.0118	0.0628	0.0372
	(0.066)	(0.040)	(0.037)
Age (< 42)=1	-0.0049	0.1411**	0.0574
	(0.058)	(0.049)	(0.039)
Observations	662	1,013	1,675
Sentiment Controls	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes
Household Controls	Yes	Yes	Yes

Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

To provide more granular insight into the effect of age, we interact the post dummy with a continuous age variable and pull out the average marginal effect of the treatment at different values of age. The findings are presented in table 6. We find that the effect is highest for younger households and declines steadily with age. Savings constraints range from a 7.8p.p. rise at the age of 50 to a peak of 16.6p.p. amongst the youngest category of potential buyers. The younger the household, the greater the likelihood of experiencing savings constraint.

Table 6: Differences Across Age for the Savings-Constrained

| | (1) | (2) | (3) |
	House Saver (Con)	Potential Buyer (Con)	Constrained
Age = 25	0.0239	0.1659**	0.0859*
	(0.072)	(0.052)	(0.045)
Age = 30	0.0124	0.1485***	0.0740*
	(0.060)	(0.045)	(0.038)
Age = 35	0.0010	0.1310***	0.0621*
	(0.051)	(0.039)	(0.033)
Age = 40	-0.0103	0.1133**	0.0503*
	(0.046)	(0.035)	(0.029)
Age = 45	-0.0214	0.0956**	0.0384
	(0.047)	(0.032)	(0.027)
Age = 50	-0.0324	0.0776**	0.0265
	(0.053)	(0.032)	(0.028)
Observations	662	1,013	1,675
Sentiment Controls	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes
Household Controls	Yes	Yes	Yes

Standard errors in parentheses, $^{*}\ p < 0.1$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

4.2.2. How Were Private Renters Affected?

The introduction of policy measures is estimated to have had a significant impact on renters in particular, when taking into account the likelihood of potential buyers becoming savings constrained. According to Table 7, the likelihood of an individual being constrained increased by 8.9 per cent amongst homeowners and 15.9 per cent among private renters after the policy measures were introduced.

Table 7: Differences Across Tenure for the Savings Constrained

	(1)	(2)	(3)
	House Saver (Con)	Potential Buyer (Con)	Constrained
Homeowner	0.0306	0.0892**	0.0544*
	(0.056)	(0.034)	(0.031)
Private Renter	-0.0872	0.1591*	0.0372
	(0.082)	(0.088)	(0.063)
Observations	662	1,013	1,675
Sentiment Controls	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes
Household Controls	Yes	Yes	Yes

Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.3. Heterogeneity based on income uncertainty

As has been previously discussed, precautionary savings behaviour may occur as a result of policy uncertainty (Giavazzi and McMahon, 2012). Given the change in macroprudential policy, it is important to observe how savings behaviour varied between groups with different levels of income uncertainty. *Ceteris paribus*, the precautionary savings effect would interact and possibly compete with the demand for a now larger downpayment. Under this theory, those more likely to be subject to greater income uncertainty would be particularly exposed to greater savings constraints.

In Table 8 we present the differences between households in different sectors of employment. It is assumed that greater job security implies greater income uncertainty, therefore the private sector is expected to be particularly exposed in terms of savings constraints. We find that macroprudential policy contributed to a 14.3p.p. increase in the likelihood of potential buyers experiencing a savings constraint, relative to the pub-

lic sector.

Table 8: Uncertainty: Differences by Employment Sector

	(1) House Saver (Con)	(2) Potential Buyer (Con)	(3) Constrained
Public Sector	-0.0478	0.0851	0.0195
	(0.097)	(0.103)	(0.079)
Private sector	0.0182	0.1427**	0.0710
	(0.069)	(0.053)	(0.044)
Observations	338	336	678
Sentiment Controls	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes
Household Controls	Yes	Yes	Yes

Standard errors in parentheses, $^{*}\ p < 0.1$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

As a final proxy for income uncertainty, Table 9 examines responses to what individuals would consider their main risk when approaching the housing market. Those subject to affordability risks exhibit an increased likelihood of being constrained among potential buyers with an 10.8p.p. increase following the introduction of policy measures. In both cases, it appears those exposed to greater degrees of income uncertainty reacted far more strongly following the introduction of macroprudential policy measures. The combination of requiring a thicker layer of insulation against financial shocks through greater levels of precautionary saving and the introduction of a policy measure which placed greater demands on individuals to produce a larger downpayment culminate into likelihoods of experiencing self-perceived savings constraints.

Table 9: Uncertainty: Differences by Main Risk

	(1)	(2)	(3)
	House Saver (Con)	Potential Buyer (Con)	Constrained
Affordability Risk=1	-0.1678**	0.1083*	-0.0166
	(0.077)	(0.056)	(0.052)
Observations	343	349	696

Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5. Robustness Checks

In this section, we present two robustness checks on our estimates. We first explore whether adding additional controls for the macroeconomic cycle affect our findings. Second, we attempt to deal with some sample selection issues that may arise due to the nature of our cross-sectional data.

5.1. Time-Varying Macroeconomic Factors: Adjusting for the Cycle

The variation that identifies our main findings are changes in savings constraints over time across groups. While our use of theoretically suggested groups as treatment and control provide for a good identification approach, there is a possibility that changes across these groups could come through general changes in the macroeconomy that alters the relative constraints. To control for such changes, we include region-time varying macroeconomic factors that should account for differences in trends in the local economies where the households are residing. The variables we include are house price growth (ΔHP_{rt-1}) and the unemployment rate ($UneRate_{rt-1}$) which should capture housing market and labour market developments at the region-time level. These are included in Table 10. Both of these factors are included with a one quarter lag to the survey period to avoid simultaneity bias. While these variables are insignificant, the main effect still holds at the 5 per cent significance level. This suggests our findings are not driven by divergent economic trends before and after the regulations were introduced.

Table 10: Inclusion of Macro-Time Varying Factors

	(1)	(2)	(3)
	House Saver (Con)	Potential Buyer (Con)	Constrained
ΔHP_{rt-1}	-0.0003	0.0018	0.0011
	(0.002)	(0.002)	(0.001)
$UneRate_{rt-1}$	-0.0021	0.0057	0.0012
	(0.014)	(0.009)	(0.008)
Post	-0.0227	0.1105**	0.0460
	(0.059)	(0.046)	(0.037)
Observations	662	1,013	1,675

Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5.2. Testing for Sample Selection Effects

Our main analytical evaluation tests the impact of the introduction of macropruden-tial regulations on savings constraints using both younger households and those in the rental sector as the treatment groups. While our baseline findings control for a range of factors including borrower controls, a potential issue arises in relation to whether the underlying composition of the sample in terms of age or tenure could have shifted as a consequence of the policy. If this is the case, then using these variables as treatment groups could lead to some bias in the estimate of the impact of the policy. Indeed, given the macroprudential regulations were aimed at increasing downpayment constraints it is likely that the policy may have increased the share of households in the "renting" category. It is less likely the policies impacted the age structure of the population, in particular in the short run.

To deal with this particular issue, we draw on an inverse probability weighting ap-proach suggested by Stuart et al. (2014) for estimating difference-in-difference models using cross sectional data. The rest of this section presents a short overview of the tech-nique and the results of the robustness checks.

5.2.1. Multi-Group Cross Sectional Matching

Given the cross-sectional nature of our data, and the fact that we do not observe the same households over time, it is likely that in each repeated cross-section, the sample composition may differ across household characteristics. In particular the share of renter households or younger households could shift across the survey waves, and in particular, could have changed after the introduction of the policies. Furthermore, using age and renter as classification variables could lead to biases if these groups are systematically different and the difference is linked to credit access or savings behaviour.

If either of these sample issues are occurring then it is likely the estimates are biased due to the sample selection. Some of the sample selection issues will be controlled for by the inclusion of the range of covariates in our estimates, however, Stuart et al. (2014) note that average responses calculated with covariates depend on the distribution of the data and if treatment variables differ on observables but are not equally balanced across the data, covariates will not address the issue fully.

To address this issue, we follow McCann and O'Toole (2019) and Kinghan et al. (2019) by applying the Stuart et al. (2014) inverse probability weighting approach to match the borrowers on observables across our treatment and control groups before and after the policy. Our data are split into four groups: pre-policy treated, pre-policy control, post-policy treated, post-policy control. In our case, treatment is either being a private renter or being a borrower aged less than 43. A multinomial model is then estimated on the four groups with a range of covariates included which should control for the sample selection differences. The predicted probabilities of being in each group given the multinomial estimates are then used as the weights:

$$w_i \quad = \quad \frac{Pr_1(X_i)}{Pr_g(X_i)} \tag{3}$$

$$where \quad 1 = \quad (\sum_{g=1}^{4} Pr_g(X_i)) \forall i \tag{4}$$

where X are the group of covariates selected and g are the four groups noted above across each household i. These weights can then be applied as probability weights in

the second stage logit model. The covariates included in the X vector in this regression are gender, region, marital status, education, children, work and employment status, occupation, economic sentiment expectations, views on purchasing activity, financial stress and expected changes to financial circumstances.

5.2.2. Multinomial Weighted Results

The results of the multinomial weighted logit regressions are presented in Tables 11 and 12. The former presents the estimates for young households and the latter presents the estimates for private renters. The tables contain the marginal effects of the policy for young households (renters) for each of the three constraint indicators from a model including the interaction of age and policy and weighted using the multinomial probability weights.

The findings indicate that savings constraints increased for younger households and renters following the introduction of macroprudential policies which is in line with our main baseline estimates. The results continue to have statistical significance at conventional levels (10%) and the magnitudes are in line with the baseline findings. Given these results, the issue of sample selection biases from differences in the observable samples, in the cross section or over time are highly unlikely and, as a consequence, our findings appear robust.

Table 11: Multinomial Inverse Weight for Young Households: Average Effect

	(1)	(2)	(3)
	House Saver (Con)	Potential Buyer (Con)	Constrained
Post	-0.0151	0.1031*	0.0064
	(0.039)	(0.061)	(0.040)
Observations	662	1,013	1,675

Standard errors in parentheses, $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Multinomial Inverse Weight for Renters: Average Effect

	House Saver (Con)	Potential Buyer (Con)	Constrained
Post	-0.0767	0.1425*	0.0319
	(0.080)	(0.082)	(0.062)
Observations	662	1,013	1,675

Standard errors in parentheses, $p < 0.1$, $^{**} p < 0.05$, $^{***} p < 0.01$

5.3. Testing for Effects on Overall Savings and Potential Buyers

We begin by testing whether or not the rules impacted the share of home savers or the share of potential buyers in the market. Ruling out changes in these metrics is important to identifying the effect of the policy on constraints. If the policy had changed these underlying groups, any findings on constraints could have been due to differences in the samples saving for, or looking to purchase, a house.

Tables 13 provides the initial set of estimates from equation 1 where $Pr(SC = 1)_{it}$ includes savers, house savers and non-saving potential buyers. The term $Post$ corresponds to β_1 from equation (1). The interpretation of the coefficients is that, controlling for borrower specific characteristics [8], there is no significant effect of macroprudential policy implementation on savings objectives towards the housing market nor on saving levels in general. We also do not find any effect on potential buyers.

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[8]Including gender, education, working conditions, economic and personal financial situations within X_{it}, as well as regional and monthly dummy variables

Table 13: Policy Volume Effect - Savings Behaviour

	(1)	(2)	(3)
	Saving	House Saver	Potential Buyer
Post	-0.0052	0.0077	0.0021
	(0.013)	(0.011)	(0.020)
Observations	10,474	6,542	3,935
Sentiment Controls	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes
Household Controls	Yes	Yes	Yes

6. Conclusions and Policy Implications

In this study, we use novel, nationally representative survey data on households in Ireland before and after the unanticipated introduction of macroprudential mortgage rules to explore the impact of loan-to-value and loan-to-income limits on household savings. We exploit quasi-natural experimental variation across groups of households who are a-priori expected to suffer from household downpayment and income constraints to test the impact of the regulations. Therefore, our study uniquely traces the impact of changes in macroprudential policy on standard household finance issues. We also build on existing studies by splitting households into those facing savings constraints (feel they are not saving sufficiently) and those saving to purchase a house to better identify the effects of macroprudential regulations.

We find that households intending to purchase a home were more likely to experience savings constraints in response to the introduction of macroprudential policy. Overall savings rates (including those households saving for unanticipated events or other non-housing purchases) do not adjust, nor does the decision to purchase a home. Instead this study reveals a greater difficulty amongst certain households in generating

sufficient savings necessary to pursue homeownership. From our quasi-experimental testing, we find that the effects are largest for younger households and those in the private rental market; both groups of households are more likely to face downpayment constraints when entering the housing market.

Supportive of the precautionary savings behaviour, we find that households who are part of the private sector or indicate they see income shocks as the main risk they face, are particularly exposed to this form of savings constraint pressure.

The macroprudential limits in the mortgage market are vital in ensuring financial stability and limiting systemic risk. However, as is evident from our findings, they have important heterogeneous effects across households, in particular on savings activity. A number of implications arise for policy. This paper shows the incidence of these policies is focused on specific subgroups of the population (young borrowers, renters) and those likely to experience income uncertainty. As these policies have clear distributional impacts, their calibration across groups are important. Indeed, frameworks which disaggregate across potential buyer types, such as is the case with the Irish rules, can limit some of the distributional consequences. Given these findings, the interaction between macroprudential rules and broader housing market policies are also important to broad housing affordability goals can be met.

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Appendix

Table 14: Overview of Control Variables

Control Variable	Description
$Female_i^t$	Dichotomized as female (1) or male (0),
$Month_i^t$	Every even month between 2013M08 and 2016M06
Age_i^t	Continuous variable, ranging from 16 to 99,
$AgeG_i^t$	Dichotomized as below 42 (1) or 42 and above (0) years of age,
$NUTS3_i^t$	Categorical variable indicating household location across seven distinct regions;
	Border, Dublin, MidEast, Midland, MidWest, Southeast, Southwest and West
$Education_i^t$	Dichotomized as third level (1) or lower (0),
$MaritalStatus_i^t$	Categorical variable indicating marital status of respondent;
	Married/Partner, Single, and Widowed/Divorced/Separated
$Tenure_i^t$	Dichotomized as homeowner (1) or private renter (2),
$Children_i^t$	Dichotomized as no children (0) or children (1),
$WorkingStatus_i^t$	Categorical variable indicating number of adults at work (over 18) in household;
	No working adults (0), one working adult (1), and multiple working adults (2)
$Occupation_i^t$	Dichotomized as Professional/Technical (1) or Manual (2),
$EmploymentGroup_i^t$	Categorical variable indicating the employment status of respondent;
	Employee (1), self-employed (2), and other (3)
$EconomicOutlook_i^t$	Categorical variable asking how the economic situation will develop in 12 months;
	Better (1), Same (2), and Worse (3)
$MajorPurchases_i^t$	Categorical variable asking if it is a good time to make large household purchases;
	Good Time (1), Neither (2), and Bad Time (3)
$FinancialPosition_i^t$	Categorical variable asking self-perceived financial position of the household;
	Difficult (1), Moderate (2), and Easy (3)
$FinancialExpectations_i^t$	Categorical variable asking how financial situation will change over next 12 months;
	Better (1), Same (2), and Worse (3)
$AffordabilityRisk_i^t$	Categorical variable asking main risk of purchasing a home for respondent;
	Dichotomized as Affordability (Income) Risk (1) or Other (0),
$RegionalHousePrice_i^{t-1}$	Continuous variable, year-on-year house price growth by Nuts3 region
$RegionalUnemploymentRate_i^{t-1}$	Continuous variable, year-on-year unemployment rate by Nuts3 region

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