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The effects of a macroprudential loosening: The importance of borrowers' choices

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Abstract

Macroprudential policy implementation in the mortgage market has generally involved a *policy tightening*, as policies have been introduced in settings where no such policies previously existed. In this paper we produce rare evidence on an episode of *loosening* under the macroprudential regime for mortgages. We exploit a reform of the Irish borrower-based measures in 2017 that increased LTV limits for a cohort of First Time Buyers. We show in response to the reform that borrowers bunched at the new maximum LTV of 90, increasing LTVs relative to the counterfactual. We highlight an adjustment mechanism that has important policy implications: we find no evidence that treated borrowers purchased more expensive properties; rather, we find that treated borrowers post lower downpayments after the reform, displaying a preference for cash retention once the opportunity arises. While economic intuition leads one to expect house price amplification after a policy-induced credit loosening, we show that borrowers' choices to rebalance towards greater cash retention dampened this channel in the Irish case in 2017.

JEL classification:G21; G28; G51.

Keywords: Macroprudential policy; credit loosening; household finance.

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Non-technical summary

What are the effects of macroprudential policy actions? The answer to this question has been central to a growing literature since the 2008 Global Financial Crisis (GFC). Many jurisdictions have imposed macroprudential regulations in the mortgage market, limiting borrowing amounts relative to collateral values, incomes, or both, in response to the experience of that crisis. The literature up to now has established firmly that these policies have led to a reduction in higher-risk lending, improved borrower resilience to shocks, and a reduction in aggregate credit flows and credit-fuelled house price growth. Taken together, the evidence base suggests that, relative to the pre-policy period, these macroprudential mortgage regulations have worked as intended, improving financial stability outcomes.

The literature has primarily studied the effect of policy introduction, which has involved a "tightening" of mortgage credit conditions compared to the no-policy regime. In this paper we provide, to our knowledge, the first empirical evidence on the impact of a *loosening* of macroprudential mortgage policies. The focus on the effects of tightening up to now is a natural consequence of the life-cycle of these policies, which have only been in existence in the majority of developed economies for less than a decade. We are in a position to provide initial evidence on the effects of loosening due to a policy change enacted in Ireland in 2017. Reviewing mortgage measures in place since early 2015, the Central Bank of Ireland removed a stricter LTV restriction in place for borrowers of higher-value properties (i.e., above €220,000). After the policy change, all First-Time Buyer (FTB) mortgages were subject to a maximum LTV of 90 per cent, compared to a position where those purchasing more expensive properties had a maximum LTV that tended towards 80 as the property value rose. In the language of experimental research, the policy change allows us to study a "treatment" effect of the LTV change, comparing the choices of borrowers exposed to the LTV loosening to a "control" group of borrowers purchasing lower-priced properties, for whom the LTV limit does not change either side of the 2017 policy introduction.

The main findings of the paper can be summarized as follows: firstly, in response to the loosening of LTV limits, borrowers in the "treated" group increase their LTV by around 1.2 percentage points. As policy loosens, borrowers do indeed respond by increasing their mortgage leverage, as one would expect, particularly in a market where borrowers are credit constrained and house prices are high relative to income.

Secondly, we explore *how* the adjustment takes place. Most macroeconomic models with macro-financial linkages take as a given that a credit loosening will lead to house price growth, as borrowers utilise their available resources, combined with higher leverage, to bid up the price of housing. We term this mechanism "accelerator" behaviour. We highlight that, in practice, other choices are available to borrowers. Recent research has highlighted that an important cost of macroprudential policy introduction is that borrowers forego short-term liquidity, which moves from bank account savings into downpayments for house purchase. This lack of liquidity can in some cases make borrowers *less resilient* to adverse shocks, such as employment loss, with wealth tied up in illiquid housing. A corollary of this behaviour is that, when faced with a policy loosening that allows for higher LTVs, borrowers may act to reduce the size of downpayment posted, continuing to purchase similar properties, rather than post similar downpayments, and purchase more expensive properties.

Our empirical investigation confirms that, faced with the 2017 policy change, borrowers in Ireland opted to purchase similar priced properties with smaller downpayments, rather than purchase more expensive properties with similar downpayments. In so doing, the evidence suggests that the retention of liquid assets, either for savings or consumption, was the predominant response to this policy change, rather than an "accelerator" response which led to stronger house price growth.

Finally, we discuss the relevance of these findings for macroprudential policymakers globally. We do not claim that our results will be generalizable to all contexts. The policy reform in Ireland in 2017 was restricted to one pocket of the FTB market, which allows for clean research design, but means that it is difficult to predict which type of borrower response would dominate in the face of a broader market-wide policy loosening. Further, the Irish LTV reform occurred at a time when a 3.5 LTI limit remained in place for all borrower types. While we confirm that our results are not dominated by borrowers that were constrained at the LTI limit, it is impossible with the data available to study what would have happened *in the absence of a complementary LTI limit*.

Our aim is that our results will form part of a growing evidence based that, in its totality, can support policymakers globally in understanding, when mortgage measures are loosened, the range of possible outcomes that may arise. Given changes that have occurred over time, including the usage of macroprudential tools at the onset of the COVID-19 pandemic has a policy tool to stabilise the housing market in the face of a potentially adverse shock, evidence on the effects of policy loosening is likely to become increasingly useful as policymakers assess the potential effects of macroprudential policy changes in the mortgage market.

1 Introduction

Macroprudential policies in the mortgage market, generally taking the form of restrictions on loan to value (LTV) ratios or borrowing amounts relative to income, have been implemented widely in response to the post-2007 crisis. These policies generally aim to improve borrowers' resilience to adverse shocks, reduce build-ups in risky household leverage that have been shown to have had such devastating effects in the past, or dampen credit-house price spirals. A rapidly expanding literature, benefiting from rich granular data sources, has confirmed across many jurisdictions that these policies have generally been effective in achieving their objective.

The literature up to now has primarily studied incidences of what are often called "tightening" episodes: in most cases, these policies have only been introduced for the first time in the last decade, and papers study the contractionary or stabilising effect of policy introduction relative to a no-policy pre-period.

However, what has received far less attention in the literature is the potential set of outcomes in periods where the restrictions under macroprudential mortgage policies have been eased: what we call "macroprudential loosening". This is a natural consequence of the life-cycle of these policies: since their introduction in the past decade, the majority of these policies have yet to undergo a loosening episode. Figure 1 uses data from the IMF iMapp and confirms empirically that almost all macroprudential policy changes in the mortgage market since 1990 have involved instances of policy tightening. Notable exceptions are Asian economies such as South Korea where these policies had been introduced in advance of the 2008 Global Financial Crisis (GFC). [1]

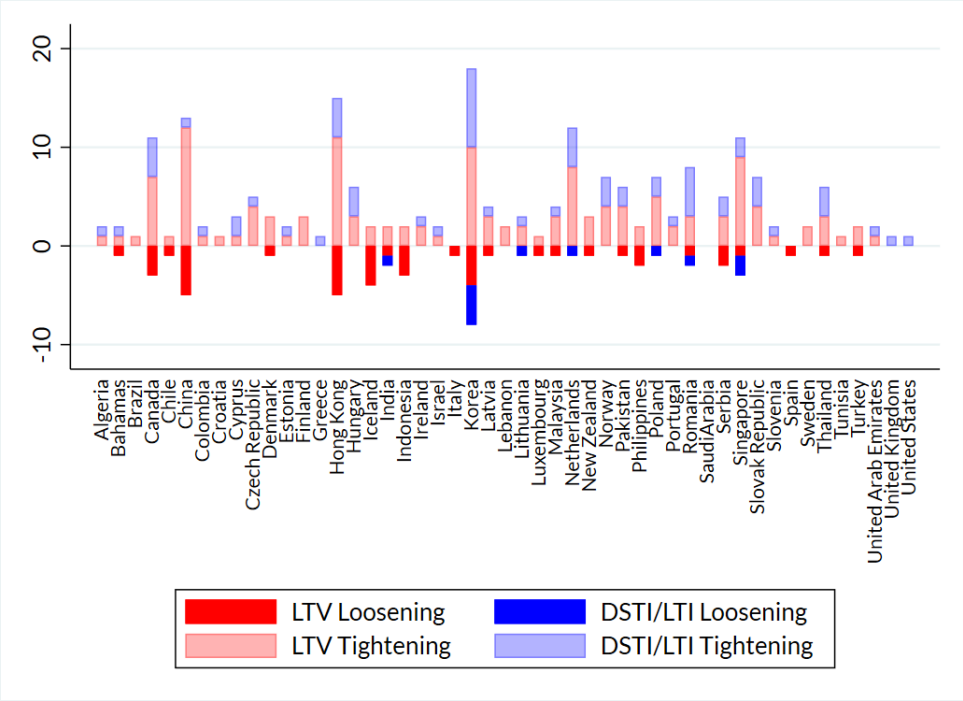
An assessment of likely outcomes under a macroprudential loosening is becoming ever more important for many central banks and supervisory authorities. There are a range of salient short-run costs of these policies (restricted access to homeownership among certain cohorts of society; limitations on construction activity; liquidity constraints among those required to save for larger downpayments; wider general equilibrium economic costs), that receive public attention and are important in the policy discourse (see Aikman et al. (2021) for of thorough description of the range of benefits and costs of macroprudential mortgage policy). In certain cases, an increasing public salience of these costs may lead authorities to assess the potential effects of policy changes that loosen the calibration of policy. Our research aims to contribute to an evidence base that can inform such impact assessments.

In jurisdictions where mortgage measures have a cyclical dimension similar to the stated rationale of the countercyclical capital buffer (CCyB), impact assessment of policy loosening may also prove particularly valuable. For example, policy loosening of mortgage restrictions during the COVID-19 pandemic was common, with the loosening justified as a stabilization tool to support activity in the mortgage and housing market at a time of great uncertainty. One notable case was New Zealand, where the competent authority reversed course within a matter of months as the pressure that the pandemic-induced demand shock was having on house prices became apparent.

In this paper we exploit a change to Ireland's borrower-based macroprudential mortgage measures framework in 2017 to provide, to our knowledge, the first causal evidence of the effects of macroprudential mortgage policy loosening on borrower

[1] See OECD (2021) for a detailed overview of how macroprudential policy actions have evolved in Asian countries.

FIGURE 1. Primacy of tightening over loosening episodes since 1990



Source: IMF iMapp database (1990 - 2018). The figure captures the cumulative number of macroprudential policy actions (LTV and LTI/DSTI only) implemented between 1990 and 2018 in the respective country. Data capture both tightening and loosening actions.

leverage and a granular assessment of borrowers' choices on downpayments, loan size and property values. The nature of the policy change allows for cleanly-identified causal effects to be estimated: as of 1 January 2017, First Time Buyer (FTB) home purchases for properties valued above €220,000 were subject to a flat LTV at origination of 90, having been subject to a "sliding scale" regime during 2015 and 2016 whereby the component of property values above this threshold was subject to an LTV limit of 80. In practice, this meant that the further a property value was above €220,000, the closer the LTV requirement was to 80, and therefore the 2017 reform created greater loosening for those purchasing more expensive properties. By contrast, properties valued below the threshold were subject to an LTV limit of 90 either side of the policy change, thereby representing an ideal control group for quasi-experimental policy assessment. Throughout the policy change, a fixed Loan to Income (LTI) constraint of 3.5 times gross annual income remained in place, which is likely to have limited the adjustment capacity of some borrowers when presented with an opportunity through the LTV loosening.

We focus on *intensive margin* effects of the policy change, looking at how LTV, borrowing, property price, and downpayment choices vary among those accessing the mortgage market. We do not formally assess whether policy change affects the *extensive margin* of additional entry of previously-constrained households, but show that borrower composition is stable either side of the policy change. Our headline result using a traditional Difference-in-Difference estimator is that, across all FTB purchases, the macroprudential loosening in Ireland in 2017 induced a 1.2 percentage point increase in the average LTV ratio at mortgage origination, a relatively small effect relative to a

standard deviation in our sample of 14. When measuring leverage as a ratio of $\frac{debt}{equity}$, we uncover a treatment effect of 0.6, relative to a standard deviation of 3.

Having established that a treated cohort of households increases average leverage after the reform, we next assess the adjustment mechanism. Households can respond to macroprudential loosening by posting smaller downpayments on similar sized properties (rebalancing their portfolio towards more liquid assets), or posting similar downpayments to purchase higher-value properties (an accelerator-type reaction, familiar from the macro-finance literature). There are important normative policy implications associated with this choice: if tilted more heavily towards the former, there are likely to be liquidity-enhancing effects for households, without risk of increased cyclical growth in house prices. By contrast, if the latter is the more prevalent response, concerns around cyclical pressures and housing overvaluation resulting from policy loosening are warranted.

Repeating the descriptive and formal empirical techniques used in the case of LTV, separately with the downpayment amount, loan size and property value as explanatory variables, we uncover that Irish mortgage holders responded to looser LTV requirements in 2017 by posting smaller downpayments. Corresponding to this increase in downpayments, we uncover an increase in indebtedness when inputting loan size at mortgage origination as our dependent variable.

We find no causal evidence that property prices grew among the treated group, suggestive that "accelerator" type behaviour as expected by models in the spirit of Bernanke et al. (1999) were absent in the Irish case. There are two potential ways in which downpayments can be lowered: firstly, mortgage borrowers may be withholding liquidity themselves, which can then be used to fund consumption or savings; secondly, affected borrowers may previously have been relying on family support (e.g. gifts from parents) to finance larger downpayments, which they no longer require upon policy loosening. In either case, we believe our results provide evidence of households' preferences for liquidity: once presented with an opportunity to increase leverage, the predominant mechanism chosen is to retain liquidity which would counterfactually have been tied up in the housing asset, which is shown to have occurred upon policy introduction in Netherlands Bekkum et al. (2019) and Norway Aastveit et al. (2021).

The continued existence of the 3.5 LTI limit may also be a determining factor in how households respond, given that it restrains certain borrowers from availing of more leverage under an LTV loosening. While it is impossible to formally test how the LTV loosening episode would have transmitted through the market in the absence of the LTI limit, we provide suggestive evidence that it is not critical to our findings by showing that results are robust when omitting all transactions near to the 3.5 LTI limit both before and after the policy change, as well as showing that there are no substantive differences in LTV and downpayment reactions among low versus high LTI mortgages.

There are potential reasons to expect *ex ante* that responses to macroprudential policy are asymmetric. In response to policy tightening, borrowers are forced to reduce their LTV ratios to comply with the introduced limits. Given that many borrowers are liquidity constrained, it is unlikely in a tightening episode that such borrowers will respond by maintaining purchase prices and posting larger downpayments to comply. One may expect it is more likely that borrowers, with a fixed amount of liquid wealth available, will be forced to purchase less expensive property in response. Kinghan et al. (2019) provide evidence for this type of logic in Ireland, showing that higher income borrowers use additional downpayment to maintain purchase prices, while lower

income borrowers reduce purchase prices, in response to the 2015 introduction of macroprudential mortgage measures. In a loosening, on the other hand, the option of maintaining a similar purchase while retaining more liquid wealth is something that is available to all borrowers, regardless of their wealth and income levels. Our analysis of heterogeneity suggests that this liquidity-preferring option is exercised most vigorously by older borrowers, who are likely to have a more burdensome set of non-mortgage expenses, indicative that financial constraints may dictate the attractiveness of the method of adjustment chosen. Due to a lack of detailed data on mortgage borrowers' finances around the drawdown date, we cannot formally test the underlying mechanisms at play, which leaves this asymmetry and its causes as a promising avenue for future research.

We proceed with a review of relevant literature on macroprudential regulation and mortgage financing, before moving on to describing our empirical approach and results, and drawing out policy implications.

2 Relevant literature

Our results relate to the emerging literature on the effects of macroprudential policy, which have focussed up to now primarily on the "tightening" effects of policy introduction. Recent contributions have shown that these policies have been successful in their stated aims of reducing household leverage (Félix et al. (2021); Peydro et al. (2020); Aastveit et al. (2021); Bekkum et al. (2019); Kinghan et al. (2019); DeFusco et al. (2020)), cooling house price growth (Acharya et al. (2020)) and promoting borrower resilience (see Gaffney and Greaney (2020) for evidence that borrowers with lower LTV and LTI ratios had less need for payment moratoria during the COVID-19 crisis in Ireland in 2020).

Researchers have also highlighted a range of potential costs or side-effects of macroprudential mortgage policies, many of which are articulated by Svensson (2019), who suggests that following the introduction of policy in Sweden, households "oversave" in illiquid housing, which reduces their liquidity resilience, increasing the sensitivity of their consumption to income shocks, as well as leading to higher housing costs among those unable to access the mortgage market. Acharya et al. (2020) provide evidence for distributional shifts in aggregate lending flows, showing that mortgage credit grows disproportionately among higher-income cohorts after policy introduction in Ireland in 2015, with similar findings in the UK Peydro et al. (2020). Bekkum et al. (2019) show that the transition from rental to home-ownership slows substantially after the introduction of LTV restrictions in the Netherlands over a one and two-year horizon, while also showing that liquidity positions are weakened over the medium term due to increased downpayments, a finding confirmed in Norway Aastveit et al. (2021). Focussing on adjustment across the income distribution, Kinghan et al. (2019) show that, among those borrowers accessing the market, lower-income borrowers face wealth constraints that mean that they must adjust to the introduction of LTV and LTI limits by reducing the value of property they purchase; by contrast, higher-income borrowers, less likely to face wealth constraints, purchase similarly priced properties after policy introduction, posting larger downpayments to comply with the new leverage limits.

An important backdrop to our research is the large literature on the role of credit loosening in the run-up to the previous crisis. Papers such as Adelino et al. (2016)

and Foote et al. (2020) suggest that the mortgage and housing boom in the USA was a widespread phenomenon, with credit demand and exuberant expectations leading to leverage growth across all parts of the household sector. By contrast, papers in the spirit of Mian and Sufi (2009) suggest that the primary cause of the boom was a loosening in credit supply specifically to higher-risk, or subprime borrowers, facilitated by the emergence of private label mortgage securitization. Our research shares with this literature the focus on the implications of credit loosening for borrower leverage, household finances and the housing market. By contrast, our contribution is unique in focussing on an active loosening decision by a central bank during the post-crisis era of tight macroprudential policies, whereas the previous studies focus on lax and relaxing private lending standards during a period of weak regulation and financial innovation.

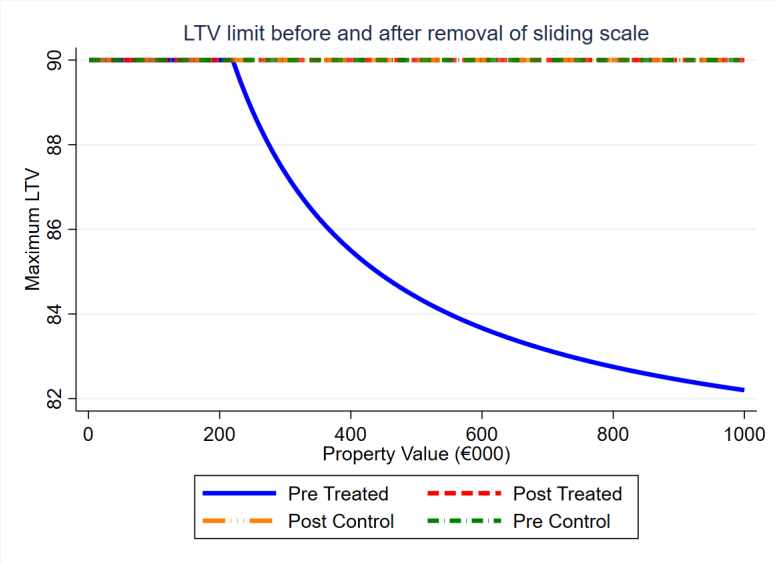
Finally, our work is also related to the growing literature on the effect of releasing macroprudential capital buffers on credit supply. This literature is more developed than that on macroprudential mortgage measures, because central banks have taken a more activist approach to changing the calibration of these buffers in response to the economic cycle. Jimenez et al. (2017) is the reference point in the literature, highlighting the effectiveness of a precursor to the CCyB, the Spanish dynamic provisioning policy, with policy loosening supporting credit supply and employment. Recent studies have shown that regulators' approach during the pandemic was effective in supporting credit supply, but ex-ante capital headroom was an important determinant of banks' capacity to benefit from policy flexibility during the pandemic. Berrospide et al. (2021) show that Basel III capital buffers were limited in their usability during the COVID-19 crisis, as evidenced by the weaker lending supply of banks closer to the minimum required level of these buffers, while Couaillier et al. (2022) show that in Europe, in an environment where the CCyB had been released in most jurisdictions and the supervisor had announced the usability of certain macroprudential buffers, banks closer to regulatory minima still engaged in more pro-cyclical credit tightening during the pandemic.

3 Policy context

The Irish mortgage market differs from large markets such as the United States in a number of substantively important ways. A detailed description of these is provided in Acharya et al. (2020). Some key points worth highlighting here include the almost total reliance on an "originate and hold" rather than "originate and distribute" model that is more common in markets such as the USA, and the dominance of retail banks, who at the time of this study accounted for over 95 per cent of new lending. Lenders maintain credit risk on their balance sheet in Ireland, with securitization and portfolio sale markets being more commonly used to transfer Non-Performing Loans emanating from the 2008 crisis off lenders' balance sheets. Mortgage insurance, or quasi-governmental credit risk transfer via entities such as Fannie Mae and Freddie Mac in the USA, do not exist in the Irish market. Up until 2015, new lending was predominantly done at variable interest rates, with fixed rate lending of more than 5 years' fixation only becoming common in the years preceding the COVID-19 pandemic.

The Central Bank of Ireland introduced macroprudential mortgage measures in 2015 as part of the post-crisis policy response. The measures were introduced at a time when the Irish economy was beginning to recover from the previous crisis. At the time, lending standards were relatively tight in a historic context, lending volumes were subdued,

FIGURE 2. Pre-reform policy environment - LTV maximum



Note: The figure shows the macroprudential policy reform introduced in Ireland in 2017.

negative equity remained a concern for many borrowers with a mortgage, and default rates remained above 10 per cent as the resolution of mortgage arrears remained a challenge for lenders and policymakers.

The measures originally introduced a refined set of restrictions across borrower types. In the First Time Buyer (FTB) market, loans valued below €220K had an LTV limit of 90, while for more expensive properties, the component valued above this threshold was subject to an LTV limit of 80. This created a "sliding scale", with the LTV limit converging towards 80 as property values approached infinity, as visualised in Figure 2. At the same time, an LTI limit of 3.5 times gross income was implemented for all borrowers purchasing a primary home. A "proportionate cap" or allowance system was also created, whereby a fixed proportion of lending for each bank was allowed above the LTI and LTV limits.

In late 2016, the regulations were reformed, with the LTV limit being simplified in the First Time Buyer (FTB) market: as of January 1st 2017, all First Time Buyer (FTB) loans were to be subject to an LTV limit of 90. These changes are outlined in Table 1. At the same time, the system of allowances was altered in response to the observation that the majority of allowance lending in 2015 and 2016 was allocated to First Time Buyer (FTB). From 2017 on, a specific proportion of First Time Buyer (FTB) loans were allowed above the LTI and LTV limits, and a separate allowance pool was defined for movers (second and subsequent buyers - SSBs). We limit our attention in this study to the changes in First Time Buyer (FTB) LTV ratios, which represent an ideal quasi-experimental setting given that a portion of the First Time Buyer (FTB) market was not subject to any policy change between 2016 and 2017. In the language of quasi-experimental design, we will from here on refer to mortgages on properties valued below the €220K threshold as $Control$ mortgages, and those on properties valued above the threshold as $Treat$ mortgages.

Importantly from the perspective of empirical identification, the Central Bank of Ireland's policy decision in its late-2016 review was not motivated by an endogenous

response to evolving economic conditions. Rather, the rationale laid out as follows related to a simplification away from the "sliding scale" regime which imposed stricter LTV requirements as properties grew more expensive:

> First, the property value threshold of €220,000, above which a lower LTV limit applies for First Time Buyers (FTBs), was re-considered. The €220,000 threshold level was originally calibrated with reference to median house prices in Dublin. The existence of a fixed nominal threshold value as part of the LTV limits for First Time Buyers (FTBs) means that the Regulations would have to be updated every year. Taking into account the medium-term orientation of the measures and considering the evidence arising from the review, the property value threshold for First Time Buyers (FTBs) will be removed and a 90 per cent LTV limit will apply for First Time Buyers (FTBs) at all house prices from 1 January 2017. [2]

This policy rationale means that traditional concerns about the endogenous response of policy to economic conditions, which render causal identification challenging and motivate the usage of "narrative" and other approaches that allow identification of shocks for causal inference in the spirit of Romer and Romer (2004) for monetary policy, do not arise here. In the case of macroprudential policy, recent contributions such as Richter et al. (2019) have adopted such a narrative approach to the estimation of the effects of LTV restrictions.

Separately, many studies in empirical banking and finance adopt a "Bartik-like" approach to identification, in cases where policy interventions are common across the economy and therefore collinear with a time dummy. In such a setting, researchers typically construct ex-ante measures of "exposure to treatment", which are interacted with the policy implementation time dummy to infer causal effects. Examples include Acharya et al. (2020) who interact ex-ante bank lending above macroprudential limits with a time dummy for policy introduction in Ireland in 2015, and Bottero et al. (2019) who interact ex-ante measures of banks' reliance on liquid assets with a dummy for introduction of negative interest rate policies to show how unconventional monetary policy affects banks and borrowers.

In our case, we require neither identification of high-frequency policy shocks, nor the creation of an ex-ante exposure variable. Due to the nature of the 2017 reform, we will proceed on the basis that the policy decision that creates the variation of interest in LTV, leading to distinction between $Treat$ and $Control$ loans, is orthogonal to economic forces that could also explain this variation across the property price distribution. On this assumption, we will infer the causal effect of macroprudential loosening from a traditional Difference-in-Difference estimation procedure outlined below.

TABLE 1. Changes in First Time Buyer LTV limits in 2017

	2015 and 2016	2017
Properties valued below €220K	90	90
Properties valued above €220K	$80 < LTV < 90$	90

[2] https://www.centralbank.ie/docs/default-source/financial-system/financial-stability/macroprudential-policy/policy-documents/2016-review-of-residential-mortgage-lending-requirements.pdf?sfvrsn=12

4 Data and Summary Statistics

Our empirical investigation is based on a granular loan-level dataset (i.e., Monitoring Template data, MTD) collected by the Central Bank of Ireland since 2015. The data cover new lending from 6 institutions. We focus only on new property purchases and First Time Buyer (FTB) - these are the borrowers affected by the change in regulation in 2017.[3] The dataset contains a number of variables related to borrowers' characteristics (such as total income, marital and occupational status) and loan characteristics including downpayment, LTI, LTV, interest rate, maturity and others. The tables below provide an overview of the main variables used in the empirical analysis for both treated (FTBs with loans >220K) and control groups (FTBs with loans < 220K). In Table 2, we report the mean and standard deviation for our key variables of interest.

TABLE 2. Summary Statistics on key variables of interest

	Mean	SD
Deposit	56,678	74,923
Property Value	265,043	139,111
LTV	80	14
Loan Size	208,373	102,977
LTI	3.01	0.76
Income	69,906	32,883
Property Size	1300	1852
Joint Applications	0.671	0.470
Non-Salaried Employment	0.072	0.258

Note: MT data (2015-2018). Number of observations: 47,634. Property Size measured in square feet. Non-salaried employment relates to borrowers receiving irregular income such as through self employment

Table 3 reports summary statistics across the treated (properties valued above €220K) and control (properties valued below €220K) groups, in both the pre and post reform periods. Critically, barring minor growth in nominal values for property prices and loan sizes, there is minimal evidence of significant compositional change across borrower types within either $Treat$ or $Control$ groups either side of the policy introduction. The relevance of this is discussed in more detail in later sections. In our most saturated specifications, the set of controls below are included in all cases.

5 Results on borrower leverage

5.1 Borrower leverage in response to the policy shock: simple data exposition

Our headline narrative is clearly visualised in Figure 3. Using a box plot across the four groups (Treatment versus Control, and Pre versus Post), a particularly large increase in LTV is apparent between the Pre and Post periods for the treated group (those

[3]The First Time Buyer (FTB) market represents 47 per cent of new lending in 2015, 45 per cent in 2016 and 48 per cent in 2017 and 2018, meaning that this analysis covers almost half of the new mortgage lending market in the years in question.

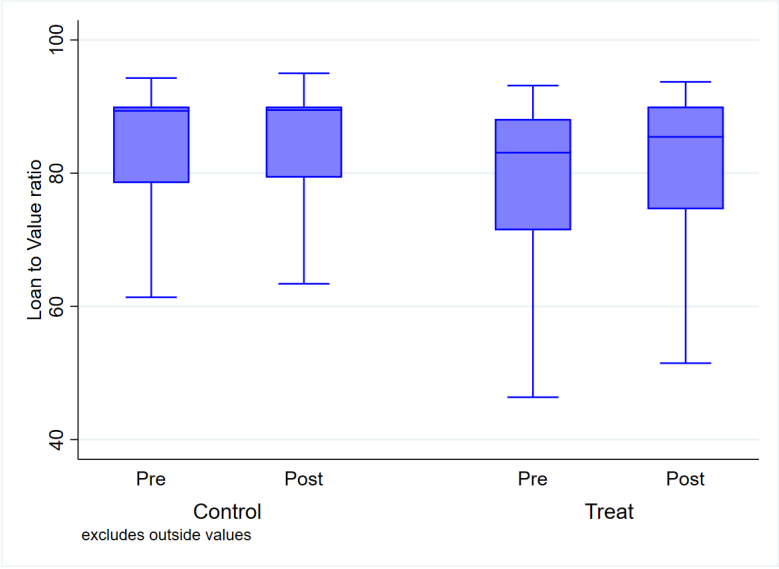
TABLE 3. Summary Statistics: Pre and Post period for Treated and Control group

	Pre $Control$	Post $Control$	Pre $Treat$	Post $Treat$
Property Value	152,613	160,814	335,129	349,211
Loan Size	124,864	132,296	255,003	273,060
LTI	2.63	2.70	3.21	3.29
Income	49,397	50,645	82,731	85,373
Property Size	1236	1295	1331	1321
Joint Applications	0.54	0.55	0.75	0.77
Non-Salaried Employment	0.08	0.06	0.09	0.06

Note: MT data (2015-2018). Number of observations: 47,634. All loans originated in 2015 and 2016 are designated "Pre", while all loans originated in 2017 and 2018 are designated "Post". Property Size measured in square feet. Non-salaried employment relates to borrowers receiving irregular income such as through self employment

loans on properties valued at more than €220K). This provides prima facie evidence in favour of our primary hypothesis: that treated borrowers responded to the Central Bank of Ireland's loosening in macroprudential LTV limits at the start of 2017 by disproportionately increasing their leverage via higher originating LTV ratios.

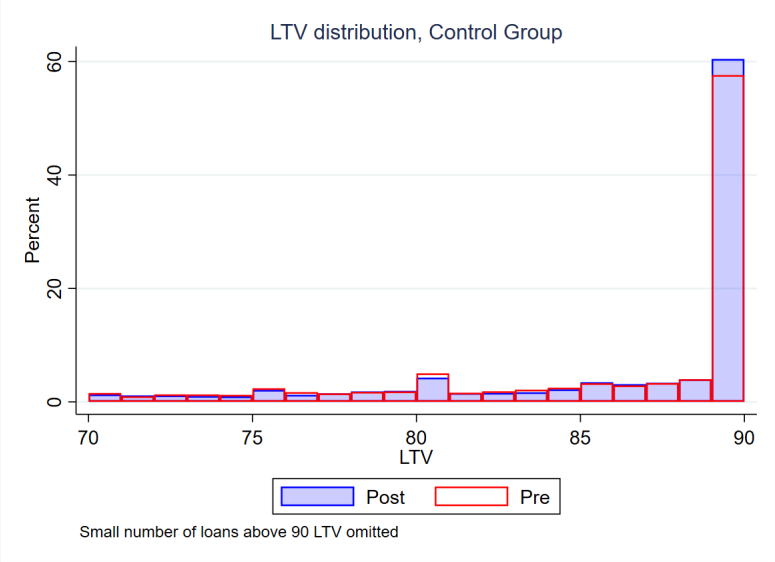
FIGURE 3. LTVs rose disproportionately in the $Treat$ group after the policy change



Source: MT data (2015-2018)

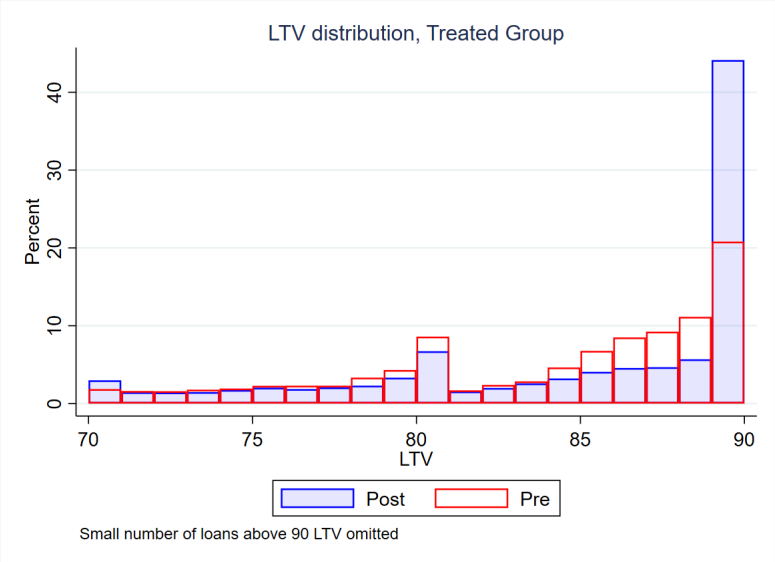
We provide more detail on the evolution in the LTV distribution either side of the treatment date in Figures 4 and 5. Our control group appears appropriate for the study at hand, given that the LTV distribution on this type of loan is close to identical either side of the policy reform (Figure 4). By contrast, the effect of the removal of the "sliding scale" LTV requirement for larger, treated loans is evident in Figure 5. During the Pre period of 2015 and 2016, a number of bunches in the distribution are evident between LTV levels of 85 and 90, reflective of the decreasing effective maximum LTV levels as properties become more valuable. By contrast, there is a decline in mass at these notches below 90, with close to 45 per cent of new loans in the sample in 2017 and 2018 having LTVs of exactly 90, the new regulatory maximum.

FIGURE 4. LTV distribution - control group



Source: MT data (2015-2018)

FIGURE 5. LTV distribution - treated group



Source: MT data (2015-2018)

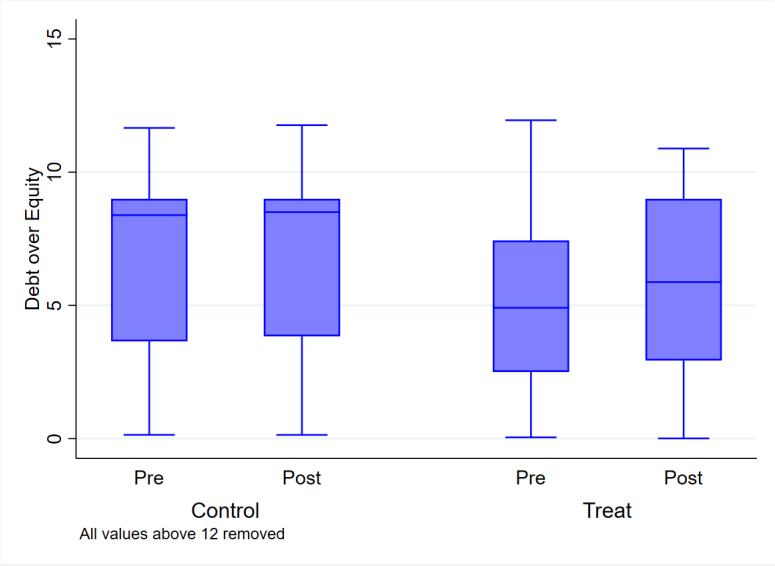
Finally we consider an alternative LTV variable, calculated as the ratio of total mortgage balance to the downpayment posted. Figure 6 plots the distribution of leverage across our four groups. Among the $Control$ group, leverage is close to constant either side of the January 2017 policy reform. By contrast, among $Treat$ loans, the median mortgage increased from around 5 times leveraged in the Pre period to 6 times in the Post period, while at the 75th percentile the magnitude of increase is from around 7.5 times to close to 9 times.

5.2 Difference-in-difference estimation on borrower leverage

We formalise the patterns in Section 5.1 through a traditional difference-in-difference estimation (DiD). In deploying this type of estimation to infer causality from the policy change to borrowers' leverage, there are two sources of concern that must be alleviated.

Firstly, one might be concerned about non-parallel movements in the macroeconomic environment or the housing market facing the $Treat$ and $Control$ loans, which might pollute the causal effect of the policy loosening on higher LTVs. In particular, if property price growth were higher among ex-ante more valuable property types through our threshold date of January 1st 2017, then this differential property price growth could be spuriously explaining the choice of higher LTVs that we aim to assign to the policy change. We deal with this concern in two ways. Descriptively, we point to evidence from Gaffney (2018) that shows that across the 2016-2018 period, property price growth in Ireland was higher *among cheaper properties*, suggestive that non-parallel property market developments are unlikely to be explaining our results. Formally, we include county-time varying average house price values as controls within some of our specifications, to more conservatively estimate the effect of the policy reform in a DiD setting.

FIGURE 6. Leverage rose substantially in the treated group



Source: MT data (2015-2018)

Secondly, given that new mortgage lending data are not panel data, one might be concerned about changes in borrower composition within either the $Treat$ or $Control$ group over time, which might influence the average LTV level within the group across time. If compositional changes in the $Treat$ group were disproportionately towards borrower types that were more likely to choose higher leverage in any state of the world, this shift could again lead us to spuriously assign causality to the policy change. We point to Table 3 which highlights stability across time within the $Treat$ and $Control$ groups on a number of important demographic dimensions, including marital status, occupational status, the size of property being purchased, and household income. This stability in the composition of borrower types over time, along with the inclusion of these factors as control variables within the empirical framework, provides comfort that any estimated

effect of the policy change on borrower leverage in a DiD framework has not been driven by spurious changes in composition.

We estimate equation 1 below, where Y is our measure borrower leverage (LTV at origination), while X_i is a set of loan and borrower specific characteristics, with bank fixed effects are also included in many specifications.

$$Y_i = \beta_0 + \beta_1 Post + \beta_2 Treat + \beta_3 Post * Treat + \beta_4 X_i \epsilon_i \quad (1)$$

Table 4 reports the headline results for a model of borrowers' leverage (LTV), where β_3 is our DiD coefficient of interest. The results on $Post$ and $Treatment$ indicate that LTVs are on average lower in the $Treat$ group, while the coefficient on the $Post$ period does not appear stable. In an unsaturated model, including only β_1, β_2 and β_3, our DiD estimates that the policy reform induced an increase in LTV of 1.7 percentage points. Iteratively adding bank fixed effects, borrower and loan characteristics, and county-time varying house prices does not negate the main result: we estimate that the macroprudential loosening in the FTB market in Ireland in 2017 led to an increase in average LTVs of 1.3 percentage point in the most-saturated model. These regression results provide formal evidence, accounting for a range of potential confounding factors, to underpin the graphical illustration in Section 5.1: borrowers respond to a macroprudential loosening by increasing LTV on new mortgage lending. In magnitude terms, the 1 percentage point effect is relatively small, when compared to a one-standard deviation LTV value of 14.

TABLE 4. Baseline DiD results for LTV ratios

	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.389**	0.354*	-0.295	-0.416**	-0.613***	-0.053
	(0.196)	(0.197)	(0.181)	(0.197)	(0.190)	(0.199)
Treatment	-4.825***	-4.864***	-14.415***	-14.641***	-15.390***	-14.027***
	(0.198)	(0.199)	(0.209)	(0.228)	(0.220)	(0.227)
DiD	1.700***	1.631***	1.341***	1.034***	1.088***	1.279***
	(0.264)	(0.264)	(0.242)	(0.262)	(0.252)	(0.258)
Observations	47634	47634	47634	40783	40731	38573
r2	0.019	0.023	0.179	0.186	0.246	0.265
Bank FE	No	Yes	Yes	Yes	Yes	Yes
Loan Controls	No	No	Yes	Yes	Yes	Yes
Property Size	No	No	No	Yes	Yes	Yes
Borrower Chars	No	No	No	No	Yes	Yes
County HPs	No	No	No	No	No	Yes

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. $Post$ indicates all loans originated after Jan 1st 2017. Treatment Group is all loans against properties valued above €220K. Borrower characteristics: marital and employment status. Loan characteristics: total household income, LTI and property size. MT data (2015-2018)

We repeat the specification of Equation 1 using the debt to equity variable as in Figure 6. The DiD estimate in Table 5 is that the causal effect of policy loosening is to increase the household leverage ratio by 0.57 times, relative to a standard deviation of 3.5.

TABLE 5. Baseline DiD results for leverage ratios

	(1)	(2)	(3)	(4)	(5)	(6)
Post	-0.009	-0.019	-0.113***	-0.157***	-0.199***	-0.107**
	(0.042)	(0.042)	(0.041)	(0.045)	(0.043)	(0.045)
Treatment	-1.488***	-1.476***	-2.916***	-2.973***	-3.129***	-2.882***
	(0.043)	(0.043)	(0.047)	(0.052)	(0.050)	(0.052)
DiD	0.634***	0.630***	0.585***	0.560***	0.573***	0.612***
	(0.057)	(0.057)	(0.055)	(0.059)	(0.057)	(0.059)
Observations	47622	47622	47622	40776	40724	38567
r2	0.036	0.039	0.111	0.115	0.169	0.181
Bank FE	No	Yes	Yes	Yes	Yes	Yes
Loan Controls	No	No	Yes	Yes	Yes	Yes
Property Size	No	No	No	Yes	Yes	Yes
Borrower Chars	No	No	No	No	Yes	Yes
County HPs	No	No	No	No	No	Yes

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. $Post$ indicates all loans originated after Jan 1st 2017. Treatment Group is all loans against properties valued above €220K. Leverage defined as the ratio of the opening mortgage balance to the posted downpayment. Borrower characteristics: marital and employment status. Loan characteristics: total household income, LTI and property size. MT data (2015-2018)

6 Results on the adjustment mechanism

In Section 5 we have established that borrowers did indeed adjust to the 2017 policy loosening by choosing higher leverage. In this section we investigate the potential adjustment mechanisms available to borrowers after an LTV loosening, and their implications for macroprudential policy makers.

In a traditional macroeconomic framework with financial frictions (for example, Kiyotaki and Moore (1997); Bernanke et al. (1999)), an increase in LTV requirements or a loosening of downpayment requirements would induce additional borrowing by households that raises house prices. In these models, collateral acts as a financial accelerator through which small shocks can propagate into large changes in asset prices. In practice however, there is a more nuanced range of options available to a cross-section of borrowers after a loosening of LTV requirements:

1. "Classic accelerator" behaviour: post similar downpayment, purchase more expensive property.

2. "Cash retention" behaviour: post smaller downpayment, retain more liquid assets for either savings or consumption, purchase similar property.

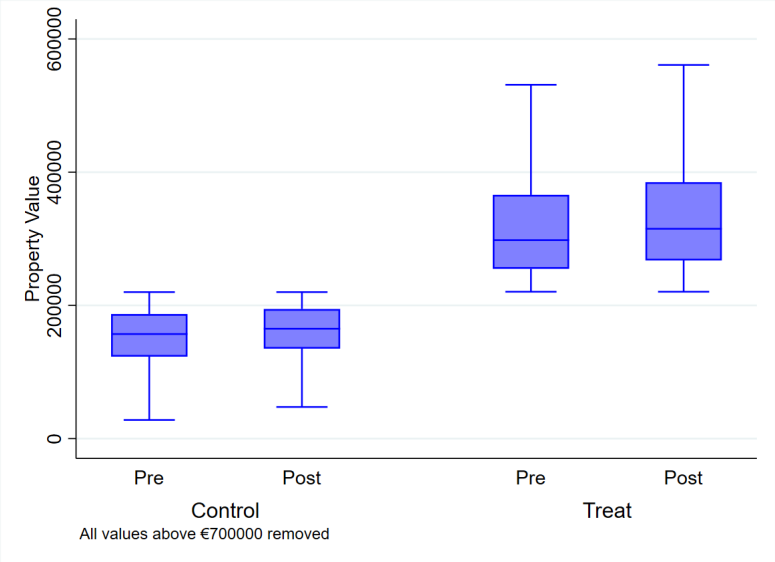
If borrowers predominantly choose option 1 above, the macroprudential authority should expect an increase in house prices and housing cyclicality to accompany an LTV loosening, with knock-on implications for medium-term financial stability via well-documented leverage channels that operated in the run-up to the 2008 crisis. However, if option 2 dominates, one might expect minimal effect on house prices, as borrowers purchase similar properties at similar prices, but simply have higher housing leverage and improved liquidity positions. Our analysis in this section will attempt to use the Irish micro data at hand to shed light on this choice set. We will analyse the response of borrowers in terms of their downpayment amount, their loan size, and their property purchase value.

6.1 Adjustment mechanism - simple data exposition

As in Section 5, we begin by providing descriptive evidence from the distribution of the key choice variables outlined in the previous paragraph. Inspecting the potential operation of the "classic accelerator" mechanism, we display movements in the distribution of the purchase value of properties in both groups, along with the price-to-income ratio of each new mortgage in the data. The cut-off between $Treat$ and $Control$ is defined by the "running variable" in this exercise, which places a natural limitation on the potential size of increase in purchase prices for the $Control$ group. Nonetheless, consistent with nominal house price growth across the country between the Pre and Post periods, Figure 7 reports increases in the distribution of nominal purchase prices across both groups, albeit with higher nominal increases visible in the $Treat$ group of higher-valued properties.

One way to account for movements in nominal values across time is to scale the purchase prices by borrowers' incomes. In doing so in Figure A3, the price-to-income ratio distribution appears unchanged across time in both the $Treat$ and $Control$ group, suggestive that the underlying affordability of purchases was not altered by the policy loosening. In our formal empirical analysis, we will include household income as a control variable in the majority of specifications.

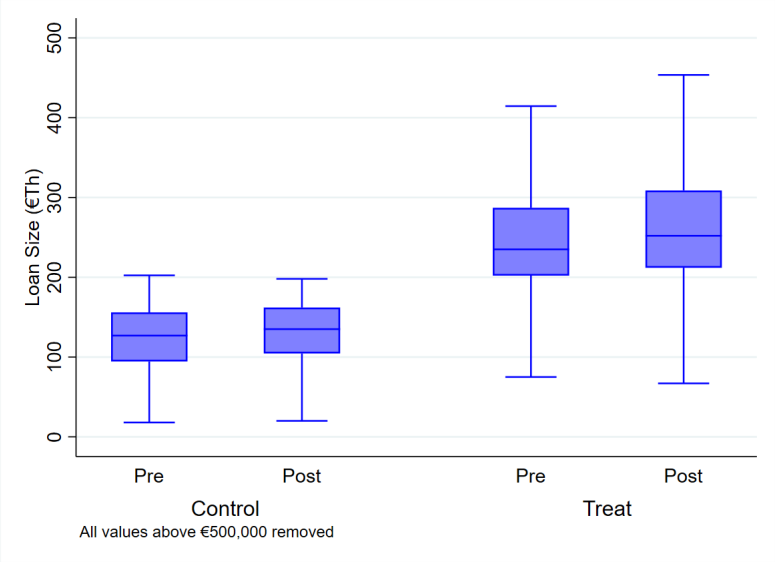
FIGURE 7. Accelerator effects in response to the loosening? Nominal purchase prices grew in both groups



Source: MT data (2015-2018)

The distribution of loan sizes, in Figure 8, follows a similar pattern to that for purchase prices in Figure 7: nominal loans grow between the Pre and Post periods for both borrower groups. Similar to the price-to-income ratio reported in Figure A2, the picture is less clear when scaling loan volumes by borrowers' income (Figure A1).There is evidence of small increases in median LTI ratios in both groups, consistent with aggregate house prices growing more quickly than household incomes. However, in the $Treat$ group the effect appears to be smaller at the median, and there is in fact a *reduction* in the 75th percentile LTI ratio between the Pre and Post period.

FIGURE 8. Loan sizes grew in both groups



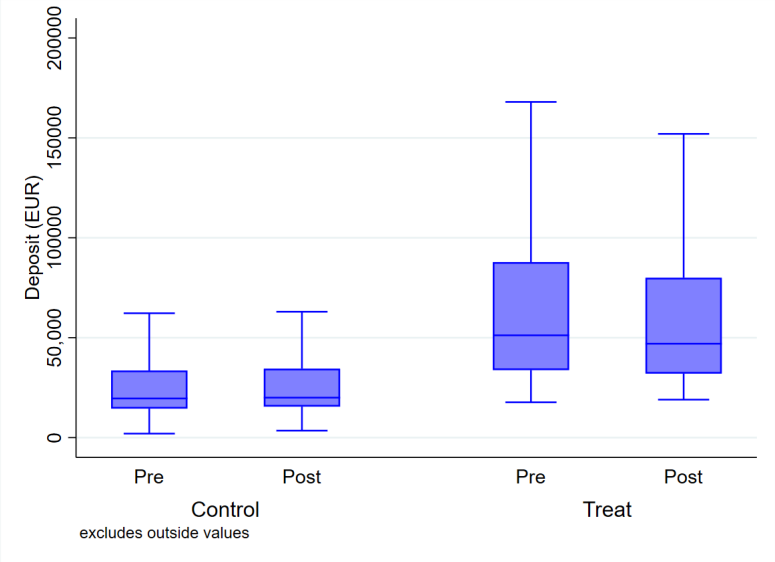
Source: MT data (2015-2018)

In the absence of clear evidence for accelerator-type behaviour in response to the leverage loosening, we next investigate whether borrowers may have adjusted their portfolio by retaining more liquid assets after the loosening. In Figure 9 we provide initial support for the idea that borrowers may respond to looser downpayment requirements by simply retaining more liquidity. While among the $Control$ group the downpayment distribution is flat either side of the reform, in the $Treat$ group there is clearly a downward shift in downpayments posted, both at the median (from €52K to €48K) and the 75th percentile (from €80K to €75K).

In Figure A3, we confirm that this effect holds when the nominal value of downpayments is scaled by borrowers' income, with the proportional shifts across groups and time being similar to the case of Figure 9. $Control$ borrowers have median downpayments that are about two fifths of annual gross salary in both periods. Median $Treat$ borrowers, on the other hand, post downpayments above 60 per cent of annual income in the Pre period, falling below 55 per cent in the Post period. The fall is larger at the 75th percentile of the DI distribution, from around 1.2 times to 1.05 times income.

The totality of our findings is that there is little evidence of an accelerator-type mechanism in operation among the $Treat$ group in the aftermath of the macroprudential LTV loosening in 2017. Purchase prices do not appear to rise disproportionately, particularly when scaled relative to household incomes, allaying fears that such a loosening must lead to a heightened housing-credit spiral. This provides important nuance to the likely policy intuition when a macroprudential authority is considering the loosening of an LTV limit: the Irish experience in 2017 indicates that it is not inevitable that policy loosening leads to house price amplification. The importance of borrowers' choices, and in particular their potential preference for liquidity, is the mitigating force in operation which may dampen any expected pro-cyclical effect on the housing market. Section 7 draws out the policy implications of our empirical analysis in more depth.

FIGURE 9. Cash retention behaviour? Downpayments fell by more in the $Treat$ group after the policy change



Source: MT data (2015-2018)

6.2 Adjustment mechanism: difference-in-difference specification

We now formalise the findings of the previous sections' graphs in a DiD setting, with specifications set up analogously to Equation 1. In Table 6, we adopt the same specification as in Table 4, but replace LTV with the euro value of downpayment on the mortgage. The coefficients on $Post$ and $Treatment$ indicate that, on average, downpayments are larger in the post-period, and are larger on treated loans (for more expensive properties). The results for the DiD coefficient across columns 1-3 indicate a robust finding, that in response to the macroprudential loosening, borrowers respond to the weakening leverage requirement by posting smaller downpayments of the order of €5K less than the counterfactual. These are statistically significant effects, but their magnitude relative to a one-standard-deviation in downpayments of €56k in our regression sample suggests their overall aggregate economic magnitude is relatively muted.

The findings of Table 6 are suggestive of a trade-off between leverage and liquidity for borrowers. Previous studies in the Netherlands Bekkum et al. (2019) and Norway Aastveit et al. (2021) both show that upon introduction of macroprudential mortgage measures, borrowers' liquidity position suffers due to the tightening of the downpayment requirement. Our results suggest that there is a welfare cost associated with that loss of liquidity: when a cohort of borrowers were presented with the opportunity to increase their leverage in Ireland, part of their response was to keep an average of an additional €5k in liquid form, through a reduction in posted downpayments. Readers should note that this does not necessarily equate to the borrower household itself increasing liquid assets: recent evidence from Ireland suggests that gifts from family members are an important component of downpayments, particularly for borrowers constrained at the LTI limit Gaffney (2019). Our results therefore can be indicative of one of two things: either borrower households have retained more liquidity which can be used for consumption or savings, or borrowers have

TABLE 6. Baseline DiD results for downpayment amounts

	(1)	(2)	(3)	(4)	(5)	(6)
Post	754	899	1389*	1407*	2016***	-196
	(725)	(727)	(721)	(798)	(781)	(832)
Treatment	50788***	50134***	54139***	54214***	56489***	51829***
	(729)	(736)	(839)	(926)	(907)	(949)
DiD	-5455***	-5204***	-5204***	-3932***	-4033***	-4639***
	(974)	(974)	(965)	(1059)	(1036)	(1079)
Observations	47560	47560	47560	40721	40669	38511
R^2	0.172	0.175	0.189	0.190	0.225	0.235
Bank FE	No	Yes	Yes	Yes	Yes	Yes
Loan Controls	No	No	Yes	Yes	Yes	Yes
Property Size	No	No	No	Yes	Yes	Yes
Borrower Chars	No	No	No	No	Yes	Yes
County HPs	No	No	No	No	No	Yes

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. $Post$ indicates all loans originated after Jan 1st 2017. Treatment Group is all loans against properties valued above €220K. Borrower characteristics: marital and employment status. Loan characteristics: total household income, LTI and property size. MT data (2015-2018)

received less gifts in response to looser downpayment requirements, meaning that the parents of potential homeowners increase their liquid holdings in response to the looser leverage requirement.

A borrower could also respond to an increased leverage limit by purchasing a more expensive property, with Figures 7 and A2 providing inconclusive descriptive evidence of any effects in response to the reform studied in this paper. In Table 7, we test this hypothesis in a DiD specification. We observe that property values on new mortgage loans are higher in the post period, on average, and higher in the treatment group, which should be true by construction of the policy treatment. The DiD coefficient indicates that, once a credible set of regressors are included, we have no support for the hypothesis that borrowers respond to a leverage loosening by purchasing more expensive properties.

Finally we investigate in Table 8 whether borrowers responded to LTV loosening by increasing the nominal value of their borrowings. In unsaturated models, $Treat$ borrowers are shown to have increased their loan sizes by €10-11k more than the counterfactual, while specifications 3-6 suggest that this effect holds and is statistically significant but is of smaller magnitude when all controls are included. The finding of a causal effect of €5k must be viewed in the context of a one-standard deviation in loan size in our sample of just over €100K.

6.3 Heterogeneity in borrower responses by age

We next highlight heterogeneity in the response of borrowers to the policy loosening. In Figure 10, we run our baseline LTV model separately in each quintile of the mortgage borrower age distribution. The full model results are included in the Appendix in Table A1. There is a clear distinction between quintiles 4 and 5 and the rest, both in terms of statistical and economic significance: the overall baseline effect appears driven by the oldest borrowers. In Figure 11, we investigate the age heterogeneity in our key adjustment mechanisms. The results are consistent, with negative and statistically

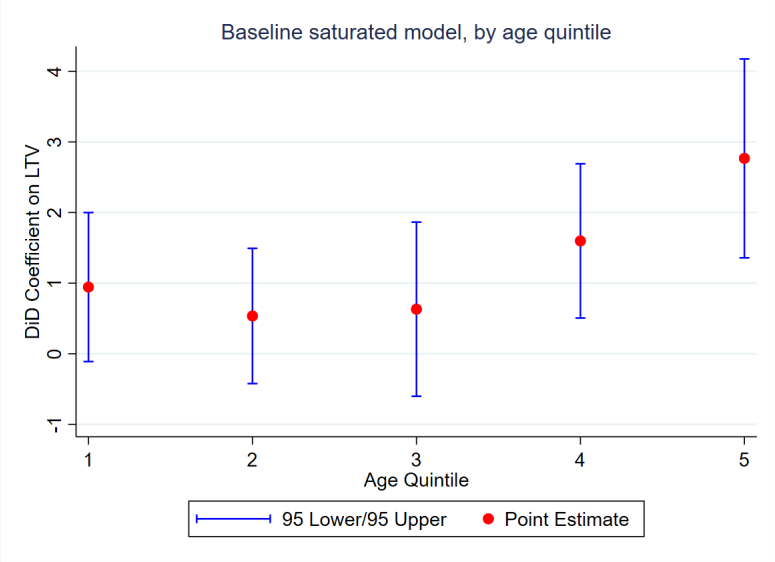
TABLE 7. Baseline DiD results for property values

	(1)	(2)	(3)	(4)	(5)	(6)
Post	8202***	7906***	1212	1188	1480	-960
	(1233)	(1231)	(816)	(909)	(904)	(965)
Treatment	179660***	175631***	61156***	61708***	62888***	57437***
	(1241)	(1246)	(954)	(1060)	(1055)	(1104)
DiD	5270***	5646***	974	1344	1369	680
	(1658)	(1648)	(1092)	(1207)	(1200)	(1251)
Observations	47541	47541	47541	40705	40654	38496
R^2	0.522	0.528	0.793	0.789	0.791	0.789
Bank FE	No	Yes	Yes	Yes	Yes	Yes
Loan Controls	No	No	Yes	Yes	Yes	Yes
Property Size	No	No	No	Yes	Yes	Yes
Borrower Chars	No	No	No	No	Yes	Yes
County HPs	No	No	No	No	No	Yes

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. $Post$ indicates all loans originated after Jan 1st 2017. Treatment Group is all loans against properties valued above €220K. Borrower characteristics: marital and employment status. Loan characteristics: total household income, LTI and property size. MT data (2015-2018)

significant downpayment effects dominating at higher age quintiles, again suggestive that our mechanism is driven by older borrowers. The tendency towards larger loan sizes as a result of the reform appears common across borrowers of all ages. Finally, the lack of evidence for "accelerator" behaviour is confirmed, with insignificant property price coefficients across the age distribution.

FIGURE 10. LTV model across the age distribution



Source: MT data (2015-2018)

What might explain this source of heterogeneity? While conclusive evidence is beyond the scope of this paper, we propose a number of potential explanations. Among the First Time Buyer cohort, older borrowers are likely to have larger expenditure obligations on childcare and other family-related items, whereas younger First Time

TABLE 8. Baseline DiD results for loan sizes

	(1)	(2)	(3)	(4)	(5)	(6)
Post	7431***	6994***	-145	-321	-633	-745
	(1065)	(1062)	(448)	(464)	(457)	(490)
Treatment	129648***	126341***	7773***	5198***	4294***	3633***
	(1071)	(1075)	(520)	(538)	(531)	(559)
DiD	10783***	10893***	6605***	5279***	5472***	5400***
	(1431)	(1422)	(599)	(615)	(606)	(635)
Observations	47621	47621	47621	40773	40721	38563
R^2	0.451	0.459	0.904	0.915	0.918	0.916
Bank FE	No	Yes	Yes	Yes	Yes	Yes
Loan Controls	No	No	Yes	Yes	Yes	Yes
Property Size	No	No	No	Yes	Yes	Yes
Borrower Chars	No	No	No	No	Yes	Yes
County HPs	No	No	No	No	No	Yes

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. $Post$ indicates all loans originated after Jan 1st 2017. Treatment Group is all loans against properties valued above €220K. Borrower characteristics: marital and employment status. Loan characteristics: total household income, LTI and property size. MT data (2015-2018)

FIGURE 11. Adjustment mechanisms across the age distribution

Source: MT data (2015-2018)

Buyers (FTBs) may be more likely to enter the mortgage market before family formation. These greater non-housing expenditures may increase the desirability of cash to older borrowers, which makes them more sensitive to the potential liquidity-enhancing benefits of a macroprudential LTV loosening.

Older First Time Buyers (FTBs) may also have a greater demand for precautionary savings for lifecycle reasons, which would also increase their marginal benefit from increased access to liquidity.

Finally, non-mortgage debts are larger in Ireland for older borrowers. Similar to the expenses channel mentioned above, older First Time Buyers (FTBs) may have a larger set

of non-mortgage debt obligations at time of mortgage origination, which may also make them more sensitive to the LTV loosening.

7 Implications for macroprudential policy

These findings have important implications for policy. A large literature has emerged since the Global Financial Crisis (GFC) on the effects of borrowing on property prices, and the important role that household mortgage borrowing, and looser credit conditions, had in driving the boom-bust cycle that precipitated the Crisis. While this literature predominantly focusses on *lender-led* loosening of credit standards, there are obvious intuitive implications for macroprudential policymakers: all things equal, a loosening of macroprudential policy relating to mortgage credit conditions should lead to increased amplification in the housing market, bringing with it heightened financial stability risks.

Our research highlights an important nuance that makes the above intuition less clear. In the face of a loosening of downpayment requirements, a borrower can deploy the same amount of liquid wealth as would have been deployed in the absence of policy change, and purchase a more expensive property with greater leverage. Doing so would be consistent with the intuition arising from the aforementioned literature on credit and housing boom-bust cycles. However, we highlight another choice facing borrowers, which we term a "cash retention" mechanism: rather than deploying a fixed amount of liquid wealth and purchasing more expensive housing through heightened leverage, borrowers can also respond to an LTV loosening by deploying *smaller liquid resources* in the house purchase transaction, purchasing a similarly priced home. If borrowers choose this latter option, the fears that macroprudential loosening will inevitably lead to heightened housing cyclicality are alleviated somewhat.

Outside of this direct benefit in alleviating cyclical fears, we highlight an additional important household resilience benefit that arises when borrowers react along the lines of the "cash retention" strategy. When borrowers choose to retain more of their own liquid resources while increasing mortgage leverage, they may make themselves more "liquidity resilient" in the short run. This helps alleviate one of the major short-run costs of macroprudential mortgage policy that has been highlighted in recent literature: that in achieving greater system-wide resilience when measured through indebtedness, macroprudential mortgage policy may create short term vulnerabilities by weakening households' liquidity positions due to onerous downpayment requirements. With liquidity tied up in housing downpayments, new mortgage holders in fact become *less resilient* to certain types of shock Aastveit et al. (2021); Svensson (2019). Our findings suggest that these liquidity-enhancing benefits of an LTV *loosening* may have been in operation in Ireland from 2017.

We emphasise that our results are not necessarily generalizable to other jurisdictions, or even to other policy settings in Ireland. The LTV loosening in Ireland in 2017 was an isolated policy change, introduced during a time of economic expansion rather than in response to economic weakness. Further, the LTV loosening was implemented in a policy setting where an LTI limit remained in place, and was becoming increasingly binding during the period from 2015 to 2020 as house prices rose consistently more quickly than household incomes. The restrictive effects of a binding LTI limit are likely to have mitigated the overall potential for "accelerator type" effects of mortgage borrowers in response to an LTV loosening, and may be an

important explanation for borrowers' choice to preserve liquidity as a response to the policy loosening. In other jurisdictions, depending on the other constraints in place in the credit market, it is difficult to assess how likely it is that our results would hold. While our empirical setup does not allow us to formally assess the counterfactual case of causal effects in the absence of an LTI limit, we provide suggestive evidence by showing that our results broadly hold when loans near the 3.5 LTI maximum are removed, and are broadly consistent across quintiles of the LTI distribution, implying that distance from the LTI maximum does not induce greater accelerator-like behaviour.[4]

Macroprudential mortgage limits come with a range of costs and benefits to the economy. These costs and benefits, as articulated during the 2021-22 review of the Central Bank of Ireland's macroprudential framework review, are laid out in Aikman et al. (2021). In this context, a macroprudential loosening by any authority can be thought of as a policy move that alleviates certain costs of the current policy calibration (for example relating to restricted construction activity and associated economic activity, or liquidity constraints placed on would-be homeowners), while at the same time foregoing some of the benefits of the current tighter calibration (for example by increasing cyclical risks in the housing market, or reducing borrowers' resilience to shocks). Our analysis suggests that, based on the experience of the 2017 loosening in Ireland for higher-priced First Time Buyers (FTB) purchases, the benefits foregone turned out to be minor, due to the option available to borrowers to translate the LTV loosening into a boosted liquidity position, rather than a higher-leverage, higher-priced outcome.

Rather that claim generalizability, we view our results as one important first step in building an evidence base on the effects of macroprudential loosening on the mortgage and housing market. We reiterate the importance of gaining an understanding at this current juncture of the mechanisms that may be at play when policy is loosened: macroprudential policy in the mortgage market remains a relatively new policy instrument, with policy implemented as a *tightening* in most jurisdictions after the Global Financial Crisis. However, now that these tighter regimes have been in place for a number of years in many countries, there is potential for rising demands from the political system and the wider public for policy loosening. These demands may become particularly acute as GFC memories fade further from (particularly younger) people's memories, and are likely to be heightened in settings where households face challenges in accessing homeownership. Even in settings where these issues arise due to a complex combination of supply-side problems relating to *inter alia* barriers to and costs of construction, the challenges imposed by macroprudential mortgage restrictions can provide a visible and salient target for public scrutiny. The rationale for loosening may also strengthen in cases where economic stresses emerge, and mortgage restrictions come to be seen by policymakers as a cyclical policy tool with potential stabilization benefits in the face of a downturn. In all of these cases, a growing evidence base on the effects of loosening in varying economic and policy contexts will act as an important guide to those considering the relative merits of changes to policy calibration.

[4] Results available upon request

8 Conclusion

Does a credit loosening result in (potentially unsustainable) house price growth? This question is at the heart of many debates facing macroprudential authorities as time elapses since the introduction of post-crisis restrictions on lending in mortgage markets. Due to the costs experienced across the household sector and the economy as a result of restrictions on mortgage credit, many authorities face pressure to loosen mortgage policy instruments, which may erode the financial stability gains that have clearly been the result of the introduction of these policies in the last decade.

We provide novel evidence on the potential consequences of a loosening of macroprudential mortgage policy. Exploiting a policy reform in Ireland in 2017 that affected only a segment of the household sector, we show that macroprudential loosening, through an increase in the maximum LTV ratio on new mortgage loans, causally led to an increase in borrower leverage of 1 percentage point. A typical consequence of increased leverage resulting from looser credit conditions is that house price growth may increase, putting pressure on affordability for all aspirant homeowners. Our research highlights an important adjustment mechanism that can mitigate these risks: borrowers do not necessarily respond to an increase in LTV maxima by increasing their home purchase price. Rather, they can also express preference for more liquid assets in their portfolio, by buying similar priced homes, while posting a smaller downpayment. In this latter case, a macroprudential loosening can lead to higher borrower leverage, improved household liquidity, and minimal effects on the housing market.

Our research design allows us to say that, in the Irish case of policy reform in 2017, the dominant adjustment mechanism was through liquid asset retention, rather than house price appreciation. Downpayment amounts fell by €4K-5K relative to the counterfactual, while we find no evidence that affected borrowers increased their home purchase price. We show that this adjustment was dominant among older borrowers. Our findings in their totality provide an early contribution to a necessary global evidence base on the potential implications of macroprudential loosening that will be an important contribution to any impact assessment being carried out by authorities considering changes to policy calibration.

References

Aastveit, K. A., Juelsrud, R. E., and Wold, E. G. (2021). The household effects of mortgage regulation. Working Papers No 07/2021, Centre for Applied Macro- and Petroleum economics (CAMP), BI Norwegian Business School.

Acharya, V., Bergant, K., Crosignani, M., Eisert, T., and McCann, F. (2020). The anatomy of the transmission of macroprudential policies. NBER Working Papers 27292, National Bureau of Economic Research, Inc.

Adelino, M., Schoar, A., and Severino, F. (2016). Loan Originations and Defaults in the Mortgage Crisis: The Role of the Middle Class. *The Review of Financial Studies*, 29(7):1635–1670.

Aikman, D., Kelly, R., McCann, F., and Yao, F. (2021). The macroeconomic channels of macroprudential mortgage policies. Financial Stability Notes 11/FS/21, Central Bank of Ireland.

Bekkum, S. V., Gabarro, M., Irani, R. M., and Peydró, J.-L. (2019). Take It to the limit? The effects of household leverage caps. Economics Working Papers 1682, Department of Economics and Business, Universitat Pompeu Fabra.

Bernanke, B. S., Gertler, M., and Gilchrist, S. (1999). The financial accelerator in a quantitative business cycle framework. In Taylor, J. B. and Woodford, M., editors, *Handbook of Macroeconomics*, volume 1 of *Handbook of Macroeconomics*, chapter 21, pages 1341–1393. Elsevier.

Berrospide, J. M., Gupta, A., and Seay, M. P. (2021). Un-used Bank Capital Buffers and Credit Supply Shocks at SMEs during the Pandemic. Finance and Economics Discussion Series 2021-043, Board of Governors of the Federal Reserve System (U.S.).

Bottero, M., Minoiu, C., Peydró, J.-L., Polo, A., Presbitero, A. F., and Sette, E. (2019). Expansionary yet different: credit supply and real effects of negative interest rate policy. Economics Working Papers 1649, Department of Economics and Business, Universitat Pompeu Fabra.

Couaillier, C., Lo Duca, M., Reghezza, A., and Rodriguez d'Acri, C. (2022). Caution: do not cross! Capital buffers and lending in Covid-19 times. Working Paper Series 2644, European Central Bank.

DeFusco, A., Johnson, S., and Mondragon, J. (2020). Regulating household leverage. *Review of Economic Studies*, 87(2):914–958.

Foote, C. L., Loewenstein, L., and Willen, P. S. (2020). Cross-Sectional Patterns of Mortgage Debt during the Housing Boom: Evidence and Implications. *The Review of Economic Studies*, 88(1):229–259.

Félix, S., Abreu, D., Oliveira, V., and Silva, F. (2021). The impact of a macroprudential borrower based measure on households' leverage and housing choices.

Gaffney, E. (2018). Residential property price segments and mortgage finance. Financial Stability Notes 11/FS/18, Central Bank of Ireland.

Gaffney, E. (2019). Mortgage borrowers at the loan-to-income limit. Financial Stability Notes 11/FS/19, Central Bank of Ireland.

Gaffney, E. and Greaney, D. (2020). COVID-19 payment breaks on residential mortgages. Financial Stability Notes 5/FS/20, Central Bank of Ireland.

Jimenez, G., Ongena, S., Peydro, J.-L., and Saurina, J. (2017). Macroprudential policy, countercyclical bank capital buffers, and credit supply: Evidence from the spanish dynamic provisioning experiments. *Journal of Political Economy*, 125(6):2126 – 2177.

Kinghan, C., McCarthy, Y., and O'Toole, C. (2019). How do macroprudential loan-to-value restrictions impact first time home buyers? a quasi-experimental approach. *Journal of Banking and Finance*, page 105678.

Kiyotaki, N. and Moore, J. (1997). Credit cycles. *Journal of Political Economy*, 105(2):211–248.

Mian, A. and Sufi, A. (2009). The consequences of mortgage credit expansion: Evidence from the u.s. mortgage default crisis. *The Quarterly Journal of Economics*, 124(4):1449–1496.

OECD (2021). *Strengthening Macroprudential Policies in Emerging Asia*.

Peydro, J.-L., Rodríguez Tous, F., Tripathy, J., and Uluc, A. (2020). Macroprudential policy, mortgage cycles and distributional effects: Evidence from the uk. Working Papers 1183, Barcelona Graduate School of Economics.

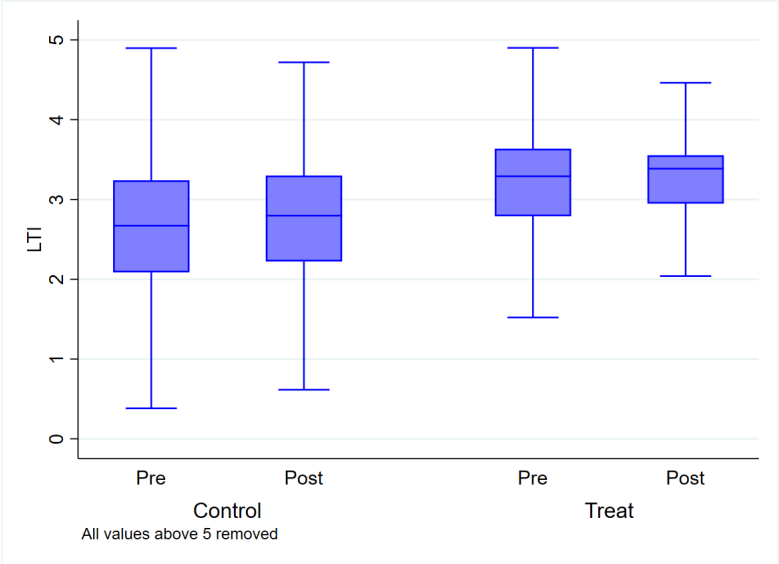
Richter, B., Schularick, M., and Shim, I. (2019). The costs of macroprudential policy. *Journal of International Economics*, 118(C):263–282.

Romer, C. D. and Romer, D. H. (2004). A new measure of monetary shocks: Derivation and implications. *American Economic Review*, 94(4):1055–1084.

Svensson, L. (2019). Amortization Requirements, Distortions, and Household Resilience: Problems of Macroprudential Policy. mimeo 2019, Stockholm School of Economics.

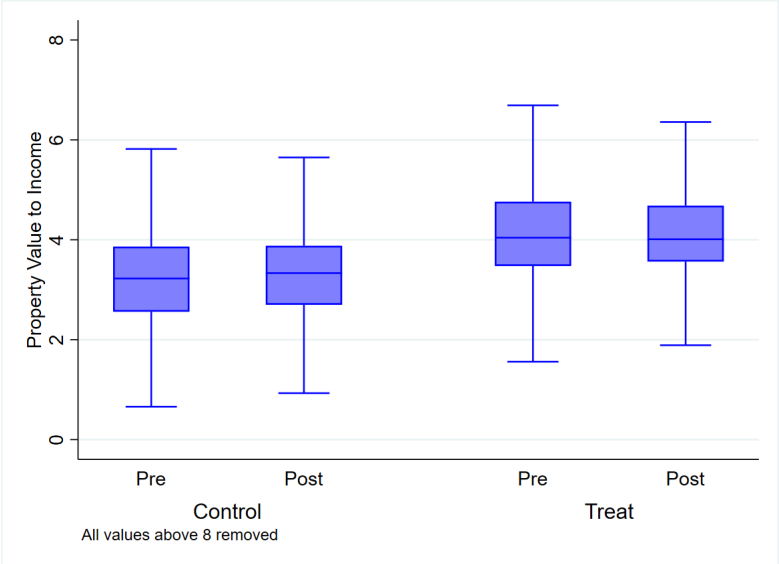
Appendix - Supplementary tables and figures

FIGURE A1. Loan-to-Income ratios did not grow by more for the $Treat$ group



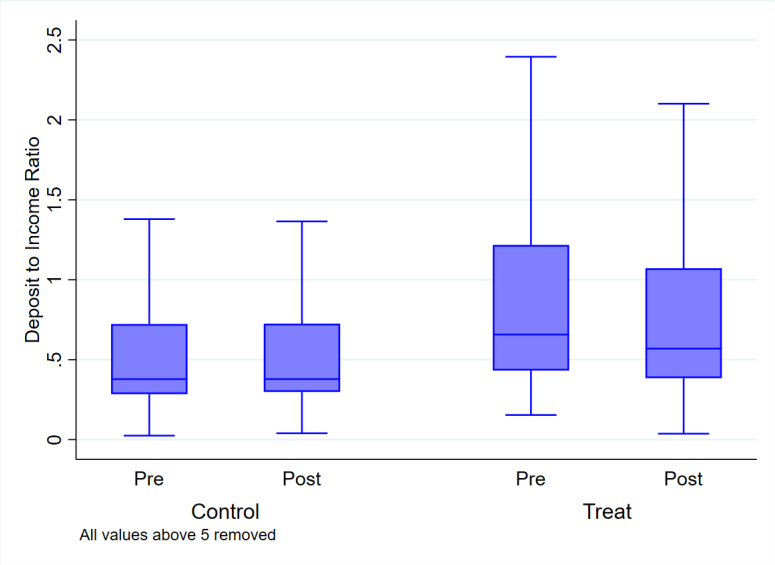
Source: MT data (2015-2018)

FIGURE A2. Price relative to income was flat in the treatment group



Source: MT data (2015-2018)

FIGURE A3. Downpayments also fell by more relative to income in the $Treat$ group



Source: MT data (2015-2018)

TABLE A1. Heterogeneity across quintiles of borrower age; baseline LTV model

	(1)	(2)	(3)	(4)	(5)
Post	-0.609	0.011	0.723	0.301	-0.585
	(0.385)	(0.384)	(0.507)	(0.443)	(0.537)
Treatment	-14.905***	-12.490***	-12.476***	-13.755***	-17.388***
	(0.481)	(0.425)	(0.540)	(0.489)	(0.646)
DiD	0.944	0.535	0.631	1.598**	2.767***
	(0.538)	(0.489)	(0.629)	(0.557)	(0.718)
Observations	7600	9408	6377	8848	6340
r2	0.299	0.235	0.223	0.245	0.339
Bank FE	Yes	Yes	Yes	Yes	Yes
Loan Controls	Yes	Yes	Yes	Yes	Yes
Property Size	Yes	Yes	Yes	Yes	Yes
Borrower Chars	Yes	Yes	Yes	Yes	Yes
County HPs	Yes	Yes	Yes	Yes	Yes

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. $Post$ indicates all loans originated after Jan 1st 2017. Treatment Group is all loans against properties valued above €220K. Borrower characteristics: marital and employment status. Loan characteristics: total household income, LTI and property size. MT data (2015-2018)

TABLE A2. Heterogeneity across quintiles of borrower age; downpayment amounts

	(1)	(2)	(3)	(4)	(5)
Post	1215	-284	-1665	-974	1850
	(1444)	(1600)	(2200)	(1954)	(2256)
Treatment	52192***	43673***	45828***	53897***	68567***
	(1809)	(1772)	(2345)	(2160)	(2721)
DiD	-462	-1426	-5226*	-6348***	-12209***
	(2023)	(2035)	(2730)	(2460)	(3022)
Observations	7593	9402	6367	8831	6318
r2	0	0	0	0	0
Bank FE	Yes	Yes	Yes	Yes	Yes
Loan Controls	Yes	Yes	Yes	Yes	Yes
Property Size	Yes	Yes	Yes	Yes	Yes
Borrower Chars	Yes	Yes	Yes	Yes	Yes
County HPs	Yes	Yes	Yes	Yes	Yes

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. $Post$ indicates all loans originated after Jan 1st 2017. Treatment Group is all loans against properties valued above €220K. Borrower characteristics: marital and employment status. Loan characteristics: total household income, LTI and property size. MT data (2015-2018)

TABLE A3. Robustness: excluding loans approved between January and June 2017

	Leverage ratio	Downpayment	Property prices	Loan size
Post	-0.08*	-519.02	-1350.38	-815.35
	(0.05)	(897.20)	(1042.74)	(537.86)
Treatment	-2.88***	52334.08***	58742.84***	4506.85***
	(0.05)	(965.50)	(1127.27)	(579.17)
DiD	0.63***	-4623.87***	1147.46	5957.54***
	(0.06)	(1147.68)	(1334.05)	(687.76)
Observations	33629	33584	33568	33626
r2	0.182	0.235	0.788	0.913
Bank FE	Yes	Yes	Yes	Yes
Loan Controls	Yes	Yes	Yes	Yes
Property Size	Yes	Yes	Yes	Yes
Borrower Chars	Yes	Yes	Yes	Yes
County HPs	Yes	Yes	Yes	Yes

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Borrower characteristics: marital and employment status. Loan characteristics: total household income, LTI and property size. MT data (2015-2018)

TABLE A4. Robustness: excluding loans in the six months prior and after the implementation date

	Leverage Ratio	Downpayment	Property prices	Loan size
Post	-0.16***	-175.44	-1052.36	-864.74
	(0.05)	(994.77)	(1155.01)	(598.94)
Treatment	-2.90***	52889.40***	58107.02***	3300.23***
	(0.06)	(1156.95)	(1349.08)	(697.05)
DiD	0.63***	-4876.93***	1546.35	6520.64***
	(0.07)	(1292.71)	(1501.35)	(778.10)
Observations	28265	28227	28209	28261
r2	0.179	0.229	0.786	0.913
Bank FE	Yes	Yes	Yes	Yes
Loan Controls	Yes	Yes	Yes	Yes
Property Size	Yes	Yes	Yes	Yes
Borrower Chars	Yes	Yes	Yes	Yes
County HPs	Yes	Yes	Yes	Yes

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Borrower characteristics: marital and employment status. Loan characteristics: total household income, LTI and property size. MT data (2015-2018)

TABLE A5. Robustness: considering PDH and in-scope of regulations loans only

	Leverage ratio	Downpayment	Property prices	Loan size
Post	0.04	-762.21	-1962.02*	-1199.17**
	(0.05)	(895.32)	(1041.13)	(524.18)
Treatment	-2.91***	52235.81***	56899.96***	2561.41***
	(0.06)	(1049.42)	(1224.88)	(614.58)
DiD	0.67***	-5340.12***	-48.26	5360.77***
	(0.06)	(1164.59)	(1354.47)	(681.55)
Observations	35302	35246	35231	35296
r2	0.183	0.232	0.785	0.916
Bank FE	Yes	Yes	Yes	Yes
Loan Controls	Yes	Yes	Yes	Yes
Property Size	Yes	Yes	Yes	Yes
Borrower Chars	Yes	Yes	Yes	Yes
County HPs	Yes	Yes	Yes	Yes

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Borrower characteristics: marital and employment status. Loan characteristics: total household income, LTI and property size. MT data (2015-2018)

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