

IARIW – BANK OF ITALY 2023

Wednesday, March 29 - Saturday, April 1

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Paper prepared for the Conference on Central Banks, Financial Markets, and Inequality March 29 – April 1, 2023

Session 5: Distributional Effects of Central Bank Policies

Time: Friday, March 31, 2023 [9:00-10:30 AM CEST]

Asymmetric effects of borrower-based measures on household access to finance and default

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This paper aims to uncover the asymmetric effects in terms of access to finance determined by the implementation of macroprudential borrower-based measures, using a rich dataset which combines credit registry data with household income records. Based on microdata at debtor-level, our results reveal that the macroprudential tightening of LTV limit in November 2011 in Romania did not constrain access to finance for low-income debtors, while reducing the flow of new loans to high-income debtors and those with larger amounts at origination. Furthermore, the regulation was successful in supporting loan origination in RON-denominated loans. From a probability of default perspective, the regulation led to a reduction in the probability of default for RON-denominated loans, while the probability of default for foreign currency standard mortgage loans increased. Concurrently, we analyze impact of a 5-year maturity that was implemented for consumer loans in the same period. We observe that loan issuance to higher income debtors, as well those who contracted larger loans, experienced a contraction, while origination of loans to low income debtors was unaffected. The introduction of a maturity cap for consumer loans did not impact the probability of default for unsecured consumer loans, however its introduction led to an important increase in the probability of default for secured consumer loans.

JEL codes: G51, E58, C35, D14.

1. INTRODUCTION

Macroprudential policies objective is to mitigate systemic risk by creating a space to maneuver in case of systemic shocks through buffers that absorb the impact. These tools can be addressed to financial institutions and affect credit supply (like countercyclical capital buffers) or directed at borrowers and impacting the credit demand (like loan-to-value ratios, LTV or debt service-to-income ratios, DSTI). Financial stability practice highlights two categories of borrower-related risks: (a) risks associated with collateral value, and (b) risks concerning debtors income and their debt servicing capacity. The existing literature explores, from multiple perspectives, the effects of macroprudential policies, both on the financial sector and the real economy, although there is no consensus on this topic.

Experience so far showed that borrower-based measures has a direct effect on bank loan extension, with income-based DSTI limits being more effective in reducing credit growth than the value-based LTV limits (Malovaná et al, 2022). Loose credit standards, such as lower down-payments and higher or no debt-service-to-income limits, expand the access to finance for households by increasing the pool of eligible debtors and allowing those accepted to take out higher amounts. While these effects will increase affordability for households in the short run, in the medium and long run, looser credit standards fuel appreciation of house prices (Kelly et al., 2018; Anenberg et al., 2017), thus forcing debtors to take on higher debt in order to afford a similar home. However, as the subprime mortgage crisis has shown (Mian and Sufi, 2019), these short term gains may be overshadowed in the long run if borrowers have an untenable level of debt in relation to their income, thus becoming unable to service their monthly instalments.

In the aftermath of the global financial crisis, started in 2007-2008, central banks and regulators responded by increasingly relying on macroprudential instruments to strengthen financial stability. Extensive evidence shows that borrower-based macroprudential policies are effective in moderating the amplitude of credit and asset price cycles (Kuttner and Shim (2016) , Cerutti et al. (2015), Claessens et al. (2013), Richter et al. (2018), Alam et al. (2019), Araujo et al. (2020)). As these papers rely on aggregate data, they cannot identify which categories of the population are most affected by macroprudential measures. However most empirical studies have focused on the potential benefits of macroprudential policies, while the potential costs have received less attention. Macroprudential instruments may have welfare costs, such as restricting access to credit and access to the financial market in a broader sense and could slow down economic growth in the short run (Richter et al., 2019). Additionally, DNB (2015) show that introducing a stricter LTV limit would postpone the decision of purchase for firsttime home buyers, as they would require additional savings, thus putting extra pressure on the rental market, leading to a slow-down in house prices and residential investment. Another conclusion documented in the literature is that the exact moment of macroprudential action implementation is of increased significance, with tighter regulation ahead of a crisis reducing income inequality and mitigating the effects of a financial crisis, proving an increase in the financial sector resilience (Malovaná et al., 2023). On the other side, macroprudential policies can contribute to greater inequality on the strength of its negative effects on housing credit and price growth.

Over the past years, studies employing granular micro-data have appeared, focusing on the drivers for default of debtors. Many have focused on the ability-to-pay hypothesis, demonstrating that default is associated with a higher level of indebtedness or a negative income shock (McCarthy (2014), Kelly and O'Malley (2016), Kukk (2021)). Nier et al. (2019) highlight there is a non-linear relationship between DSTI and the probability of default, with probability of default responding to increases in DSTI only above a 50% level for mortgages and 30% for consumer loans. Similarly, O'Toole and Slaymaker (2021) find that changes in DSTI have a stronger effect on default for highly indebted individuals, while shocks to DSTI have a larger impact on borrowers' payment discipline during crisis periods. Other have focused on the dual-trigger hypothesis: that debtors face a combination of affordability and negative equity shocks (Connor and Flavin (2015), Gerlach-Kristena and Lyons (2018), Byrne et al. (2017), Linn and Lyons (2019)).

Our paper is part of the growing body of literature which utilizes microdata to study the implications of macroprudential actions, bringing to light its asymmetric effects depending on borrower characteristics and show-casing its distributional consequences. Tzur-Ilan (2020) analyzes the introduction of LTV limits in Israel in 2010 and 2012 using loan level microdata. According to their results, the LTV limit measure resulted in changing borrowers preference to more affordable dwellings, located far from city center in less advanced areas, with investors experiencing a stronger effect compared to first-time home borrowers. Acharya et al. (2019), using data on loans in Ireland to study the impact of LTV and LTI, shows that mortgage loans are reallocated from low-income to high-income borrowers and from urban to rural area borrowers. Peydro et al. (2020) show that low-income debtors were affected to a greater extent by the LTI cap imposed in 2014 on UK mortgage lenders, with effects both on intensive and the extensive margin. Van Bekkum et al. (2019) focus on the implementation of LTV ratio limits in Netherlands in 2011 by connecting credit registry data with administrative information regarding ownership records and income. They find a stronger impact on LTV of newly issued loans for liquidity-constrained households and first-time homebuyers. Furthermore, lower leverage has a positive effect on borrower resiliency, as they are better able to absorb a negative income shock. Aastveit et al. (2020) find similar results in the case of Norway on the effectives of LTV limit on the extensive and intensive margin, however according to their results households are more vulnerable to an income shock after purchasing a home with a higher down-payment as this depletes their liquid assets. Giannoulakis et al. (2022) extend Gross and Poblacion's (2017) framework and prove that borrower-based measures are more effective when implemented jointly and the effect is stronger for low-income and low-wealth debtors. In addition, Kinghan et al. (2019) find that the LTV limit introduced in Ireland in 2015 impacted high income borrowers to a greater extent, while low income borrowers did not experience reduced leverage after the introduction of the regulation, as a stricter LTV limit was placed for loans above 220,000 euros. More recently, Hodula et al. (2022) obtained, using machine learning methodology on loan-level survey data in Czech Republic, that LTV limits determined a reduction in average loan size, an increase in interest rate on newly granted loans and also an increase in collateral value after their introduction. It is worth mentioning that LTV limits did not mitigate the risks in the mortgage loan market sufficiently, thus additional recommendations on borrower income-based limits (DTI and DSTI) were issued. The estimates showed that additional DTI and DSTI caps, alongside the LTV limits put into effect before, significantly and more effective than the LTV limits alone, reduced the average mortgage loan size over twenty times. Our paper is closer to the methodology in Abreu et al. (2021), in which based on credit register data from Portugal and difference-in-difference estimations, the authors show that the LTV limit introduced in 2018 constrained loan value and lowered loan-to-income ratios as well as households leverage.

Additionally, theoretical frameworks provide an important starting point evaluating the asymmetric effects of macroprudential policies on heterogeneous agents, given the lack of access to micro data in many jurisdictions (Punzi and Rabitsch (2017), Rubio and Unsal (2017), Gete and Reher (2016)). Others combine calibrations from survey data with DSGE modelling to construct micro-macro simulation models in order to evaluate the impact of macroprudential tools on households, the economy and the banking sector (Gross and Poblacion, (2017), Jurča et al. (2020), Reichenbachas (2020), Gross et al. (2022), Ampudia et al. (2021)).

The present paper analyses the consequences of macroprudential policies on access to finance, loan volumes and default. We take advantage of Romania's rich history with debtor based macroprudential instruments and focus our analysis on the implementation of currency-differentiated LTV caps for mortgage loans and consumer loans maturity restriction in 2011. We utilize a unique debtor-based dataset which combines information regarding loan characteristics and default, with income data from the Ministry of Finance.

In the first place, the granular debtor-level data is consolidated at bank level and using a quarterly panel model we are able to evaluate the probability of a debtor being granted a loan, before and after the macroprudential regime was changed. Finally, we evaluate debtors' default behavior, using a logit model, by monitoring them for 3 years after the origination of the loan. As we observe income on an annual basis, we are able to control for transitions to unemployment and changes to salary, as well as for debt-service shocks due to changes in interest rates of fluctuations of the exchange rate.

To our knowledge, this is a unique paper that studies a rather novel but of high importance field for which empirical evidence is still scarce, specifically the impact of macroprudential policies on access to finance using microdata from the credit register, as well as their impact on debtors' payment discipline rate. In order to emphasize the effects of our investigated macroprudential actions, we also present a counterfactual analysis, including scenarios that reflect the situation in which the structure of the loans granted remains unchanged. We apply an income correction for each age bracket to debtors in the first year included in our sample in order to match the evolution between the two samples. Using incomes thus updated, we create an estimated probability of accessing a loan, providing us with an image of the amount and size of loans that would have been granted in the absence of the regulation.

We complement existing literature using credit registry data from Romania. Our approach is closely related to Epure et al. (2018) who study the impact of macroprudential policies between 2004 and 2012 on loan amounts and find that tightening of macroprudential conditions is associated with a decline in average loan amounts to households, especially for riskier

foreign currency loans and for borrowers with higher DSTI ratios. We extend their research by analyzing the impact of macroprudential policies on the extensive margin, controlling for the selection bias on the impact of the amount at origination, as well as including consumer loans bellow 4,000 Euros from the Credit Bureau, thus giving a complete assessment of borrowers' indebtedness. Furthermore, we also control for access to finance by debtor's income category, thus being able to identify asymmetries in the transmission mechanism of macroprudential policies on credit demand. We also complement Neagu et al. (2015), which using aggregate credit registry data on a bank level for Romania between 2003 and 2012, find that borrower based measures are effective in reducing credit growth, but the impact lasts only for one year. Additionally, they find that the period of self-regulation was associated with a deterioration in the quality of loans granted. In the present paper we go further by analyzing how specific income categories have been affected, both in terms of loan issuance, as well as payment discipline.

Finally, our paper is one of the few works utilizing panel credit registry data over multiple years. Similar to our work is also Mocetti and Viviano (2017) who utilize panel data from Italy credit register and tax records for loans granted between 2005 and 2011 showing that stricter credit standards in the aftermath of the Global Financial Crisis led to a halving of the delinquency rate. Additionally, Kukk (2021) deploys a panel approach based on Estonian credit registry data for loans granted between 2005 and 2011, demonstrating that lower income and higher debt service ratio borrowers are likely to have a higher probability of arrears.

Our findings show that the (re)introduction of hard LTV limits in 2011 did have a restrictive effect in terms of overall access to mortgage credit. However, we observe significant heterogeneous effects by currency, income category and loan amount. Overall, the probability of being granted a mortgage loan was unchanged for low-income debtors. In contrast, the average probability of accessing a loan fell for high-income debtors. The measure was also successful in supporting lending in national currency given the stricter LTV limits for foreign currency denominated loans. In addition, larger amount loans were affected to a greater extent.

As respects the impact of the maturity cap for consumer loans implemented alongside the LTV limit for housing loans, the measure led to a significant decrease in the probability of accessing both secured and unsecured consumer credit, as well as to a reduction in the amount granted if accepted. Again, debtors with higher incomes experienced the strongest decreases.

However, in a context of deteriorating macroeconomic environment, the average probability of default for standard mortgage loans granted under the new regime worsened compared to the no-policy regime, due to a deterioration of payment discipline for FC-denominated loans. In terms of income category, the probability of default increased only for those with incomes between the 50th and the 90th percentile. This shows that the regulation was able to support mortgage lending to low-income debtors without increasing the risks, despite a challenging macroeconomic environment.

In terms of our probability of default model, we find that the introduction of the currency differentiated LTV limit led to a reduction in the probability of default for RONdenominated mortgage loans, while the probability of default for foreign currency loans increased. In terms of income category, middle-income debtors experienced a deterioration of payment discipline, while the probability of default for other income categories was stable.

On the consumer credit side, the introduction of the 5-year maturity cap did not impact the probability of default for unsecured consumer loans, however its introduction led to an important increase in the probability of default for secured consumer loans. This impact on banks' balance sheets was more than offset by the significant reduction in new loan volumes.

The rest of the paper is structured as follows. A data section describing the macroprudential measure implemented in Romania, stylized facts regarding the real estate market as well as information with respect to data used in the empirical analysis and the estimation procedure. Section 2 presents methodological notes and Section 3 reports the results, while the last section concludes.

Policy background 1.

Romania has a rich history of implementing macroprudential measures starting in 2004, when limits on DSTI and LTV were first introduced. The maximum level of indebtedness was set at 30% for consumer loans, 35% for mortgage loans and a 75% LTV ratio for mortgage loans (Figure 1). However, from 2004 to 2007 Romania witnessed a period of rapid increase of indebtedness, with the nominal value of household debt increasing almost ten-fold within that period, household debt to GDP increasing from 4 percent to 17 percent,

In 2007, when Romania joined the European Union, hard limits on debtor indebtedness and loan-to-value were seen as administrative measures that could impair proper market functioning, therefore a new regulation paradigm was implemented focused on self-regulation, as credit institutions were required to establish through internal regulations the maximum level of indebtedness based on the debtors' risk profile.



Figure 1. Timeline of NBR's macroprodential tools and credit evolution

Source: National Bank of Romania, own calculations

Foreign currency lending remained a concern in the aftermath of the financial crisis of 2007-2008: compared to the regional peers, Romania had the highest proportion of foreign currency loans in the period before 2012 (of over 60% compared to less than 40 percent in Bulgaria or Poland), which translates in highly exposed debtors to mounting currency risk. This vulnerability materialized from the onset of the financial crisis in 2007, when the national currency (RON) experienced a massive depreciations of nearly 30% against the euro in the timeframe July 2007-March 2009, a much more pronounced evolution than in Poland (-18%) or Hungary (-19%). This development exacerbated the negative impact of the Global Financial Crisis, as debtors had limited resilience to absorb any negative income shocks, thus the probability of default increased significantly for both consumer and mortgage loans. Additionally, after a period of rapid house price appreciation to the financial crisis of 2007-2008, unfavorable developments in real estate market made it harder for debtors to maintain a prudent level of the risk indicators in the following 2009-2011 period, given that house prices in Romania experienced the third largest fall in Europe (-35 percent March 2011 versus March 2008) after Ireland (-52 percent) and Latvia (-43 percent). This significantly increased the number of debtors with negative equity, putting additional strain on household payment discipline.

Given that Romania has one of the highest homeownership rates in Europe (93 percent for the period 2007-2013), only 4 percent of the working population had an outstanding mortgage loan, while access to consumer loans was much more prevalent with around half of the population having such a loan. However, it is worth mentioning that there exist significant differences in terms of access to finance between income categories. Around 8 percent of population with incomes in the upper percentiles (above the 90th percentile) have a mortgage loan, compared to less than 1 percent for those with income bellow the median (Figure 2). The difference is less pronounced for consumer loans, however there still exists a 20 percentage point gap between the highest income earners versus those with incomes bellow the median(45 percent versus 25 percent) (Figure 3). As a result, around 40 percent of mortgage loans are held by those with incomes above the 90th percentile, while for consumer loans the figure is around 25 percent.





with consumer loans by income percentile



Source: Ministry of Finance, National Bank of Romania, Credit Bureau, own calculations

Source: Ministry of Finance, National Bank of Romania, Credit Bureau, own calculations

In this context, in November 2011 the National Bank of Romania introduced a hard LTV limit, as well as a maturity cap for consumer loans. Following the recommendation of the European Systemic Risk Board regarding foreign currency lending and the recognized systemic risks of the banking sector, distinct LTV limits were established in November 2011, depending on the borrowers' characteristics (hedged or unhedged) and on the currency the loans are denominated. The LTV caps were introduced for all new loans, except for "First Home" government program. The LTV ratio was capped as follows: (i) 85% for leu-denominated credit; (ii) 80% for foreign currency-denominated housing loans to hedged borrowers; (iii) 75% for EUR-denominated housing loans to unhedged borrowers, and (iv) 60% for housing loans in other currencies extended to unhedged borrowers. Consumer credit maturity was restricted to five years in order to prevent household over-indebtedness and ensure that debtors were not utilizing these loans for long-term investment purposes.

2. DATA

In order to assess the impact of macroprudential instruments on borrower's access to credit market, we use debtor-level data from the Central Credit Register, covering all consumer or housing loans above RON 20,000 (around EUR 5,000 equivalent) on banks' balance sheets. The credit registry has detailed information regarding loan characteristics such as month and year of issuance, amount at origination and outstanding amount, residual maturity and maturity at origination, as well as currency or interest rate of the loan. Given this information, we calculate the monthly instalment using the constant annuity assumption. Personal information regarding debtors are also available, including age and county of residence. Alongside the Credit Register, a private Credit Bureau was in place at that time, allowing us to include in our analysis unsecured consumer credit loans as well. The Credit Bureau was founded in September 2008 and covers all household loans.

Our sample starts with Q4 2010, a full year before the implementation of the analyzed regulation, in order to control for changes in access to credit. As the First Home governmentprogram was already in place back then, we differentiate debtors by the type of mortgage loan they have taken out (standard loan vs. First Home), while also controlling for additional consumer loans. First Home loans represented around a third of the new loans granted between 2009 and 2012¹, increasing to 50% of new loans in 2012 as the government increased the allocated funding for the project. Our control group for the self-regulation period spans Q4 2010 to Q3 2011, the transition period is Q4 2011 to Q1 2012, while the sample for evaluating the efficiency of the measures spans Q2 2012 to Q1 2013. Loans granted in the transition period (Q4 2011 to Q1 2012) are not included in the estimation sample.

Firstly, we consolidate at debtor-level all loans taken out by a borrower within a year, excluding refinanced and restructured loans and then we construct a residual maturity and current interest rate average weighted by outstanding amounts. Finally, we divide debtors by the type of loan granted (mortgage loan vs. secured consumer loan vs. unsecured consumer

¹ In 2009, a social governmental program (called "the First Home") is introduced in an attempt to support the rebound of mortgage lending, providing 80% state-guarantee for the issued loans. Debtors benefited from lower financing costs compared to regular mortgages and the minimum down-payment was 5%. In order to qualify for a First Home loan, debtors were not allowed to own any properties and the maximum amount was capped at 67,500 Euros.

loan) and amount bucket. We introduce this specification as it allows us to better identify how access to finance in both the extensive, as well as the intensive margin, has changed after the switch in the regulation. Debtors that already had loans outstanding exceeding one third of the newly granted amount were excluded.

In order to evaluate debtors' financial standing and access to credit in respect to the general population, we intersect data on newly issued loans with yearly tax records from the Ministry of Finance. These records cover all households that pay income tax within a fiscal year, thus includes both self-employed, as well as salaried employee. We divide debtors into four income categories: those bellow the 50th percentile (low income), those with incomes between the 50th and the 75th percentile, those with incomes between the 75th and the 90th percentile and those with incomes above the 90th percentile. Given that we control for income category, this is an important determinant of demand for loans. If there exists a fall in overall demand for loans, we should observe a parallel shift in probability of being granted a loan for all income categories. Moreover, we also divide debtors based on age: bellow 30 years, between 30 and 35 years, between 35 and 40 years and above 40 years. Especially for mortgage loans, age is a very poignant indicator for loan demand as younger debtors are more likely to start a family and purchase a home. However, these debtors tend to have lower incomes and smaller savings, thus can be affected to a greater extent by the introduction of an LTV limit. Finally, we also categorize debtors by gender.

i. Access to finance dataset

For our access to finance dataset, the no policy period, spanning the period between 2010 Q4 and 2012 Q3, contains 369 thousand new loan observations, out of which 11,4 thousand are standard mortgage loans, 16,7 thousand "First Home" loans, 16,7 thousand secured consumer credit and 324 thousand unsecured consumer loans (Table i. 1).

The introduction of the LTV limit in November 2011 led to a decrease in the number of standard mortgage loans that were granted in the following year (-39% - no policy period 2010 Q1 – 2011 Q3 versus policy period 2012 Q2 – 2013 Q1). The decrease was caused by FC-denominated loans which fell by 55%, while RON-denominated loans more than doubled. As a result, the share of RON-denominated newly-issued loans rose from 6% to 33%. Thus, we observe that the regulation provided an important incentive for domestic currency mortgage-financing, thus decreasing exposure to any future currency depreciation. "First Home" loans, which were not under the purview of the regulation, increased by 50%. These loans were almost exclusively denominated in Euro due to the significant interest-rate differential (~3,5 percentage points). The 5-year maturity cap had a significant effect on secured consumer loans (-81%) and, to a lesser extent, on unsecured consumer loans (-19%). The maturity cap also encouraged debtors to take out consumer loans in the local currency, thus the share of newly issued RON-denominated loans increased from 18% to 49%.

Approximately half of mortgage debtors have incomes above the 90th percentile, while only 14 percent are in the bottom 50 percent of the distribution. Debtors between the 50th percentile and the 90th percentile make up 40 percent of loans. The divergence is less pronounced for First Home loans: debtors above the 90th percentile make up around a third of the portfolio. Debtors with unsecured loans have the lowest incomes, with around a third with incomes below the median and only 15 percent above the 90th percentile, while the income distribution of secured loans is similar to First Home loans.

Regarding the amount at origination, around 30 percent of mortgage loans are between 22,500 Euros and 45,000 Euros, and only 9% are above 60,000 Euros. The average amount for a standard mortgage loan was relatively stable across the two policy regimes (~48,500 Euros). For First Home loans, the maximum property value is 75,000 Euros for new apartments, 60,000 Euros for apartments older than 5 years, thus the average amount was slightly lower compared to standard mortgage loans (~40,000 Euros).

Secured consumer loans previous to the policy intervention had an average maturity of 18.5 years and 38,900 Euros average amount. This was significantly affected by the maturity cap, which led to a reduction of the average maturity to 8.5 years and to an average amount of 17,200 Euros. As expected, unsecured consumer loans have the lowest amounts at origination during the no-policy period (~8,300 Euros). This reduced by ~1.100 Euros as a result of the introduction of the maturity cap.

ii. Default dataset

In order to measure default, we track debtors that have taken out a loan in a specific quarter for 8 quarters starting 1 year after the origination of the loan. Each specific quarter is presented as a distinct observation in the logit model. We define a debtor as having defaulted if the repayment on any of their loans outstanding within that specific quarter has a delay greater than 90 days. This allows us to identify if a negative credit event occurs for any of the loans taken out, which is relevant for debtors with multiple loans. We also track changes in debtor's income by performing an intersection with the income database from the Ministry of Finance, allowing us to control for changes in their revenues after loan origination. If a debtor has no loans outstanding, given that they have repaid in advance or the loan has matured, they are no longer included in the logit sample for the following quarters. Once a debtor has been classified as defaulted on a loan during a certain quarter, he will be excluded from further vintages. Additionally, if debtors take on new loans, exceeding 33% of the existing outstanding amount, they will also be excluded from the sample as their current level of indebtedness, as well as loan characteristics, are no longer representative of the credit conditions at origination.

The dataset contains approximately 1,1 million unique debtors, out of which 990 thousand are unsecured consumer loans, 22 thousand standard mortgage loans, 44,8 thousand First Home loans and 38 thousand secured consumer loans. Around 52 percent are issued during the prior self-regulation period, and 48 percent after the introduction of the new macroprudential measures.

Overall, "First Home" loans have the lowest probability of default for the entire period (0,13%), in line with literature that emphasizes the superior creditworthiness of first time homebuyers. Standard mortgage loans have an average probability of default of 0,38%, while for secured consumer loans it is 0,9%. The highest probability of default is observed for unsecured loans (1,47%). The mean probability of default of loans after the new macroprudential regulations were implemented increased compared to the previous regime for standard mortgage loans (0.47% versus 0.32%), as well as secured consumer credit (1.3% versus 0.58%), while it has was stable for "First Home" loans and unsecured consumer loans.

Important differences in terms of default between currency of denomination can be observed for mortgage loans (0,39% compared to 0,3%), while for secured consumer loans, RON-denominated loans have a higher probability of default (1.1% versus 0.7%).

3. METHODOLOGY

We employ debtor-level microdata to assess the impact of macroprudential policy tools on access to finance on the extensive margin (the probability of being granted a loan) and on the intensive margin (conditional on acceptance, the amount granted). Finally, we evaluate the impact of macroprudential policy on the resilience of debtors via their probability of default.

The baseline model utilized to measure the impact of macroprudential policies on households' access to finance is a quarterly bank level panel, where the dependent variable $x_{ivrfxav}$ measures the share of debtors in each gender, income and age bucket which took out a loan from a specific bank within that quarter, differentiated by currency and amount at origination:

$$\begin{aligned} x_{ivrfxav} &= \beta_0 + \pmb{\beta_1} Policy \ dummy + \beta_2 \ income_cat_v + \\ \beta_3 age_cat_r + \beta_4 currency_{fx} + \beta_5 \ amount_cat_a + \\ + \beta_6 gender_v + Bank \ FE \\ + \ Quarter \ FE + \ \varepsilon_{ivrfxav} \end{aligned}$$

We estimate four different models, by credit type: standard mortgage loan, "First Home" mortgage loan, secured consumer credit and unsecured consumer credit. This allows us to thoroughly analyze the impact of the LTV limit, the potential transfers of debtors from standard housing loans to the social program "First Home" and also the extent to which the maturity cap had a differential effect by loan type. We have decided upon this empirical strategy as it captures the decision process of the household who can choose between different types of loans depending on their financing needs.

The extended models, separately for housing and consumer loans, we also take into consideration interactions between currency, loan amount, income category and age category, in order to evaluate potential asymmetric effects of regulation on different borrowers:

$$\begin{aligned} x_{ivrfxav} &= \beta_0 + \sum_{v=1}^{T} \theta_v \text{ Policy dummy} + \beta_2 \text{ income}_{cat_v} + \\ \beta_3 age_{cat_r} + \beta_4 currency_{fx} + \beta_5 \text{ amount}_{cat_a} + \\ + \beta_6 gender_v + Bank FE \\ + Ouarter FE \end{aligned}$$

In order to determine the counterfactual probability of being granted a loan we employ a two-step procedure. First of all, we analyze the way the medium income has changed between the two different years of origination. We apply the income correction for each age bracket to debtors in the first year of our sample. Finally, using our updated incomes for the initial year, we create an estimated probability of being granted a loan with the dummy for the initial year, which controls for other changes besides household income.

The second model we deploy is a logit model utilized to quantify the impact of the discussed macroprudential measures on default. The dependent variable $X_{i,t,j}$ is equal to 1 if the debtor had any delay in installment payment greater than 90 days during the specific quarter *t* for debtor *i* with loan type *j* and 0 otherwise:

$$\begin{split} X_{i,t,j} &= \alpha_0 + \alpha_1 * \text{Policy dummy}_t + \alpha_2 * \text{Income dummy}_{i,t} + \\ &+ \alpha_3 * Age_{i,t} + \alpha_4 * DSTI_{i,t,j} + \alpha_4 * Amount_{i,t,j} \\ &+ \alpha_5 * \text{Interest rate}_{i,t,j} + \alpha_6 * \text{Residual maturity}_{i,t,j} + \\ &\alpha_7 * \text{Currency}_j + \alpha_8 * \text{Quarters from origination}_{i,t,j} + \\ &\text{Bank FE} + \text{County FE} + \varepsilon_{i,t,i} \end{split}$$

where j refers to loan type (standard mortgage loan, First Home loan, unsecured consumer loans or secured consumer loan) Using a logit model is a standard approach for micro-data in order to determine the impact of borrower characteristics on default, widely used in papers, as for example in Connor and Flavin (2015) or Nier et al (2019).

Finally, in order to evaluate any non-linear effects of currency denomination of the loan, and income category, after a change in the macroprudential regime, we perform interactions between the specific dummy variables and the policy regime at origination:

4. **RESULTS**

i. Access to finance model

We find that the introduction of the LTV limit led to a 30 percent reduction in the average share of households being granted a mortgage loan (Figure 4), while First Home loans, which were not under the purview of the regulation, fell by 25 percent (Figure 42).

Figure 4 Average probability of being granted a mortgage loan





As expected, the measure had diverging effects by currency, supporting standard mortgage loans denominated in RON (+30 percent), while the estimated probability of being granted a foreign currency-denominated mortgage loans fell by 40 percent. Our results are in line with Epure at al. (2018) findings, showing that tighter macroprudential conditions are associated with a decrease in the volume of household credit, especially for foreign currency loans.

On the other hand, the maturity cap led a significant decrease in access to finance for debtors taking out secured consumer loans (-66%) (Figure 43), while having a stronger effect for FC-denominated loans (-78%) compared to RON-denominated secured loans (-48%), The impact on unsecured consumer loans was more contained, with the average probability of being granted a loan decreasing by 22% (Figure 4) (Table i. 2).



As we are interested in determining whether macroprudential measures had a differentiated effect based on income categories, we also run a interaction of the policy-period dummy with the income category dummies (Table i. 3). Overall, access to finance for mortgage loans for debtors with average salary below the 75th percentile was stable, indicating that access to finance for low- and medium-income borrowers was not affected (Figure 4). On the other hand, in the case of debtors with incomes above the 90th percentile wage, the predicted probability of being granted a loan fell significantly (-45%), while the impact was more muted for those with incomes between the 75th and 90th percentile (-23%). The evolution of First Home loans was similar, with the share of debtors above the 90th percentile falling by 34 percent, while those bellow were not affected. Given that loan issuance fell for both types of mortgage loans, this indicates a reduced regulatory leakage for high-income borrowers which could benefit from lower down payment under the First Home program.



For consumer loans we see that the probability of being granted such a loan decreased for those with incomes above the 75th percentile, with those above the 90th percentile experiencing the largest decrease (-80 percent) (Figure 10). Similar to mortgage loans, those with incomes bellow the 75th percentile were not impacted. In the case of unsecured consumer loans, we observe a similar pattern, with debtors above the 75th percentile experiencing important decrease in the probability of being granted a new loan (-35 percent) (Figure 11).

Figure 10 Average probability of being granted a secured consumer loans, by income level





The impact of the 2011 macroprudential policy regime on the loan value, given that the debtor was selected for accessing finance, was also tested by interacting the policy dummy with the amount at origination dummy. Issuance of standard mortgage loans with loan amounts bellow 30,000 Euros at origination declined by 20 percent in comparison to -40 percent for other loan amount brackets (Figure 12). Furthermore, First Home loans between 50,000 Euros and 70,000 euros declined by 17 percent, showing the lack of regulatory leakages from standard mortgages, while other issuance in smaller loan brackets was stable (Figure 13).







The maturity cap significantly reduced the origination of consumer loans with larger amounts: issuance of secured loans with amounts bellow 15,000 Euros was relatively stable, while those with amounts higher than 30,000 Euros fell by 80 percent (Figure 14). A similar pattern is observed for unsecured loans where loan issuance with amounts bellow 3,000 Euros were not impacted, while those above 5,000 euros shrank by 50 percent (Figure 15) (Table i. 4)

Figure 14 Average probability of being granted a secured consumer loans, by amount interval

Figure 15 Average probability of being granted an unsecured consumer loan, by amount interval



ii. Probability of default model

Analyzing the impact of the newly introduced macroprudential measures on default, we observe a deterioration in the average probability of default for standard mortgage loans issued when the LTV limit was in place (+45%) compared to the no-policy period, while the evolution of First Home loans has been stable (Figure 16) (**Table ii. 1**) Given that the number of newly issued mortgage loans decreased by 38%, the overall expected loss for banks fell by 9 percent. The regulation was successful in supporting mortgage loans denominated in RON during the policy implementation period, thus it is important to note that the probability of default for these loans is decreased by around 50%, compared to the previous policy regime, while for FC-denominated mortgage loans, it increased by around 80% (Figure 16). Thus we can observe that the increase in the average probability of default was caused by FC-denominated loans, which still represent an important proportion of the sample.

In the case of secured consumer loans, due to the inelastic demand of risky borrowers, the average probability of default under the new regime increased by 130 percent. However, given that the number of newly issued secured consumer loans decreased by 80 percent in the policy-regime compared to the no-policy regime, the overall impact is a reduction of 60% for banks' expected loss. The introduction of the maturity cap of the for unsecured consumer loans the introduction of the maturity cap did not lead to a change in the average probability of default.

Figure 16 Average probability of default by macroprudential regime and loan type

Figure 17 Average probability of default by macroprudential regime and currency for standard mortgage loans



Going in depth regarding the interaction between payment discipline and income for mortgage loans, we observe that the deterioration for standard mortgage loans was mainly due to debtors with incomes between the 50th and the 90th percentile, while the probability of default was not significantly higher for other income categories (Figure 16) (Table ii. 3). In case of secured consumer loans, the largest increases in the probability of default are observed for debtors with incomes below the median and those with income between the median and the 75th percentile. Finally, in the case of consumer loans, the probability of default was stable across all income categories.

Figure 18 Average probability of default by macroprudential regime by income category – standard mortgage consumer loans

Figure 19 Average probability of default by macroprudential regime by income category – secured consumer loans



5. CONCLUSION

Empirical evidence regarding the asymmetric effects of macroprudential policies is still scarce, given the relative novelty of such instruments, as well as the challenges regarding granular data. In this paper we utilize a novel dataset which combines credit-registry information and data regarding tax returns to analyze the consequences of macroprudential policies on extensive and intensive margin, as well as debtor's payment discipline. Our paper is one of the few works which utilizes such granular data over multiple years.

Using a rich dataset which combines credit registry data with household income records, our paper aims to uncover the asymmetric effects in terms of access to finance determined by the implementation of macroprudential borrower-based measures. Based on granular debtor-level data, our results reveal that the implementation of a LTV limit in November 2011 did not impede access to finance for low-income debtors, while reducing the flow of new loans to high-income debtors and those with larger amounts at origination. The regulation was also successful in supporting lending denominated in the local currency. Furthermore, the probability of default for RON-denominated loans issued after the regulation was in place decreased, showing that it improved borrower resilience.

Concurrently, we analyze the impact of a 5-year maturity cap that was implemented for consumer loans in the same period. In a similar manner, we observe that higher income debtors, as well those who contracted larger loans, experienced the strongest reduction in terms of access to finance, while low income debtors were unaffected. The introduction of a maturity cap for consumer loans did not impact payment discipline for unsecured consumer loans, however its introduction led to significant deterioration in the probability of default for newly issued secured consumer loans, especially for low income borrowers. However, the negative impact of higher probability of default on banks' balance sheets was more than offset by the significant reduction in new loan volumes.

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7. ANNEX 1 Descriptive statistics

i. Access to finance dataset

Table i. 1 Number of debtors by loan type

	Standard mortgage	First Home	Secured consumer loan	Unsecured consumer loan	Total
No policy	11,457	16,772	16,749	324,823	369,801
Policy implementation	7,130	24,989	3,147	262,066	297,332
Total	18,587	41,761	19,896	586,889	667,133

Table i. 2 Share of loans denominated in foreign currency by loan type

	Standard mortgage	First Home	Secured consumer loan	Unsecured consumer loan
Dec-10	94%	99%	87%	5%
Mar-11	94%	98%	87%	5%
Jun-11	95%	99%	80%	3%
Sep-11	92%	99%	77%	3%
Dec-11	93%	98%	78%	3%
Mar-12	85%	98%	71%	2%
Jun-12	68%	97%	59%	2%
Sep-12	61%	96%	46%	1%
Dec-12	70%	95%	44%	1%
Mar-13	69%	92%	51%	1%

ii. Default dataset

Table ii. 1 Number of debtors by type of	of credit, currency o	f denomination and s	sample

	No policy regime	Policy regime
Standard mortgage	110,585	69,865
RON-denominated	5,809	21,368
FC-denominated	104,776	48,497
First Home	160,971	236,825
RON-denominated	957	9,740
FC-denominated	160,014	227,085
Secured consumer loan	162,494	116,634
RON-denominated	29,721	92,638
FC-denominated	132,773	23,996
Unsecured consumer loan	3,456,472	2,920,665
RON-denominated	3,022,536	2,589,195
FC-denominated	433,936	331,470

Table ii. 2 Average probability of default by	y type of credit,	currency of	denomination
and sample			

	No policy regime Policy regim	
Standard mortgage	0.32%	0.47%
RON-denominated	0.46%	0.25%
FC-denominated	0.31%	0.56%
First Home	0.12%	0.13%
RON-denominated	0.10%	0.11%
FC-denominated	0.12%	0.13%
Secured consumer loan	0.58%	1.31%
RON-denominated	0.47%	1.32%
FC-denominated	0.61%	1.29%
Unsecured consumer loan	1.46%	1.48%
RON-denominated	1.38%	1.44%
FC-denominated	2.00%	1.73%

Quarters since origination	Standard mortgage	First Home	Secured consumer loan	Unsecured consumer loan
+5	22,086	44,827	37,638	989,752
+6	21,439	44,653	35,644	895,458
+7	20,961	44,529	33,979	824,792
+8	20,488	44,403	32,187	762,940
+9	20,004	44,253	30,725	678,550
+10	19,529	44,091	29,172	629,574
+11	19,121	43,897	27,765	581,131
+12	18,694	43,685	26,563	539,576
+13	18,128	43,458	25,455	475,364
Total	180,450	397,796	279,128	6,377,137

Table ii. 3 Number of debtors by quarter of origination and sample

8. Annex 2 - Results

i. Access to finance

Table i. 1 Mortgage loans - baseline and Currency of denomination interaction

	Standard	Standard	Standard		
	mortgage	mortgage	mortgage	First Home	First Home
	loan	loan	Ioan - FC		
Macroprudential regime -2 Appouncement		0.000/1***			0.00124**
period		-0.00064***	0.00010		0.00124**
Macronrudantial regime – 3 Policy		(0.00010)	(0.00024)		(0.00052)
implementation		-0.00102***	0.00039**		-0.00218***
Macroprudential regime -2 Appouncement		(0.00008)	(0.00019)		(0.00039)
period # Foreign currency denominated			-0.00082***		
Magrammudantial maging -2 Deliay			(0.00026)		
implementation# Foreign currency			-0.00172***		
denominated			(0.00021)		
Quarter = 6, Q2		0.00100***	0.00100***		0.00242***
		(0.00010)	(0.00010)		(0.00051)
Ouarter = 9, O3		0.00040***	0.00040***		0.00450***
		(0.00010)	(0.00010)		(0.00052)
Ouarter = 12, O4		0.00055***	0.00054***		0.00272***
2 million 12, 2 .		(0.00009)	(0.00009)		(0.00042)
Amount bracket = 2	0.00006	0.00010	0.00007	-0.00068	-0.00066
	(0,00009)	(0,00009)	(0,00009)	(0.00045)	(0.00045)
Amount bracket – 3	-0.00056***	-0.00047***	-0.00050***	-0.00058	-0.00056
	(0.000000)	(0,00010)	(0.00050)	(0.00047)	(0.00047)
A mount bracket -4	_0.00071***	_0.000/5***	-0.00047***	0.00266***	0.00268***
Amount bracket – 4	$-0.00071^{+0.00}$	(0.00043)	$(0.0004)^{10}$	(0.00200^{-10})	(0.00208^{+++})
Income setagory $= 1.0$ n50	0.00282***	0.00206***	0.00207***	0.00480***	0.00477***
income category = 1, 0-p50	(0.00282)	(0.00012)	(0.00012)	(0.0048)	$(0.00487)^{-0.00487}$
Income setagory $= 2, p50, p75$	0.00216***	0.00227***	0.00226***	0.00252***	0.00252***
$\frac{1}{1000} = 2, \frac{1}{100} = 2, \frac{1}{100} = 100$	-0.00210***	$-0.00237 \cdots$	-0.00230^{+++}	-0.00332***	(0,00052)
In series and series 2 = 75 = 00	(0.00013)	(0.00012)	(0.00012)	(0.00032)	(0.00032)
Income category = 3 , $p/5-p90$	-0.0016/****	-0.00184****	-0.00183***	-0.00150****	-0.00151****
	(0.00010)	(0.00010)	(0.00010)	(0.00043)	(0.00043)
Currency = 1, Foreign currency	0.00124***	0.00121***	0.00231***		
	(0.00010)	(0.00010)	(0.00018)	0.00415***	0.00412***
Age bracket = 2 , [30-35)	-0.00066***	-0.00044***	-0.00044***	-0.00415***	-0.00413***
	(0.00011)	(0.00010)	(0.00010)	(0.00042)	(0.00042)
Age bracket = 3 , [$35-40$)	-0.00115***	-0.00097***	-0.0009/***	-0.00479***	-0.00479***
	(0.00011)	(0.00011)	(0.00011)	(0.00048)	(0.00048)
Age bracket = 4, $[40-65)$	-0.00244***	-0.00244***	-0.00243***	-0.00607***	-0.00605***
	(0.00010)	(0.00010)	(0.00010)	(0.00055)	(0.00055)
Gender = 1, Female	0.00032***	0.00026***	0.00026***	0.00025	0.00025
	(0.00007)	(0.00007)	(0.00007)	(0.00034)	(0.00034)
Constant	0.00382***	0.00380***	0.00307***	0.00709***	0.00442***
	(0.00030)	(0.00029)	(0.00031)	(0.00133)	(0.00129)
Observations	8,509	10,697	10,697	9,513	9,513
R-squared	0.38838	0.35330	0.35760	0.42728	0.42521
Banks FE	Yes	Yes	Yes	Yes	Yes
R2	0.388	0.353	0.358	0.427	0.425
Likelihood	36721	45388	45424	25742	25725

Table i. 2 Consumer loans - baseline and currency of denomination interaction

	Secured	Unsecured	Secured	Secured	Unsecured
	consumer	consumer	consumer	consumer	consumer
	loan	loan	loan	loan - FC	loan
				interaction	
	1			r	r
Macroprudential regime $= 2$,			-0.00085***	0.00004	-0.00027
Announcement period			(0.00014)	(0.00022)	(0.00061)
Macroprudential regime = 3, Policy			-0.00209***	-0.00073***	-0.00426***
implementation			(0.00013)	(0.00019)	(0.00048)
Macroprudential regime $= 2$,				-0.00122***	
Announcement period # Foreign				(0.00026)	
currency denominated				(
Macroprudential regime =3, Policy				-0.00237***	
denominated				(0.00026)	
Amount bracket -2	0.00074***	0.00155**	0.00068***	0.00067***	0.00120**
Amount bracket – 2	(0.00015)	(0.00075)	(0.00012)	(0.00007^{10})	(0.00129^{++})
A mount breaket = 2	(0.00013)	(0.00073)	(0.00012)	(0.00012)	(0.00064)
Amount bracket = 5	0.00172***	0.00056	0.00166***	0.0016/***	0.00038
	(0.00016)	(0.00074)	(0.00013)	(0.00013)	(0.00064)
Amount bracket = 4		0.00936***			0.00912***
		(0.00072)			(0.00062)
Currency = 1, Foreign currency	0.00159***	-0.02380***	0.00140***	0.00231***	-0.02306***
	(0.00015)	(0.00070)	(0.00012)	(0.00016)	(0.00060)
Quarter = $6, Q2$		0.00473***	0.00078***	0.00086***	0.01198***
		(0.00097)	(0.00015)	(0.00015)	(0.00062)
Quarter = $9, Q3$		0.00454***	0.00064***	0.00071***	0.00747***
		(0.00098)	(0.00015)	(0.00015)	(0.00062)
Quarter = $12, Q4$		0.00114	0.00042***	0.00041***	0.00330***
		(0.00099)	(0.00013)	(0.00013)	(0.00054)
Income category = $1, 0-p50$	-0.00347***	-0.00743***	-0.00344***	-0.00344***	-0.00684***
	(0.00021)	(0.00071)	(0.00017)	(0.00017)	(0.00061)
Income category = $2, p50-p75$	-0.00291***	-0.00333***	-0.00289***	-0.00290***	-0.00318***
	(0.002)1	(0.00070)	(0.0020)	(0.002)0	(0,00060)
Income category = $3, p75-p90$	-0.00209***	-0.00163**	-0.00211***	-0.00213***	-0.00158***
	(0.00016)	(0.00105	(0.00014)	(0.00213)	(0.00058)
Age bracket = $2 [30-35]$	0.00071***	0.00077***	0.00073***	0.00073***	0.00072***
1 ge blacket = 2, [50 55)	(0,00020)	(0,00071)	(0.00073)	(0.00073)	(0.00972)
Age bracket $= 3$ [35-40)	(0.00020)	(0.00071)	(0.00010)	(0.00010)	(0.00001)
Age blacket = $5, [55-40)$	0.00031	-0.01149***	0.00034***	0.00034***	-0.01149***
A as hypolyst -4 [40, 65]	(0.00020)	(0.00072)	(0.00017)	(0.00017)	(0.00062)
Age blacket = 4, $[40-63)$	-0.00110***	-0.0104/***	-0.00108***	-0.0010/***	-0.01063***
	(0.00018)	(0.00067)	(0.00015)	(0.00015)	(0.00058)
Gender = 1, Female	-0.00004	0.00019	0.00004	0.00004	0.00020
	(0.00012)	(0.00050)	(0.00010)	(0.00010)	(0.00043)
Constant	0.00206***	0.00505***	0.00203***	0.00170***	0.00677***
	(0.00055)	(0.00146)	(0.00045)	(0.00045)	(0.00121)
Observations	6,595	19,321	8,593	8,593	24,001
R-squared	0.28178	0.34923	0.27680	0.28421	0.35578
Banks FE	Yes	Yes	Yes	Yes	Yes
Vintage FE	Yes	Yes	No	No	No
R2	0.282	0.349	0.277	0.284	0.356
Likelihood	26020	38464	34340	34384	48809

Table i. 3 Income category interaction

	Standard Einst H		Secured	Unsecured
	mortgage	First Home	consumer	consumer
	loan	IOan	loan	loan
Macroprudential regime $=$ 3,	-0.00223***	-0.00433***	-0.00500***	-0.01012***
Policy implementation	(0.00011)	(0.00067)	(0.00022)	(0.00097)
Income category = 1, 0-p50	-0.00381***	-0.00879***	-0.00498***	-0.01287***
	(0.00015)	(0.00081)	(0.00023)	(0.00097)
Income category = $2, p50-p75$	-0.00309***	-0.00738***	-0.00425***	-0.00764***
	(0.00016)	(0.00079)	(0.00022)	(0.00098)
Income category = 3 , p75-p90	-0.00240***	-0.00454***	-0.00316***	-0.00315***
	(0.00013)	(0.00071)	0.00513***	0.01114***
Macroprudential regime =3,	0.00240***	0.00481***	0.00513***	0.01114***
Policy implementation# 0-p50	(0.00020)	(0.00106)	(0.00035)	(0.00136)
Macroprudential regime =3,	0.00214***	0.00499***	0.00469***	0.00880***
Policy implementation# p50-p75	(0.00021)	(0.00102)	(0.00037)	(0.00138)
Macroprudential regime =3,	0.00165***	0.00396***	0.00346***	0.00324**
Policy implementation#p75-p90	(0.00018)	(0.00092)	(0.00032)	(0.00132)
Other controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Observations	8,509	7,852	6,595	19,321
R-squared	0.39521	0.40417	0.31077	0.34677
Banks FE	Yes	Yes	Yes	Yes
R2	0.395	0.404	0.311	0.347
Likelihood	36769	21509	26156	38427

	Standard mortgage loan	First Home loan	Secured consumer loan	Unsecured consumer loan
Macroprudential regime $=$ 3, Policy	-0.00068***	0.00044	-0.00022	0.00451***
implementation	(0.00012)	(0.00067)	(0.00025)	(0.00108)
Amount bracket = 2	0.00040***	0.00005	0.00126***	0.00320***
	(0.00012)	(0.00074)	(0.00017)	(0.00106)
Amount bracket = 3	-0.00030**	-0.00023	0.00277***	0.00459***
	(0.00014)	(0.00078)	(0.00018)	(0.00104)
Amount bracket = 4	-0.00049***	0.00346***		0.01883***
	(0.00015)	(0.00075)		(0.00099)
Macroprudential regime = 3, Policy	-0.00072***	-0.00201**	-0.00186***	-0.00305**
implementation # Amount bracket 2	(0.00018)	(0.00097)	(0.00031)	(0.00148)
Macroprudential regime = 3, Policy	-0.00054***	-0.00164	-0.00356***	-0.00765***
implementation # Amount bracket 3	(0.00021)	(0.00101)	(0.00032)	(0.00145)
Macroprudential regime = 3, Policy	-0.00044**	-0.00304***		-0.01910***
implementation # Amount bracket 4	(0.00021)	(0.00100)		(0.00135)
Other controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Observations	8,509	7,852	6,595	19,321
R-squared	0.38199	0.40234	0.29405	0.35256
Banks FE	Yes	Yes	Yes	Yes

0.382

36677

0.402

21497

0.294

26077

0.353

38513

Table i. 4 Loan amount interaction

R2

Likelihood

ii. Payment discipline results

Table ii. 1 Baseline model

	Mortgage loans	First Home	Secured	Unsecured
			consumer loans	consumer loans
Policy period	1.080***	0.549***	1.599***	0.990***
	(0.115)	(0.145)	(0.072)	(0.011)
FC denominated loan	1.505***	1.541***	0.271***	0.713***
	(0.174)	(0.336)	(0.078)	(0.014)
Income < 50 th percentile	-0.593***	-0.274	0.110	0.255***
	(0.178)	(0.218)	(0.098)	(0.012)
Income $[50^{\text{th}} - 75^{\text{th}}]$	-0.690***	-0.439**	-0.174**	-0.233***
percentile)	(0.152)	(0.183)	(0.076)	(0.011)
Income [75 th -90 th	-0.972***	-0.878***	-0.489***	-0.711***
percentile)	(0.143)	(0.177)	(0.071)	(0.012)
Income $> 90^{\text{th}}$ percentile	-1.693***	-0.984***	-1.136***	-1.364***
	(0.125)	(0.155)	(0.072)	(0.015)
DSTI	0.341***	0.258***	0.069**	0.121***
	(0.049)	(0.058)	(0.029)	(0.004)
Interest rate	0.403***	0.471***	0.104***	0.069***
	(0.032)	(0.039)	(0.010)	(0.001)
Maturity	0.047***	-0.020**	0.009**	-0.007***
	(0.007)	(0.009)	(0.004)	(0.001)
Amount outstanding	0.001***	0.003***	0.001***	0.001***
	(0.000)	(0.001)	(0.000)	(0.000)
Age	0.021***	-0.001	-0.024***	-0.035***
	(0.006)	(0.008)	(0.002)	(0.000)
			T	
Bank FE	Yes	Yes	Yes	Yes
# Quarters since	Vaa	Vaa	Vac	Vaa
County EE	Yes	Yes	Yes	Yes
Ouarter of observation	ies	Tes	ies	ies
FE	Yes	Yes	Yes	Yes
Observations	180,450	397,796	279,128	6,377,137
Pseudo R2	0.0891	0.0419	0.0562	0.0715
Likelihood	-4075	-3755	-13359	-453336
ROC	0.8167	0.8135	0.7579	0.751

Table ii. 2 Currency of denomination interaction model

	Mortgage loans
No policy period - RON	0.106
denominated	(0.256)
FC denominated	0.664**
	(0.274)
Policy period - FC	0.634**
denominated	(0.263)

Loan controls	Yes
Borrower controls	Yes
Bank FE	Yes
# Quarters since origination	
FE	Yes
County FE	Yes
Quarter of observation FE	Yes

Observations	178,335
Pseudo R2	0.132
Likelihood	-3878

	Mortgage loans	First Home	Secured consumer loans	Unsecured consumer loans
Policy period	0.584***	0.898***	0.424***	0.068***
	(0.171)	(0.260)	(0.111)	(0.015)
Income < 50 th percentile	-0.681***	-0.228	-0.228*	0.159***
	(0.212)	(0.285)	(0.128)	(0.015)
Income [50 th - 75 th percentile)	-0.866***	-0.700***	-0.579***	-0.355***
	(0.194)	(0.265)	(0.116)	(0.014)
Income [75 th -90 th percentile)	-1.119***	-1.224***	-0.838***	-0.850***
	(0.186)	(0.271)	(0.105)	(0.016)
Income $> 90^{\text{th}}$ percentile	-1.609***	-1.132***	-1.345***	-1.507***
	(0.164)	(0.231)	(0.101)	(0.020)
Policy period - Income < 50th percentile	0.035	-0.115	0.396***	0.091***
	(0.241)	(0.322)	(0.145)	(0.019)
Policy period - Income [50th - 75th percentile)	0.299	0.282	0.500***	0.121***
	(0.246)	(0.321)	(0.140)	(0.020)
Policy period - Income [75th	0.186	0.428	0.436***	0.125***
-90th percentile)	(0.251)	(0.335)	(0.134)	(0.023)
Policy period - Income >	0.047	0.105	0.256*	0.124***
90th percentile	(0.233)	(0.300)	(0.138)	(0.028)

 Table ii. 3 Income category interaction model

Loan controls	Yes	Yes	Yes	Yes
Borrower controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
# Quarters since origination FE	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes
Year of observation FE	Yes	Yes	Yes	Yes
Observations	178,335	396,721	278,872	6,377,073
Pseudo R2	0.131	0.0698	0.0717	0.0991
Likelihood	-3879	-3644	-13138	-439863