Household Credit, Global Financial Cycle, and Macroprudential Policies: Credit Register Evidence from an Emerging Country[*]

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We analyze the effects of macroprudential policies on local bank credit cycles and their interactions with international financial conditions. To this end, we exploit the comprehensive credit register containing all bank loans to individuals in Romania, a small open economy subject to external shocks. Our sample period from 2004 until 2012 covers a full boom-bust credit cycle during which a wide range of macroprudential measures were deployed. Our results show that tighter macroprudential conditions are associated with a significant decline in household credit, with substantially stronger effects for FX loans than for local currency loans. The effects on FX loans are higher for: (i) *ex-ante* riskier borrowers proxied by higher debt-service-to-income ratios and (ii) banks with greater reliance on foreign funding. Furthermore, tighter macroprudential policy has stronger dampening effects on FX lending when global risk appetite is high and foreign monetary policy is expansionary. Quantitative effects are in general larger for borrower rather than lender macroprudential policies. Overall, the results suggest that macroprudential policies are effective in mitigating bank risk-taking in household lending over the local bank credit and global financial cycles and have important implications for theory and policy.

Keywords: macroprudential policies, global financial cycle, boom-bust credit cycle, household credit, bank loans

JEL codes: G01, G21, G28

1 Introduction

Banking crises often occur after periods of strong credit growth financed with foreign liquidity (Schularick and Taylor, 2012; Gourinchas and Obstfeld, 2012; Reinhart and Rogoff, 2009). Banking crises are also accompanied by financial market freezes and credit crunches (Bebchuk and Goldstein, 2011; Ivashina and Scharfstein, 2010; Gorton and He, 2008) with significant real effects (Laeven and Valencia, 2013; Bernanke, 1983). These phenomena have generated broad agreement among academics and policymakers that macroeconomic and regulatory policies should acquire a macroprudential dimension (Claessens, 2015; Freixas et al., 2015; Brunnermeier et al., 2009; IMF, 2009).[1] Macroprudential policy encompasses instruments aimed at ensuring financial stability by limiting cyclical vulnerabilities and systemic risk over the credit cycle.[2] However, not all credit is the same, as credit to households is a major driver of financial crises (Mian et al., 2017). Despite the importance of understanding the effects of macroprudential policies on the household credit cycle, there is no systematic evidence on the ability of these policies to smooth local household credit cycles or to mitigate spillovers from the global financial cycle (Rey, 2016, 2013; Borio, 2014) on the local bank credit cycle. The recent literature argues these spillovers are significant, especially for emerging markets.[3]

In this paper we analyze the effects of macroprudential policies on local bank credit to households and how these effects interact with international factors such as foreign currency (FX) lending, foreign bank funding, and global risk appetite. Our case study is Romania, a fast-growing and small open emerging market economy in the European Union. Romania offers the ideal opportunity for an empirical study of macroprudential policy because it (i) offers a comprehensive household credit register with detailed information on all loans extended by the banking sector to individuals; (ii) has deployed a wide range of macroprudential policies during the boom and bust of the 2000s; and (iii) is exposed to global financial conditions and foreign monetary policy, including through foreign bank funding and loans in foreign currency. To our knowledge, this is the first paper that employs

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[1]The Seoul Summit in 2010 called on the Financial Stability Board, the International Monetary Fund, and the Bank for International Settlements to work on macroprudential instruments and to elaborate a report describing best practices in macroprudential policymaking. Definitions, instruments, and descriptions of country experiences with macroprudential policy are described in IMF-FSB-BIS (2016), IMF (2014), and IMF (2013).

[2]In the run-up to the global financial crisis almost one-third of countries around the world were experiencing credit booms (Dell'Ariccia et al., 2012). During this period, some countries, especially those receiving large capital inflows, employed macroprudential policies to contain credit expansion and financial sector risks. As the global crisis took hold, macroprudential instruments were used to support credit and economic recovery (Ghosh et al., 2017).

[3]For instance, Baskaya et al. (2017a) document that 43% of the corporate credit cycle in Turkey is explained by capital inflows driven by global risk appetite.

a household credit register to study the effectiveness of macroprudential policies in mitigating risky household lending over a full economic cycle, and to document the ability of macroprudential policies to dampen the effects of the global financial cycle on local credit cycles. Our main contribution is to show that macroprudential policies affect household credit and bank risk-taking, in particular by mitigating the impact of the global financial cycle on the local credit cycle, especially in relation to riskier loans such as loans denominated in foreign currencies, extended to indebted borrowers, and granted by banks that rely on foreign liquidity.

Our credit register includes the universe of bank loans to individuals in Romania during the 2004-2012 period, at quarterly frequency. Like other small and open emerging market countries, Romania is a bank-dependent economy where a large portion of the banking sector is foreign-owned, there is substantial foreign bank funding, and about one third of household loans are extended in foreign currencies (mainly Euros, EUR and Swiss Francs, CHF). These factors expose the economy to potential cross-border spillovers from foreign macroeconomic policies and the global financial cycle. We have information on close to 3,000,000 individual loans—residential mortgages and consumer loans—from 42 commercial banks. The credit register contains important household credit characteristics (e.g., loan volume and rate, loan-to-value ratio, debt-service-to-income ratio, etc.) and is matched with high-frequency supervisory information on bank balance sheets.

During 2004-2008 Romania experienced credit and housing booms that were fuelled by large capital inflows—an experience it shared with many emerging markets (Dell'Ariccia et al., 2012). During this period bank credit grew at an average of 23% in real terms. Over the subsequent four-year period, the economy was hit by the global financial crisis: real credit growth fell below 1% and GDP contracted at an average of 1.5% per year. Throughout the 2004-2012 period the National Bank of Romania (NBR) deployed a wide range of macroprudential instruments to manage macroeconomic and financial risks. Policies included changes in minimum reserve requirements on local and foreign currency deposits (a key source of foreign bank funding), limits on credit exposures in foreign currencies, changes in capital requirements and provisioning rules, and time-varying ceilings on loan-to-value (LTV) and debt-service-to-income (DTI) ratios for household loans.[4]

To capture changes in macroprudential policy conditions over the credit cycle, we construct an index by coding the numerous introductions and changes in macroprudential instruments as tight-

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[4]The difference between macro- and microprudential policies hinges on the time-varying component. While macroprudential policies are countercyclical (they tighten during credit booms and soften during periods of financial stress when risk is high), microprudential policies are procyclical, requiring a tightening during crises (Freixas et al., 2015).

enings (+1) or loosenings (−1).[5] Following the methodology of Cerutti et al. (2017), we then define the index as the running (cumulative) sum of these values such that each instrument is reflected in the index throughout the entire time it is in place and until it is changed or discontinued. Higher values of this index indicate a tightening of macroprudential conditions. In a similar manner we define two additional fine-grained macroprudential policy indices that group together, respectively, the instruments applied to banks (such as limits on leverage and provisioning rules) and those applied to borrowers (such as LTV and DTI limits). These indices allow us to distinguish the effects of different sets of macroprudential policies on bank credit cycles and risk-taking.

Similar to studies of monetary policy, our analysis faces the empirical identification challenge that macroprudential policy responds to and is correlated with local financial and economic conditions. As in the monetary policy literature (Kashyap and Stein, 2000; Jiménez et al., 2012, 2014), we exploit cross-sectional and time-series heterogeneity afforded by our microdata (in our case, in bank risk-taking in household lending) and control for key macroeconomic conditions (including in interactions). More concretely, we emphasize (i) double and triple interactions of macroprudential policies with loan characteristics (FX vs. local currency), borrower characteristics (more vs. less indebted), and bank characteristics (more vs. less dependent on foreign funding); and (ii) specifications that additionally control for local and international macroeconomic and financial variables (also in interactions with loan, borrower, and bank characteristics). Furthermore, we analyze the data at a high frequency with bank×period and borrower county×period fixed effects. These fixed effects control for time-varying unobserved local macroeconomic shocks and bank characteristics. Therefore, we obtain identification *within the same period* through the differential characteristics of loans, borrowers, and banks. Our regressions also include loan-type×period fixed effects to control for systematic differences between mortgages and consumer loans. We also examine the ability of macroprudential policies to mitigate (exogenous) international spillovers from the global financial cycle (proxied by the VIX or Eurozone monetary policy) on the level and composition of bank credit to households.

Our main results are as follows. We show that tighter macroprudential conditions are associated with a decline in the volume of household credit, especially for (riskier) foreign currency loans. The estimates are statistically and economically significant for all FX loans, and are of similar magnitude across EUR and CHF loans. They suggest that a tightening of macroprudential policy

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[5]For changes in macroprudential policies during the period of analysis, see Figure 1.

by one standard deviation reduces average foreign currency loan volume by 12% more than it does local currency loan volume. In addition, the mitigating effects of tighter macroprudential policy on FX credit are stronger for *ex-ante* riskier borrowers, measured with the DTI at loan origination. For borrowers with the same level of risk, a tightening of macroprudential policies reduces FX credit relative to local currency credit, suggesting that banks substitute away from riskier types of lending. Macroprudential policy is also more effective in reducing loan growth in (riskier) foreign currencies by banks that are relatively more dependent on foreign liquidity.

Turning to the cross-border spillover effects of global financial conditions, we find that macro-prudential policy is more potent at dampening lending in (riskier) foreign currencies when global risk appetite is high, as proxied by low European VIX, and when foreign monetary policy rates are low. We obtain the largest quantitative effects for tranquil periods of low VIX, suggesting greater effectiveness of macroprudential policies during economic booms compared to busts. In addition, we split macroprudential instruments into bank- and borrower-side measures. This disaggregation is useful because bank-side measures (which target, for instance, provisioning and capital) may be less binding and hence easier to circumvent during periods of benign financial conditions (Aiyar and Wieladek, 2014; Jiménez et al., 2017). Consistently, we find that borrower-side measures are generally more effective at dampening risky bank lending decisions than bank-side measures,[6] while bank-side measures are relatively more effective for banks with greater reliance on foreign funding.

Our paper is related to two main strands of literature. First, the paper adds to the literature on macroprudential policies and credit cycles. Although household leverage booms are known to be a key driver of financial crises and to predict poor subsequent economic performance, not limited to the 2007-2009 global financial crisis (Mian et al., 2017; Mian and Sufi, 2015), to our knowledge this is the first paper that employs a household credit register to study leverage and macroprudential policies over a full economic cycle. In this context, Romania is a well-suited case study because it experienced a full boom-bust cycle in household credit during the period of analysis, during which it adopted numerous macroprudential policies. Given this wide range of macroprudential policies, we are able to examine the effectiveness of certain groups of instruments that place quantitative restrictions, respectively, on financial institutions or borrowers. Most papers in this literature are

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[6]Ayyagari et al. (2017) find that borrower-side measures are more strongly correlated with corporate credit growth in emerging markets—especially for small firms—than are bank-side measures, while in advanced economies both types of measures have similar impacts. This effect may be due to the fact that small firms in emerging markets often borrow against the owner's collateral and have fewer alternative sources of external funds.

cross-country studies,[7] where empirical identification through heterogeneity—for instance, analyses across riskier loans, borrowers, or banks—is difficult to achieve.[8] Using microdata from the Spanish credit register, Jiménez et al. (2017) analyze the effects of bank-side macroprudential policies, in particular dynamic provisioning, on bank credit to firms. They document a smoothing effect of the policy on the corporate credit cycle, with beneficial effects on firm real outcomes during crises. Similar to this paper, we employ extensive loan-level data from a credit register to examine the impact of macroprudential policies, but our focus is on household credit rather than corporate credit.[9] Different from this paper, we document a larger impact of borrower-side macroprudential policies in tranquil periods (when the VIX is low), whereas Jiménez et al. (2017) find that bank-side macroprudential policies (dynamic provisioning) have a stronger impact during crisis periods. Our results thus emphasize the role of macroprudential policies in dampening the build-up of risks to financial stability during the boom phase of the credit cycle.

Second, the paper is related to the literature on spillovers from international capital flows and the global financial cycle (Rey, 2013, 2016; Borio, 2014) on domestic lending and the real sector (Forbes and Warnock, 2012). Studies of cross-border spillovers analyze the impacts of different dimensions of global financial conditions—such as changes in investors' uncertainty and risk aversion, and monetary policy of major central banks—on bank lending and risk-taking behavior (Coimbra and Rey, 2017; Bruno and Shin, 2015a,b; Giannetti and Laeven, 2012a,b) through the activities of international banking groups (Cetorelli and Goldberg, 2012, 2011).[10] For the case of Mexico, Morais et al. (2017) show that European and U.S. banks transmit monetary policy shocks from core countries to local firms' borrowing and investment through an international bank lending

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[7]See, e.g., Cerutti et al. (2017); Ghosh et al. (2017); Ayyagari et al. (2017); Vandenbussche et al. (2015); Akinci and Olmstead-Rumsey (2015); Claessens et al. (2013); Dell'Ariccia et al. (2012); Vandenbussche (2012); Lim et al. (2011); Crowe et al. (2011).

[8]Several studies analyze household credit using microdata, but do not look specifically at the impact of macroprudential policies (see, e.g., Mian and Sufi (2016) and Keys et al. (2014)), including in the household finance literature (see, e.g., Bhutta and Keys (2016) and Skimmyhorn (2016)).

[9]Other studies in this literature focus on credit to non-financial firms and are also based on microdata. Camors et al. (2015) show that a tightening of reserve requirements in Uruguay reduces the supply of bank credit to firms, worsening firm-level outcomes, and changes the composition of lending towards riskier borrowers. For Switzerland, Auer and Ongena (2016) show that macroprudential regulations targeting residential lending lead to higher loan growth in commercial lending. An exception is Acharya et al. (2017), who analyze household lending over a short period of time, whereas we analyze a full credit cycle. They find that banks in Ireland respond to the introduction of loan-to-value and loan-to-income limits for home loans by reducing lending rates to rich households, increasing holdings of risky securities, and increasing lending to risky firms.

[10]An earlier literature in international finance, discussed in Karolyi (2003), focused on co-movements of credit flows and international asset prices, with implications for the level and volatility of international capital flows. This literature examines higher-frequency movements in capital flows than do studies of the global financial cycle.

and risk-taking channel of global monetary policy.[11] Bräuning and Ivashina (2017a) find a strong link between U.S. monetary policy and credit cycles in emerging markets. Baskaya et al. (2017b) document the impact of international capital flows and global risk appetite on domestic credit to firms in Turkey.

Our contribution is to take this research agenda one step further by asking how effective macroprudential policies used by emerging markets are in mitigating the transmission of global financial conditions to the local credit cycle. Our evidence suggests they are indeed effective, with tighter local macroprudential policies reducing spillover effects from global risk appetite and expansionary foreign monetary policy on local household credit. These effects are stronger for foreign currency credit and during periods of high risk appetite (low VIX) or low foreign monetary policy rates. Our analysis also suggests that borrower-side measures are generally more effective (than bank-side measures) at dampening risky credit growth (in foreign currencies) that is driven by loose global financial conditions.

2 Institutional Background

2.1 Macroeconomic Environment

Romania is bank-dependent emerging market economy, where a large portion of the banking sector is foreign-owned, there is substantial foreign bank funding, and about one third of household loans, including most residential mortgages, are extended in foreign currencies (especially EUR and CHF). These conditions expose the domestic economy to potential cross-border spillovers from foreign macroeconomic policies and the global financial cycle.

We analyze the effectiveness of macroprudential policymaking in Romania over a full boom-bust cycle. In the years prior to joining the EU in 2007, Romania experienced an economic boom, with average GDP growth of 7.3% between 2004 and 2008. An accompanying credit boom was fuelled by the expansion of foreign-owned banks—mostly Austrian and French banks—and large capital inflows. Total bank credit, including in foreign currencies, grew at an average of 23% in real terms during 2004-2008 (see Figure A1). As a result, the credit-to-GDP ratio more than tripled in just four years, reaching 40% of GDP in 2008. The global financial crisis led to an economic slowdown

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[11]See Dell'Ariccia et al. (2014), Borio and Zhu (2012), and Diamond and Rajan (2012) for theoretical models of the risk-taking channel of monetary policy.

followed by a modest recovery. Real GDP fell by 7.8% during 2009-2010 and averaged 1.5% in 2011-2012. Post-crisis bank loan claims, at end-2012, were only four-fifths of their pre-crisis peak level. In addition, the large share of foreign currency loans extended before the crisis coupled with currency depreciation led to a significant rise in non-performing loans, slowing down credit growth and balance sheet recovery (Everaert et al., 2015).[12] Similar to other countries in emerging Europe, Romania benefitted from the "Vienna Initiative" in the early stages of the crisis. As part of this initiative, West European banking groups with significant exposures to the East European market committed to maintain credit flow to the economies in the region.[13]

Over the sample period, the banking system comprises 42 banks, of which 30 private commercial banks, 2 state-owned and development banks, and 10 branches of foreign banks. The largest five banks account for almost 80% of total banking sector assets.[14] Banks have average capital ratios (Tier 1 capital in percent of total assets) of 7.4%. The banking system is largely foreign-owned due to significant foreign bank entry through mergers and acquisitions during the boom period.[15] Foreign bank assets account for 79.2% of total banking sector assets over 2004-2012, starting at 54% in 2004 and peaking at 89% at the end of the boom. As a result, there is a relatively large degree of reliance on foreign funding, at almost 20% of total assets, exposing domestic banks to external funding shocks.

Household credit claims account for about half of total private credit. Between 2005 and mid-2008 household debt increased at an average annual rate of 77%. More than half of outstanding bank loan claims are in foreign currencies. This remarkable rise in household debt was mirrored in unhedged foreign currency exposures for banks, as wages are largely denominated in local currency (IMF, 2010). Figure 2 shows household credit by type and currency based on loan originations in the credit register. Ten percent of individual loans are residential mortgages and almost 90% are consumer loans (including mortgage-backed consumer loans). Consumer loans account for 60% of total credit volume and mortgages for 40%. Housing is priced in EUR, therefore mortgages are

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[12]In the credit register, 4% of loans originated during 2004-2012 were restructured or rescheduled and 9.7% were non-performing.

[13]De Haas et al. (2015) show that foreign banks who participated in the initiative were relatively more stable suppliers of credit compared to non-participating banks.

[14]See Duenwald et al. (2005) for a detailed description of the banking sector and the credit boom until 2005.

[15]There were one merger and 12 acquisitions between 2004 and 2012. For instance, Banca Comerciala Romana, the largest Romanian bank by assets, was acquired by the Austrian Erste Group in 2006. For purposes of the analysis, we treat bank mergers and acquisitions as follows. Banks that end up in a merger are kept as distinct banks until the year of the merger and the bank resulting from the merger is kept subsequent to the merger. When a bank ends up being acquired by another bank, that bank appears as a distinct bank until the year of the acquisition.

mostly denominated in foreign currency (81% of loans in EUR, 7% of loans in CHF, and the rest in USD, GBP, and YEN). About 20% of consumer loans are extended in forex (mainly EUR).

2.2 Macroprudential Policies

The NBR adopted a wide range of macroprudential measures during the 2004-2012 boom-bust cycle.[16] Table A1 reports the date when each measure was introduced and its detailed description. Before the global financial crisis the aim was to limit the impact of strong capital inflows on domestic credit and to address the risks of FX lending to unhedged borrowers. Subsequently, lending standards were reduced to support credit and economic recovery.

During 2004-2006, the NBR targeted the level and composition of lending by gradually raising reserve requirements on foreign currency deposits and cutting those on local currency deposits.[17] These measures were accompanied in 2005 by an outright limit on foreign currency credit exposures to unhedged individuals and firms (in percent of banks' common equity). To further discourage risky borrowing and constrain household debt, the NBR imposed limits on loan-to-value (LTV) ratios for mortgages and debt-service-to-income (DTI) ratios for all loans. The DTI ceiling was later further reduced and applied to borrowers' total debt as opposed to each individual loan.[18]

A number of macroprudential policies were reversed or harmonized with EU-wide regulations in 2007 when Romania joined the EU. Banks were allowed to set LTV and DTI ceilings based on internal risk management models (subject to central bank guidelines), foreign currency credit limits were removed, and minimum capital requirements were reduced from 12% to 8%. The NBR enforced the Basel II regulatory framework, harmonizing risk-weights and tightening operational risk management. As the credit boom continued, in August 2008 the NBR required banks to explicitly consider interest and exchange rate risk in setting DTI limits, using their internal risk models, and raised provisioning requirements for foreign currency credits to unhedged borrowers.

As the first wave of the global financial crisis unfolded in 2009 and credit crashed, reserve re-

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[16]Other countries in the region adopted similarly proactive macroprudential policymaking during this period, see, e.g., Dimova et al. (2016) and Vandenbussche (2012).

[17]Prior to 2004 there were two changes in reserve requirement ratios, namely a reduction in reserve requirements in domestic currency in 2002Q4 and an increase in reserve requirements in foreign currency in 2002Q4. There were no macroprudential measures in 2003. Therefore, the starting level for the macroprudential policy index is 0, regardless whether we start computing it in 2002 or 2004.

[18]Note that there were no specific measures targeting foreign-owned banks or foreign funding obtain in wholesale markets. Furthermore, reserves in foreign deposits were remunerated at a rate that was below the interest rate on the interbank market (ROBOR) and above the retail rate paid by banks on these deposits.

quirements for all bank deposits regardless of currency were drastically reduced. Mortgage lending to first-time home buyers was supported through the launch of a government subsidy program in 2009 which, among others, exempted new mortgages from LTV limits. In 2011 the NBR set new currency-specific LTV and DTI ceilings (see Neagu et al. (2015) for a detailed analysis).

Macroprudential Policy Index. Given the large number of macroprudential measures and the high frequency with which they were implemented and changed, it is difficult to examine their impact in isolation. Doing so would open up the possibility that effects which we ascribe to one particular measure are confounded by other measures that occur at or around the same time. Therefore, we follow the approach in Cerutti et al. (2017) and measure macroprudential policy using an index which is coded manually from the list of measures taken by the NBR. Table A1 lists the macroprudential instruments together with a variable that codes each instrument as +1 for a tightening and −1 for a loosening in the period in which the instrument is in place (starting with the quarter when it is introduced until the quarter when it is removed, if within the sample period). The simultaneous introduction of two or three measures is coded as +2 or +3. The macroprudential policy index (MPP) is computed as the running (cumulative) sum of this variable starting in 2004:Q1. The index ranges between 0 and 12, with a mean of 5.943 and standard deviation of 3.581, and with higher values indicating a tighter macroprudential policy stance. The maximum was attained in 2006:Q4 and the minimum was attained in 2011:Q2-Q3.

Using the same approach we also classify the macroprudential measures into two groups to create MPP indices separately for bank- and borrower-based instruments. In the spirit of Cerutti et al. (2017), the bank-based macroprudential index captures quantitative restrictions on financial institutions' balance sheets, targeting assets or liabilities or both, such as changes in reserve requirements on FX-denominated liabilities, ceilings on FX credit exposures to unhedged borrowers, and changes in provisioning and loan classification rules. Borrower-based measures refer to macroprudential instruments that aim at reducing risks associated with household indebtedness, for instance through time-varying LTV and DTI limits.[19] (See Table A1 for details on the coding of each index.)

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[19]Another grouping of macroprudential measures would capture instruments that reduce the risks associated with FX lending by applying different standards by currency and hence by affecting the relative cost of lending in foreign currencies. Vandenbussche (2012) conducts an analysis of FX-oriented macroprudential measures for five Central and East European Countries. For Romania, the results indicate that the limit on FX credit exposures (in percent of the banks' common equity), implemented in 2005Q3, was particularly effective at dampening growth in FX credit to households and firms during 2002-2012.

3 Data and Empirical Strategy

To estimate the impact of macroprudential policies on household credit we combine two confidential micro datasets, both sourced from the NBR: a loan-level dataset (household credit register) with information on individual loans originated by the entire banking system, and a bank-level dataset with supervisory information on bank balance sheets. The credit register contains information on loan originations (rather than loan exposures). The two datasets are merged on a unique bank identifier. We add information on domestic and global macroeconomic and financial conditions from the IMF's International Financial Statistics. The final dataset is at the quarterly frequency over the 2004:Q1-2012:Q4 period. Loan and bank variables are winsorized at the 1% level to minimize the impact of outliers.

Descriptive statistics for regression variables are shown in Table 1. Variable sources and definitions are reported in Table A2.

3.1 Credit Register

The microdata on individual loans to households comes from the "Central Credit Register" maintained by the NBR in its capacity of bank supervisor. The credit register collects, stores, and compiles information on all the loans extended by reporting financial institutions in Romania. The data come from regulatory reports sent by financial institutions to the NBR and is recorded in the "central credit file" on a monthly basis. The credit register includes loans that are larger than a threshold of RON 20,000 (approximately USD 4,500).

For each granted loan we observe the issuing bank, the terms of the loan such as loan amount, currency, maturity, and interest rate,[20] as well as key information on the borrower such as location (in one of 41 local economic areas, or "counties") and age. We also know the LTV and DTI ratios that are associated with each loan and respectively each borrower. The loans are tracked over time so we also know if and when they were classified as non-performing, rescheduled, or restructured.

The final dataset contains 2,965,479 individual loans over the 2004-2012 period, of which 2,654,962 consumer loans and 310,517 mortgages. Further, 996,240 loans are in foreign currencies (868,745 in EUR, 118,007 in CHF, and the rest in other currencies). These loans were extended by 42 banks

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[20]The actual interest rate at loan origination is available in the credit register starting in 2015, which precludes its analysis in this paper. However, it is possible to back out the interest rate from the loan's repayment schedule. Using this variable, we did not find any systematic evidence of a loan pricing impact of macroprudential policies.

to 1,437,059 unique individual borrowers (282,364 mortgage borrowers). The average loan amount is approximately USD 44,000 for mortgages and USD 11,000 for consumer loans.

3.2 Macro Variables

We are interested in examining the ability of macroprudential policies to mitigate potential effects from global macroeconomic and financial conditions. We work with two measures of global conditions. The first measure, a proxy for global uncertainty and risk aversion, is the European VIX, that is, the Euro Stoxx 50 Volatility Index, which measures implied volatility of near-term options on the Euro Stoxx 50 Index (that comprises Eurozone blue chip stock index with liquid futures and options). The VIX is a commonly used indicator of global and regional funding liquidity conditions (Miranda-Agrippino and Rey, 2015). A lower VIX reflects lower uncertainty and higher investor risk appetite.

Given the relatively high degree or eurorization of the Romanian economy, our second proxy for global financial conditions is the Euro OverNight Index Average (EONIA) targeted by the European Central Bank (on a quarterly basis, measured as the average of monthly values). The EONIA is the one-day interbank interest rate for the Eurozone.[21]

In a handful of specifications without period fixed effects, we control for the domestic economic cycle with a measure of the NBR's monetary policy stance, the real growth rate of seasonally-adjusted GDP, and the CPI inflation rate. To capture the NBR's monetary policy stance we use the policy rate, i.e., the 7-day repo rate at which the NBR conducts open market operations on the secondary government securities market.

3.3 Empirical Specifications

In this section we present the empirical strategy to identify the impact of macroprudential policy on bank credit to households. Our empirical specifications assess the role of macroprudential policies as a potential counteracting force against risky credit growth and cross-border spillovers from international financial conditions, by exploiting differences in loan, borrower, and bank characteristics. Our approach hinges on double and triple interaction terms, coupled with demanding fixed effects, and enables us to more confidently ascribe causal interpretations to our estimates.

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[21]Our results are robust to using the shadow EONIA, which captures the monetary policy stance in the Eurozone during the period of unconventional monetary policies.

A simple empirical model of the *level* effect of macroprudential policies on household credit is based on the following specification:

$$L_{ijkt} = \alpha_{it} + \eta_{kt} + \beta MPP_{t-z} + X_{t-z}\delta_0 + Z_{it-z}\delta_1 + W_{jkt}\delta_2 + \epsilon_{ijkt} \tag{1}$$

where L_{ijkt} is the log(loan volume) extended by bank i to individual borrower j in county k in year t, and z is an appropriate lag.[22] Macroeconomic, bank, borrower controls are respectively included in matrices X, Z, and W. X_{t-z} includes the domestic monetary policy rate, GDP growth, CPI inflation, and the VIX (our barometer for risk appetite). The matrix of bank characteristics Z_{it-z} includes bank size (log-total assets), capital and liquidity ratios, return on assets (ROA), non-performing loan ratio (NPL), bank risk profile (risk weighted assets divided by total assets), the share of foreign funding in total assets, and an indicator for foreign-owned banks. The matrix W_{jkt} comprises borrower and loan characteristics such as borrower age, an indicator for FX loans,[23] and an indicator for loans that were granted under the first-home mortgage program. Importantly, in all regressions we also add loan-type×period fixed effects (in particular, mortgage×period fixed effects) to make sure the results are not driven by systematic differences between residential mortgages and consumer loans.

In this specification, the coefficient of interest on macroprudential policy MPP is β, capturing the response of bank credit to macroprudential policy, and is expected to be negative. The unbiased estimation of β hinges on the identifying assumption that macroprudential policy is orthogonal on the error term ϵ. This assumption fails if macroprudential policies respond to the level of credit or to credit growth (reverse causality), or if there are confounding macroeconomic factors that correlate with macroprudential policies but are not fully captured by the included controls (omitted variables).

Our identification strategy will therefore exploit variation in loan, borrower, and bank characteristics, or *differential effects*. In particular, we use specifications with double and triple interactions, which are more robust to identification concerns. We control for unobserved (time-varying)

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[22]This specification exploits within-year quarterly variation in macroprudential policies to examine their level impact on loan growth, controlling for macroeconomic conditions, bank, borrower, and loan characteristics. In subsequent specifications, the time period is given by a quarter, unless otherwise specified.

[23]In specifications shown in the appendix, we also break down FX loans into CHF, EUR, and OTHER loans, where the OTHER category includes loans in USD, GBP, and YEN, which together account for less than 0.5% of all loans during 2004-2012.

borrower and bank-level heterogeneity with interacted bank×period fixed effects and borrower county×period fixed effects. In most specifications we include time-varying fixed effects by quarter (that is, bank×year-quarter and borrower county×year-quarter fixed effects). In several specifications where we have less variation across the various dimensions of interest in a given quarter, we use bank×semester and county×semester fixed effects. With year-quarter fixed effects, we do not independently estimate the level effect of macroeconomic variables such as macroprudential policy, VIX, domestic or foreign monetary policy, and instead we focus solely on differential effects.

Given the likely endogeneity of macroprudential policies with respect to the local economic cycle, we also make sure that the coefficients of the interaction effects of interest are robust to this concern by controlling for all the interaction terms of interest with measures of the local cycle. To determine which dimensions of the local cycle—monetary or real—are correlated with macroprudential policies, we regress the macroprudential policy index (MPP) on the domestic monetary policy rate, GDP growth, and CPI inflation. The results (shown in Table A3) indicate that the only robust determinant of MPP is the GDP growth rate. Therefore, to alleviate the potential concern that the results are picking up the effects of economic growth, all specifications with MPP interactions additionally include the corresponding GDP growth interactions.

Our workshorse specifications are given by:

$$L_{ijkt} = \alpha_{it} + \eta_{kt} + \beta MPP_{t-z} \times RISK + Z_{it-z}\delta_1 + W_{jkt}\delta_2 + \epsilon_{ijkt} \tag{2}$$

where $RISK$ can be a loan-, borrower-, or bank-level variable. The terms MPP and $RISK$ are omitted for simplicity, but they are introduced in all the regressions when not spanned by the fixed effects. If $RISK$ is a dummy for FX loans, then the coefficient of interest β captures the differential effect of a tightening of macroprudential policies on FX loans compared to local currency loans. $RISK$ can also be a bank-level variable that captures bank reliance on foreign funding, which allows us to ask if macroprudential policies are relatively more effective in dampening the risky lending of those banks which are more sensitive to external shocks and hence may cause greater spillovers to the domestic credit market. $RISK$ can also capture *ex-ante* borrower riskiness as measured by DTI, or the riskiness of foreign-currency borrowers as a double interaction $FX \times DTI$.

To examine whether cross-border spillovers from changes in investor risk attitude and foreign monetary policy are mitigated by macroprudential policies, we estimate specifications given by:

$$L_{ijkt} = \alpha_{it} + \eta_{kt} + \beta MPP_{t-z} \times SPILLOVER_{t-z} \times RISK + Z_{it-z}\delta_1 + W_{jkt}\delta_2 + \epsilon_{ijkt} \quad (3)$$

where $SPILLOVER$ is either the VIX or the EONIA, and $RISK$ is a dummy for FX loans. The relevant main terms for MPP, $SPILLOVER$ and $RISK$ and their double interactions are omitted for simplicity, but they are introduced in all the regressions when not spanned by the fixed effects. The triple interaction term $MPP \times SPILLOVER \times RISK$ allows us to determine if macroprudential policies can tame banks' risky lending when risk appetite is high (i.e., the VIX is low) or when foreign monetary policy rates are low, and thus to test whether macroprudential policymaking is equally effective during booms and busts.

All the macroeconomic and bank-level variables in baseline specifications are averaged over the past two quarters.[24] The regressions use the Ordinary Least Squares (OLS) estimator with standard errors that are clustered on bank.

4   Results

We analyze the credit supply effects of macroprudential policies—for the overall MPP index, the bank-based, and the borrower-based indices—in regressions at the *bank-loan-quarter* level. We first discuss the results for risky loans (in foreign currencies or to high-debt borrowers), then the results for banks with heavy reliance on foreign funding, and finally the findings for cross-border spillovers from investor risk appetite and foreign monetary policies.

4.1   FX Loans

Table 2 presents regression results for the level and the differential impact of the macroprudential policy index (MPP) on bank lending to households. Column 1 shows the level specification from equation 1, which includes bank×year, borrower county×year, and loan-type×year fixed effects, as well as loan, bank, and borrower controls (see Table A4 for full regression results.). Here we are able to estimate the link between the *level* of macroprudential policies and loan growth by exploiting

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[24]The results are weaker but with expected and consistent signs with one-quarter lag and they are very similar to the reported baseline with a two-quarter lag.

within-year (quarterly) variation in macroprudential policies. The regression results indicate a negative and statistically significant link between MPP and bank credit, suggesting that a tighter macroprudential policy stance is associated with lower loan volumes.[25]

In columns 2-3 we focus on the impact of MPP on the currency composition of bank credit. We show the baseline specification from equation 2 where we interact MPP with a dummy for foreign currency loans FX, as FX loans are riskier when extended to unhedged borrowers. Furthermore, we account for time-varying macroeconomic conditions (including loan demand) at the county level with a set of demanding county×year-quarter fixed effects, which allows us to focus on variation in the currency extended by *different banks to borrowers in the same county and quarter*. Loan-type×year-quarter fixed effects ensure that comparisons are made for loans of the same type (either mortgages or consumer loans). This specification further includes the usual controls as well as interactions of GDP growth with the FX dummy to avoid the possibility that the coefficient on the interaction term of interest ($MPP \times FX$) captures the effects of the local economic cycle instead of those of macroprudential policies (as discussed in Section 3.3). The estimates in column 2 of Table 2 indicate that a tightening of macroprudential policy by one standard deviation (SD) or 3.581 units reduces average foreign currency loan volume by close to 18% more than it does for local currency loan volume.[26]

In columns 3-4 we distinguish between the effects of different groups of macroprudential instruments such as bank-oriented policies (column 3) and borrower-oriented policies (column 4). We choose to include these indices one at a time in the specifications due to their high correlation with one another. To the extent that the omission of an index would cause an omitted variable bias in the estimated coefficient on the included index, we would observe strong effects for all indices. However, the results suggest that this is not the case—despite this potential bias, the coefficient on $MPP \times FX$ in column 3 is statistically insignificant for the bank index. Column 4 suggests that borrower-oriented measures are more effective in reducing risky FX lending than bank-oriented measures.

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[25] In the data the raw correlation of MPP and bank credit is positive, as expected given that macroprudential policies tighten when credit picks up. Therefore, reverse causality causes an attenuation bias in the MPP coefficient, working against us finding results. Recall that after Romania's entry into the European Union (EU) there was a temporary loosening of the macroprudential policies in spite of the credit boom. This period allows us to re-estimate the MPP coefficient with the bias working in the opposite direction and helping us find negative effects of MPP. In unreported regressions we re-estimate the specifications in Table 2 during 9 and 12 months around the date of EU entry (January 1, 2007). As expected, we find negative and statistically significant coefficients of interest, on MPP and $MPP \times FX$, but economically larger than in the baseline regressions.

[26] Using the estimates in column 2: $3.581 \times (-0.0500) = -0.179$ or -17.9%.

In Table A5 we further unpack the coefficients from Table 2 to test for differential effects of macroprudential policy for loans in different currencies (EUR, CHF, other) relative to RON. For the overall index we find similar coefficient magnitudes for EUR and CHF loans, and larger magnitudes for other currency loans (USD, GBP, YEN). That said, the latter effect is not quantitatively significant since other-currency FX loans make up less than 0.5% of the sample. The estimates suggest that macroprudential policies, especially borrower-based measures, reduce FX loan growth uniformly across major currencies such as EUR and CHF.

4.2 Borrower Riskiness (DTI, FX)

We conduct a similar exercise in Table 3 to estimate the impact of macroprudential policies on the risk composition of household credit. Our measure of *ex-ante* borrower creditworthiness is borrower DTI.[27] Focusing on a measure of *ex-ante* borrower risk is important because *ex-post* measures such as loan defaults may confound the bank's assessment of loan risk when granting the loan, with subsequent events that influence loan performance (see, e.g., Dell'Ariccia et al. (2017) and Jiménez et al. (2014)).

Here all specifications include borrower county×year-quarter and bank×year-quarter fixed effects. Column 1 shows that the coefficient on $MPP \times DTI$ is negative but statistically insignificant. However, when we break down this effect by currency (column 2), using a spline of the $MPP \times DTI$ term with FX and RON loan dummies, we notice that the coefficient estimate on $MPP \times DTI \times FX$ is negative and statistically significant, while that on $MPP \times DTI \times RON$ is positive and statistically significant. Notice that this result is similar for bank- and borrower-based MPP indices (columns 3-4). It suggests a strong negative impact of macroprudential policies on FX loan volumes and a positive impact on RON loan volumes for riskier (higher DTI) borrower. Therefore, for a given level of borrower risk, a tightening of macroprudential policies changes the composition of bank credit away from (riskier) FX lending in favor of (less risky) local currency lending.[28]

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[27]We found no effects for mortgage lending using LTV as the measure of borrower risk. One reason may be that LTV is a poor measure of borrower risk given that during the sample period Romania had full-recourse mortgages. In addition, LTV ratios in the credit register are imputed using collateral values (house prices) at end-2012 rather than the time of loan origination, and hence do not reflect the boom-bust cycle in the housing market. We also found no effects using income as a measure of borrower risk.

[28]Importantly, our results are robust to the potential concern that high-debt borrowers are more likely to take up FX loans. In an unreported regression of the FX loan dummy on borrower DTI, we find no systematic sorting of riskier borrowers into FX loans, controlling for loan characteristics (amount and interest rate), with or without interacted fixed effects (such as bank×year-quarter, county×year-quarter, and loan-type×year-quarter fixed effects).

Comparing foreign and local-currency loans extended in a given quarter by a given bank to borrowers from the same county and with the same risk profile (DTI), and using the estimates in column 2 of Table 3, we find that a tightening of macroprudential policies by one SD (3.581 units) reduces FX loan growth by 11.6% and increases RON loan growth by 6.3% on average, for a differential of 17.9 percentage points.[29] These results suggest that tighter macroprudential policies reduce the *ex-ante* riskiness of bank credit, as measured by borrower DTI, *conditional on loan currency.* In particular, for a given level of borrower creditworthiness, tighter macroprudential policies dampen the riskier forms of bank lending, in foreign currencies, and increase the less risky forms of bank lending, in local currencies. As a result, the currency composition of loan originations changes away from FX and towards the local currency.

These effects are further examined in Table A6, which shows a decomposition by individual currency (EUR, CHF, OTHER). For the overal MPP index, in column 1 we find stronger dampening effects of tighter macroprudential policies on EUR and other foreign currency loans (as opposed to CHF). The results are broadly consistent for bank- and borrower-side indices (columns 2-3).

4.3 Bank Exposure to Foreign Funding

Next we analyze how the effects of macroprudential policies on household credit vary with bank-level heterogeneity in funding model. In particular, we examine the importance of the share of foreign funding (non-resident foreign currency deposits) in banks' total assets as a measure of banks' exposure to global funding conditions and external shocks. Almost 90% of banks' foreign funding comes from parent banks, and about 5% are loans from international development banks (such as the European Bank for Reconstruction and Development and the European Investment Bank). During 2009-2016 about 43% of non-resident deposits were short term (with maturity less than 2 years). Over the same period, more than 70% of non-resident deposits were in EUR and close to 20% in RON. As expected, foreign banks rely more heavily on foreign funding (the average ratio is 25% for foreign banks compared to 9% for domestic banks). In addition, foreign banks are conduits for external financial and monetary shocks (see, among others, Bräuning and Ivashina (2017b,a), Morais et al. (2017), Ongena et al. (2015), and Cetorelli and Goldberg (2012)). To ensure our results are not confounded by foreign bank ownership, we add relevant interactions with

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[29]Using the estimates in column 2: 3.581×(-0.0323)=−11.6% for FX loans and $3.581 \times 0.0177 = 6.3\%$ for RON loans.

the foreign-bank dummy to the specifications.

We expect macroprudential policies to affect banks with varying degrees of exposure to foreign funding differently because many policies, such as minimum reserve requirement ratios, directly target banks' FX-denominated liabilities. Therefore, we would like to construct a measure of foreign funding that matches the target of such measures as precisely as possible. Prior to 2005 reserve ratios applied to short-term FX funding (with a maturity of less than 2 years); during 2005Q1-2009Q1 reserve requirements were tightened to affect *all* FX funding (regardless of maturity). This measure was reversed in 2009Q2. In line with this sequence of policies, our bank-level measure of foreign funding refers to short-term FX non-resident deposits during 2004-2005 (defined as non-resident deposits with maturity less than 1 year, instead of 2 years, due to data availability), all FX non-resident deposits during 2005Q1-2009Q1, and again short-term FX non-resident deposits during 2009Q2-2012Q4 (defined as non-resident deposits with maturity less than 2 years).

In baseline Table 2 we documented a negative effect on the $MPP \times FX$ interaction variable. Here we ask whether this effect is stronger for banks with greater exposure to foreign funding. In Table 4 we show specifications with a triple interaction term of interest, $MPP \times FX \times Foreign\ Funding$ that include the relevant loan and borrower controls, GDP growth interactions, bank and county×year-quarter fixed effects, as well as competing interactions with foreign-bank dummy.

Comparing the results in columns 1 and 2 of Table 4 reveals that interactions with the foreign-bank dummy do not materially affect the coefficient on the triple interaction of interest, which remains negative and statistically significant. The estimated coefficient on $MPP \times FX \times Foreign\ Funding$ suggests a stronger dampening effect of tigher macroprudential policies on FX loan growth for banks that rely more heavily on foreign funding. The coefficient estimate -0.0025 in column 2 of Table 4 suggests that the dampening effect of a tightening in macroprudential policies on FX loan volume is larger by 8.2 percentage points for a bank with high exposure to foreign funding (90th percentile, or 34.64%) compared to a bank with low exposure to foreign funding (10th percentile, or 2.01%).[30]

The results in the remaining columns (3-4) reveal negative and statistically significant coefficient estimates for both the bank and the borrower-based indices. However, economic magnitudes indicate that bank-based measures are quantitatively more impactful. Standardizing the estimated coefficients on $MPP \times FX \times Foreign\ Funding$ in columns 3-4 reveals that bank-based macro-

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[30]Using the estimates in column 2: $(-0.0025 \times 34.64) - (-0.0025 \times 2.01) = -8.15\%$.

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prudential policies have a dampening effect on FX credit that is about 5 times larger than that of borrower-based policies, for a given level of foreign funding reliance.[31] The relatively higher effectiveness of bank-based instruments to reduce spillovers from banks' access to foreign funding on the local credit cycle is a novel finding in the literature, which previously emphasized borrower-targeted instruments as relatively more effective in emerging market economies (see, e.g., Cerutti et al. (2017) and Ayyagari et al. (2017)).

4.4   Spillovers from Global Uncertainty and Risk Appetite

We turn to exploring the role of macroprudential policies in mitigating cross-border spillovers from the global financial cycle. In this section we focus on the European VIX, reflecting global uncertainty and investor risk appetite, as one proxy of global financial conditions. The results are reported in Table 5. In column 1 we show a specification that focuses on the interaction of macroprudential policy and the continuous variable VIX. To better identify the effect of this variable, which varies by quarter, we only include bank×semester and county×semester fixed effects. Therefore, we only exploit within-semester (quarterly) variation in the VIX. The coefficient estimates indicate that a decline in the VIX (an increase in risk appetite) increases household credit and this effect is reduced by a tightening of macroprudential policy. Specifically, with no macroprudential policy ($MPP = 0$), a reduction of the VIX by one unit, or approximately one tenth of a SD, raises household credit by 6.5%; this effect is undone by an increase in the MPP index by 3.7 units or one SD.[32]

In columns 2-5 of Table 5 we dig deeper into the estimated effect of the VIX by allowing for differential effects for FX vs. local-currency loans. Breaking down the effect of $MPP \times VIX$ by loan currency (using a spline) yields positive and statistically significant coefficients which are not statistically different from one another (at the 1% level of significance). Therefore, when higher risk appetite increases puts upward pressure on lending to households, a tightening of macroprudential policies does not affect the currency composition of household credit. This non-effect, however, could conceal some nonlinearities. Therefore, we consider one more spline which further breaks down the currency-specific effect of MPP into periods of high vs. low VIX (above/below its

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[31]Using the SD of bank-based MPP (3.593), the SD of borrower-based MPP (1.052), and the SD of the dependent variable log(credit volume), the standardized coefficients on the triple interaction term in columns 3-4 are -0.0010 and -0.0046, respectively.

[32]Using the estimates in column 1: $0.0655/0.0177 = 3.7$ units, and the SD of the MPP index is 3.581.

average over the sample period). As seen in columns 3-5, the four-term spline introduced in these specifications reveals that macroprudential policies reduce FX loan growth relatively more than it does local-currency loan growth during periods of low VIX (high risk appetite); and than loan growth in *any* currency during periods of high VIX (low risk appetite). To examine the statistical validity of this result, we report p-values for one-sided t-tests that the coefficients on the triple interaction $MPP \times Low\ VIX \times FX$ are greater (in absolute value) than those on the remaining spline terms. We find this to be true for all MPP indices considered. Put differently, macroprudential polices are more effective at dampening risky (FX) bank credit to households as global risk appetite increases. In addition, they are most effective during periods when risk appetite is high, pushing capital flows to emerging markets and, through the banking system, fuelling household credit booms.

In Table A7 we explore the effects of macroprudential policies on spillovers of global risk appetite to household credit growth by loan type, distinguishing between mortgages (columns 1-3) and consumer loans (columns 4-6). The results show that when risk appetite is high (VIX is low), the elasticity of loan growth with respect to the overall MPP index and the individual indices is larger for consumer loans compared to mortgages (column 1 vs. 4). For each specification, the p-values at the bottom of the table indicate that the coefficient on the triple interaction term $MPP \times Low\ VIX \times FX$ is larger than that on all the other terms, consistent with the message of Table 5.

4.5 Spillovers from Foreign Monetary Policy

Our final set of specifications test the ability of macroprudential policies to affect the transmission of foreign monetary conditions to the local household credit cycle. Given the large degree of eurorization of the Romanian economy, our proxy for regional monetary conditions is the EONIA. Once again we estimate differential effects with double and triple interaction terms of the EONIA with the macroprudential policy index MPP and loan characteristics (FX), as shown in Table 6. All regressions include the usual controls and relevant interactions with the VIX. The regressions are saturated with bank-, borrower county, and loan-type×year-quarter fixed effects.

Looking at the estimated coefficients on EONIA×FX interactions in Table 6, we find that periods of low Eurozone monetary policy rates are associated with higher FX lending, suggesting cross-border spillovers of regional financial conditions. In addition, the positive and statistically

significant coefficient on the triple interaction term EONIA×MPP×FX indicates that macroprudential policy reduces this spillover effect. Notice that this effect is not driven by simultaneous changes in domestic macroeconomic conditions given that the specification controls for the interaction term EONIA×GDP growth×FX. The results in columns 2-3 for bank- and borrower-oriented measures reveal stronger effects for borrower-based measures.

5   Conclusions

In this paper we examine the impact of macroprudential policies on local bank credit to households and its role in mitigating spillovers from global financial conditions. Household leverage is an important driver of consumption booms and financial crises. Therefore, understanding the ability of macroprudential instruments to smooth the domestic credit cycle and insulate it from cross-border spillovers is crucial for policy design. To date, the literature largely focuses on corporate credit, with only few studies examining household credit.

We contribute to the literature by exploiting a comprehensive household credit register that contains all the individual loans extended by commercial banks in a financially-integrated emerging market economy. Our case study is Romania during 2004-2012. Romania is particularly well-suited for this analysis due the availability of a credit register coupled with detailed bank balance sheet data and borrower information, and because it has a majority foreign-owned banking system where banks rely on foreign funding from parent banks and hence are exposed to international liquidity conditions and external shocks. In addition, Romania experienced a full boom-bust economic cycle over the period of analysis during which policymakers deployed a wide range of macroprudential policies, including adjustments in reserve requirement ratios and capital requirements, caps on loan exposures to unhedged borrowers, and loan-to-value and debt-service-to-income ceilings.

Our results suggest that macroprudential policies impact domestic bank credit differentially, with stronger dampening effects on foreign vs. local currency loans and risky vs. less risky borrowers (as proxied by their debt-service-to-income ratios). A tightening of macroprudential policies also reduces household credit extended by banks that are more reliant on foreign funding, especially FX-denominated credit. Further, macroprudential policy is more effective at taming credit growth in (riskier) foreign currencies when global risk appetite is high, as proxied by a low VIX, and when foreign monetary policy rates are low. Overall, our findings support the notion that macroprudential

policies mitigate international spillovers of the global financial cycle on local household credit growth by dampening risky forms of lending.

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Figures and tables

Figure 1: Household Credit Growth and Macroprudential Policy
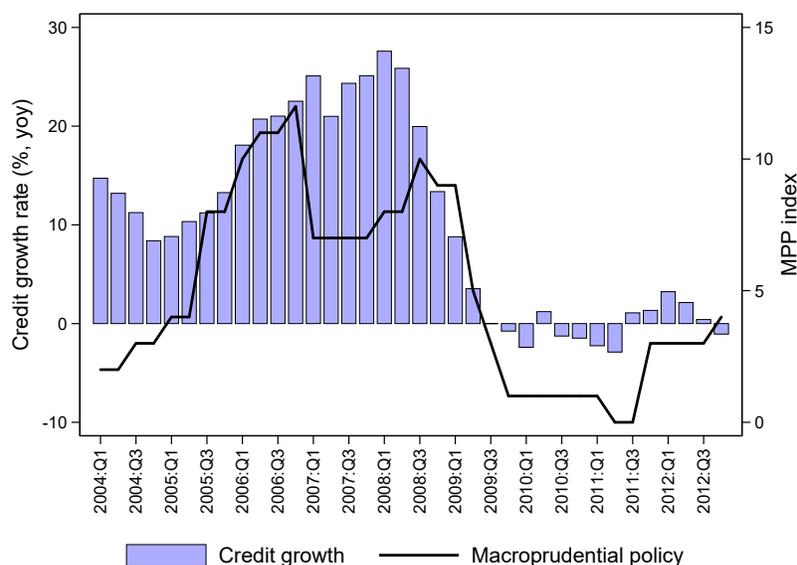
Notes: The figure plots household bank credit growth (in real terms, year-on-year) and the macroprudential policy index during 2004-2012. The macroprudential policy (MPP) index is constructed following the approach in Cerutti et al. (2017) by coding introductions and changes in macroprudential instruments employed by the NBR as tightenings (+1) or loosenings (−1). The index is defined as the running (cumulative) sum of these values such that each macroprudential instrument is reflected in the index throughout the entire time it is in place until it is changed or discontinued. Higher values of the index indicate a tightening of macroprudential conditions. Household credit is deflated by the CPI 2005=100. Data sources: National Bank of Romania.

Figure 2: Household Credit by Type and Currency
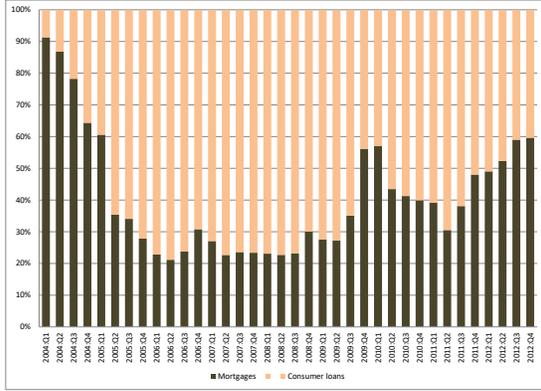
(a) Loan volume by type
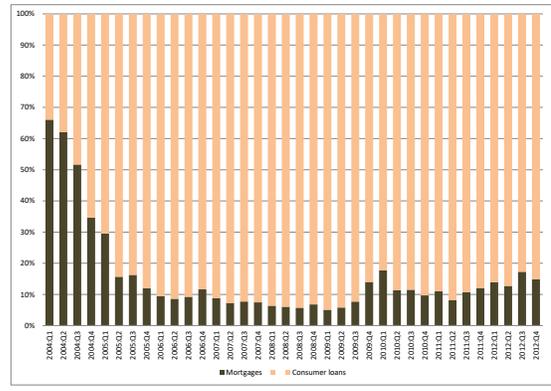
(b) Loan number by type
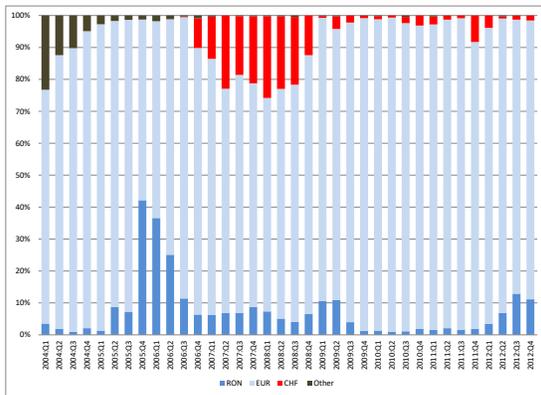
(c) Mortgages by currency
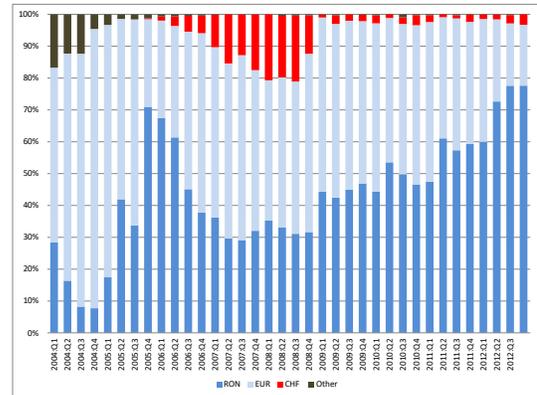
(d) Consumer loans by currency

Notes: The figure plots total bank credit by type (mortgages, consumer loans) and currency (RON, EUR, CHF, and other currencies) during 2004-2012. Data sources: National Bank of Romania.

Table 1: Descriptive Statistics

|	Obs	Mean	Median	St. Dev.
CREDIT REGISTER VARIABLES				
Loan amount (in local currency: RON)	2,965,479	68,173	37,216	208,357
Log(loan amount, in local currency: RON)	2,965,479	9.80	10.53	2.78
Borrower age (years)	2,965,479	39.17	38.02	10.01
Debt-service-to-income ratio (DTI)	2,139,977	61.66	42.65	56.49
First-home mortgage	2,965,479	0.0262	0.000	0.160
LOAN TYPES				
Foreign currency loan (FX)	2,965,479	0.336	0.000	0.472
Foreign currency loan in EUR	2,965,479	0.293	0.000	0.455
Foreign currency loan in CHF	2,965,479	0.039	0.000	0.195
Foreign currency loan in other currencies (OTHER)	2,965,479	0.004	0.000	0.061
Local currency loan (RON)	2,965,479	0.664	1.000	0.472
Mortgage (MGG)	2,965,479	0.104	0.000	0.305
Consumer loan (CONS)	2,965,479	0.896	1.000	0.305
Foreign currency mortgage (MGG-FX)	2,965,479	0.093	0.000	0.290
Local currency mortgage (MGG-RON)	2,965,479	0.011	0.000	0.104
Foreign currency consumer loan (CONS-FX)	2,965,479	0.243	0.000	0.429
Local currency consumer loan (CONS-RON)	2,965,479	0.653	1.000	0.476
MACRO VARIABLES				
Macroprudential policy index (MPP)—Overall	2,965,479	5.943	7.000	3.581
Macroprudential policy subindex—Bank	2,965,479	2.333	1.500	3.593
Macroprudential policy subindex—Borrower	2,965,479	2.25	2.000	1.052
Monetary policy rate (domestic)	2,965,479	8.136	7.500	2.373
GDP growth	2,965,479	4.367	6.340	4.998
Inflation	2,965,479	6.253	6.692	2.071
VIX	2,965,479	33.62	35.19	9.082
EONIA	2,965,479	2.389	2.634	1.542
BANK VARIABLES				
Bank size	2,943,757	23.56	23.71	1.077
Bank capital	2,777,235	7.472	7.046	3.272
Bank liquidity	2,943,757	2.584	2.092	1.847
Bank ROA	2,965,479	0.992	1.118	1.836
Bank NPL	2,965,479	3.263	0.962	4.500
Bank risk profile (RWA/assets)	2,777,234	65.10	65.13	10.38
Bank foreign funding	2,965,479	18.89	15.25	24.98
Foreign bank	2,965,479	0.812	1.000	0.391

Notes: The sample period is 2004-2012. Loan amount is expressed in local currency (*Romanian New Leu*, or RON). The DTI is available for both mortgages and consumer loans and is trimmed at a maximum value of 300%. The OTHER category of foreign currency loans refers to loans in U.S. Dollar, British Pound Sterling, and Japanese Yen (which account for less than 0.5% of all loans over the sample period). All loan type variables are dummies. Loan and bank variables are winsorized at the 1% to minimize the impact of outliers. See Table A2 for variable definitions and sources.

Table 2: Macroprudential Policies and Household Credit—FX Loans

	Overall index (1)	Overall index (2)	Bank index (3)	Borrower index (4)
Macroprudential policy	-0.0531*** (0.018)			
Macroprudential policy×FX		-0.0500*** (0.018)	-0.0305 (0.019)	-0.3630*** (0.068)
FX loan	1.6617*** (0.109)	2.1067*** (0.241)	1.9483*** (0.211)	2.5370*** (0.250)
Other controls	Yes	Yes	Yes	Yes
GDP growth interactions		Yes	Yes	Yes
Bank×Year FE	Yes			
County×Year FE	Yes			
Loan-type×Year FE	Yes			
Bank×Year-quarter FE		Yes	Yes	Yes
County×Year-quarter FE		Yes	Yes	Yes
Loan-type×Year-quarter FE		Yes	Yes	Yes
Observations	2,753,494	2,965,459	2,965,459	2,965,459
R-squared	0.219	0.263	0.263	0.264

Notes: The estimates in this table come from OLS over the period 2004-2012. Observations are at the bank-loan-quarter level. The dependent variable is log loan-volume L_{ijkt} extended by bank i to individual borrower j residing in county k during year t (column 1) or quarter t (columns 2-4). In column 1, other controls refer to macroeconomic variables (local monetary policy, GDP growth, inflation), bank variables (size, capital, liquidity, ROA, NPL, risk profile, share of foreign funding, and foreign bank dummy), borrower age, and loan variables (dummy for first-home mortgages). In the remaining columns macroeconomic variables and bank variables are spanned by the fixed effects so we only control for borrower age and loan variables (dummy for mortgages and for first-home mortgages). GDP growth interactions refer to GDP growth × FX. All macro and bank variables taken as averages over the last two quarters. Standard errors are reported in parentheses and are clustered on bank. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

Table 3: Macroprudential Policies and Household Credit—Borrower Riskiness (DTI, FX)

	Overall index (1)	Overall index (2)	Bank index (3)	Borrower index (4)
Macroprudential policy×DTI	-0.0002 (0.005)			
Macroprudential policy×DTI×FX		-0.0323*** (0.007)	-0.0296*** (0.005)	-0.1317*** (0.027)
Macroprudential policy×DTI×RON		0.0177*** (0.004)	0.0091* (0.005)	0.0447*** (0.011)
Borrower DTI	0.6595*** (0.072)	0.6489*** (0.071)	0.6695*** (0.067)	0.6625*** (0.074)
FX loan	1.3612*** (0.068)	1.5589*** (0.085)	1.5096*** (0.082)	1.5888*** (0.085)
Other controls	Yes	Yes	Yes	Yes
GDP growth interactions	Yes	Yes	Yes	Yes
Bank×Year-quarter FE	Yes	Yes	Yes	Yes
County×Year-quarter FE	Yes	Yes	Yes	Yes
Loan-type×Year-quarter FE	Yes	Yes	Yes	Yes
Observations	2,139,941	2,139,941	2,139,941	2,139,941
R-squared	0.271	0.273	0.272	0.273

Notes: The estimates in this table come from OLS over the period 2004-2012. Observations are at the bank-loan-quarter level. The dependent variable is log loan-volume L_{ijkt} extended by bank i to individual borrower j residing in county k during quarter t. The DTI ratio is divided by 100. In all columns macroeconomic variables and bank variables are spanned by the fixed effects so "other controls" refer to borrower age and loan variables (dummy for first-home mortgages). GDP growth interactions refer to GDP growth×DTI (column 1), or respectively GDP growth×DTI×FX and GDP growth×DTI×RON (columns 2-4). All macro and bank variables taken as averages over the last two quarters. Standard errors are reported in parentheses and are clustered on bank. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

Table 4: Macroprudential Policies and Household Credit—Bank Exposure to Foreign Funding

	Overall index (1)	Overall index (2)	Bank index (3)	Borrower index (4)
Macroprudential policy×FX×Foreign-funding	-0.0023***	-0.0025***	-0.0035**	-0.0048**
	(0.001)	(0.001)	(0.001)	(0.002)
Macroprudential policy×FX	-0.0166	-0.0024	0.0232	-0.4736***
	(0.017)	(0.038)	(0.045)	(0.128)
FX×Foreign-funding	0.0007	0.0015	-0.0016	-0.0002
	(0.012)	(0.011)	(0.011)	(0.010)
Macroprudential policy×FX×Foreign bank		-0.0141	-0.0124	0.2194**
		(0.036)	(0.043)	(0.090)
FX×Foreign bank		-0.2024	-0.2480	-0.6856**
		(0.406)	(0.422)	(0.337)
FX loan	2.0756***	2.2313***	2.1754***	3.0888***
	(0.237)	(0.361)	(0.391)	(0.368)
Other controls	Yes	Yes	Yes	Yes
GDP growth interactions	Yes	Yes	Yes	Yes
Bank×Year-quarter FE	Yes	Yes	Yes	Yes
County×Year-quarter FE	Yes	Yes	Yes	Yes
Loan-type×Year-quarter FE	Yes	Yes	Yes	Yes
Observations	2,965,459	2,965,459	2,965,459	2,965,459
R-squared	0.263	0.263	0.263	0.264

Notes: The estimates in this table come from OLS over the period 2004-2012. Observations are at the bank-loan-quarter level. The dependent variable is log loan-volume L_{ijkt} extended by bank i to individual borrower j residing in county k during quarter t. In all columns, macroeconomic variables and bank variables are spanned by the fixed effects (including the double-interaction Macroprudential policy×Foreign-funding) so "other controls" refer to borrower age and loan variables (dummy for first-home mortgages). GDP growth interactions refer to GDP growth×FX×Foreign-funding, GDP growth×FX (column 1), and additionally GDP growth×FX×Foreign-bank (columns 2-4). All macro and bank variables taken as averages over the last two quarters. Standard errors are reported in parentheses and are clustered on bank. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

Table 5: Spillovers of Global Risk Appetite on Household Credit

	Overall index (1)	Overall index (2)	Overall index (3)	Bank index (4)	Borrower index (5)
Macroprudential policy	-0.5885***	-0.5981***			
	(0.119)	(0.119)			
VIX	-0.0655***	-0.0667***	-0.0100	0.0069	-0.0243***
	(0.020)	(0.020)	(0.007)	(0.009)	(0.008)
Macroprudential policy×VIX	0.0177***				
	(0.004)				
Macroprudential policy×VIX×FX		0.0189***			
		(0.005)			
Macroprudential policy×VIX×RON		0.0174***			
		(0.005)			
Macroprudential policy×Low VIX×FX			-0.2317***	-0.2850***	-0.8161***
			(0.050)	(0.071)	(0.128)
Macroprudential policy×Low VIX×RON			-0.1821***	-0.2224***	-0.4627***
			(0.052)	(0.071)	(0.145)
Macroprudential policy×High VIX×FX			-0.0928**	0.0273	-0.6135***
			(0.036)	(0.069)	(0.088)
Macroprudential policy×High VIX×RON			-0.1131***	-0.0086	-0.4230***
			(0.038)	(0.066)	(0.078)
FX loan	1.6474***	1.5234***	1.8998***	1.8813***	2.3223***
	(0.105)	(0.201)	(0.225)	(0.200)	(0.235)
Other controls	Yes	Yes	Yes	Yes	Yes
GDP growth interactions	Yes	Yes	Yes	Yes	Yes
Bank×Semester FE	Yes	Yes	Yes	Yes	Yes
County×Semester FE	Yes	Yes	Yes	Yes	Yes
Loan-type×Semester FE	Yes	Yes	Yes	Yes	Yes
P-value t-tests coefficient on MPP×Low VIX×FX greater than					
Macroprudential policy×Low VIX×RON			0.000	0.000	0.000
Macroprudential policy×High VIX×FX			0.000	0.000	0.000
Macroprudential policy×High VIX×RON			0.000	0.000	0.000
Observations	2,753,494	2,753,494	2,753,494	2,753,494	2,753,494
R-squared	0.228	0.228	0.228	0.229	0.229

Notes: The estimates in this table come from OLS over the period 2004-2012. Observations are at the bank-loan-quarter level. The dependent variable is log loan-volume L_{ijkt} extended by bank i to individual borrower j residing in county k during year t. In all columns, other controls refer to macroeconomic variables (local monetary policy, GDP growth, inflation), bank variables (size, capital, liquidity, ROA, NPL, risk profile, share of foreign funding, and foreign bank dummy), borrower age, and loan variables (dummy for first-home mortgages). GDP growth interactions refer to GDP growth×VIX in column 1, and to GDP growth×VIX×FX and GDP growth×VIX×RON in columns 2-5. All macro and bank variables taken as averages over the last two quarters. Standard errors are reported in parentheses and are clustered on bank. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

Table 6: Spillovers of Foreign Monetary Policy on Household Credit

	Overall index (1)	Bank index (2)	Borrower index (3)
EONIA×FX	-0.3015***	-0.0966	-0.6035***
	(0.101)	(0.111)	(0.109)
EONIA×Macroprudential policy×FX	0.0448***	-0.0263	0.2411***
	(0.015)	(0.030)	(0.045)
Macroprudential policy×FX	-0.2791***	-0.1139	-1.3423***
	(0.051)	(0.074)	(0.235)
VIX×FX	-0.0137	0.0121	-0.0296
	(0.021)	(0.015)	(0.031)
VIX×Macroprudential policy×FX	0.0060***	0.0046**	0.0284***
	(0.002)	(0.002)	(0.009)
FX loan	2.6930***	1.6440***	3.8198***
	(0.390)	(0.309)	(0.581)
Other controls	Yes	Yes	Yes
GDP growth interactions	Yes	Yes	Yes
County×Year-quarter FE	Yes	Yes	Yes
Bank×Year-quarter FE	Yes	Yes	Yes
Loan-type×Year-quarter FE	Yes	Yes	Yes
Observations	2,965,459	2,965,459	2,965,459
R-squared	0.265	0.265	0.265

Notes: The estimates in this table come from OLS over the period 2004-2012. Observations are at the bank-loan-quarter level. The dependent variable is log loan-volume L_{ijkt} extended by bank i to individual borrower j residing in county k during quarter t. In all columns, macroeconomic variables and bank variables are spanned by the fixed effects so "other controls" refer to borrower age and loan variables (dummy for first-home mortgages). GDP growth interactions refer to the term EONIA×GDP growth×FX. All macro and bank variables taken as averages over the last two quarters. Standard errors are reported in parentheses and are clustered on bank. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

## Appendix figures and tables

Figure A1: Household and Corporate Credit Growth
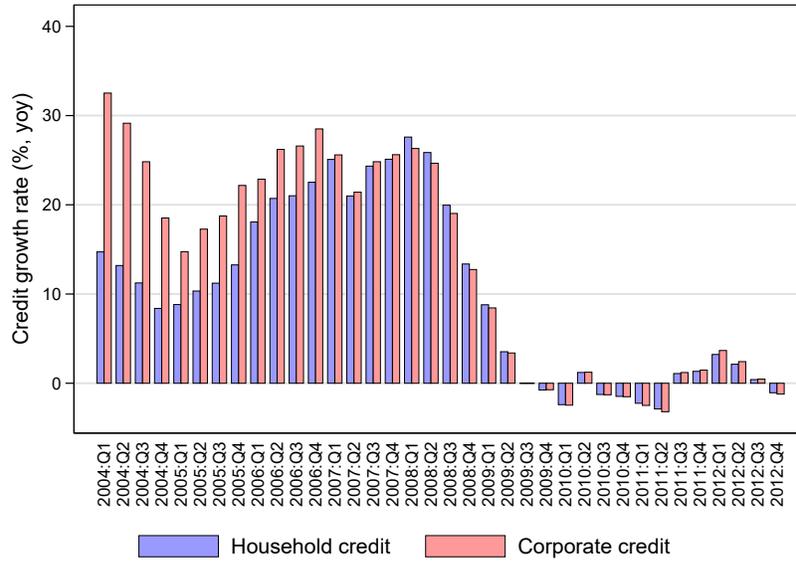
Notes: The figure plots household and corporate credit growth in real terms (year-on-year). Credit is deflated by the CPI (2005=100). Data source: National Bank of Romania.

Table A1: Macroprudential Policy Measures, 2004-2012

Date	Macroprudential policy measure	Overall index	Bank index	Borrower index
		+1 if tightening and −1 if loosening		
2004Q1	consumer credit: installments shall not exceed 30% of net incomes of the borrower and his family; mgg credit: installments shall not exceed 35% of net incomes of the borrower and his family	1	0	1
2004Q1	consumer credit: downpayment of at least 25% or cosigner commitment for purchases of goods; collateral and/or cosigner commitment for other types of consumer credit; mortgage credit: credit value shall not exceed 75% of property value	1	0	1
2004Q3	reserve requirement ratio on foreign currency deposits raised from 25% to 30%, reserve ratio on domestic currency deposits stays at 18%	1	1	0
2005Q1	reserve requirements broadened to include all foreign currency liabilities carrying maturities of over 2 years	1	1	0
2005Q3	regulation on provisioning and loan classification refined to take into account the foreign currency risk of the borrower	1	1	0
2005Q3	eligibility criteria for DTI was further tightened; overall installments associated with the sum of all credit contracts shall not exceed 40% of net incomes	1	0	1
2005Q3	foreign currency credit exposure of a credit institution arising from loans granted to unhedged individuals and legal entities shall not exceed 300% of own funds	1	1	0
2005Q3	provisioning rules tighten: credit institutions may include borrowers who do not earn steady income in the currency in which their loan is denominated at most in the "B" financial performance category	1	1	0
2005Q3	reserve requirements on domestic currency liabilities reduced from 18% to 16%	-1	-1	0
2005Q3	reserve requirements base broadenend to include all foreign currency liabilities carrying maturities of over 2 years regardless of when they were raised	1	1	0
2006Q1	reserve requirements on foreign currency liabilities raised from 30% to 35% and later to 40%	2	2	0
2006Q2	reserve requirements increased from 16% to 20% (for the first time in 6.5 years)	1	1	0
2006Q4	eligibility constraints (LTV, DTI) on household loans apply to regulated non-bank credit institutions as well	1	0	1
2007Q1	eligibility criteria for DTI defined by banks' internal models	-1	0	-1
2007Q1	foreign currency credit exposure limits removed	-1	-1	0
2007Q1	loan-to-value (LTV) limit removed	-1	0	-1
2007Q1	following entry into the European Union, minimum capital requirement lowered from 12% to 8%	-1	-1	0
2007Q1	full enforcement of Basel II regulatory framework. Lower risk-weights (standardized approach) and tightening of operational risk management	-1	-1	0
2008Q1	higher provisioning rate for loans to unhedged foreign currency borrowers	1	1	0
2008Q1	the October 2005 restriction regarding the possibility to classify an unhedged borrower in the"B" financial performance category at most is removed	-1	-1	0
2008Q1	a new requirement introduced, regarding distinct provisioning coefficients for loans in foreign currency or linked to another currency and granted to unhedged borrowers, as compared to hedged borrowers	1	1	0

Table A1: Macroprudential Policy Measures, 2004-2012 (continued)

Date	Macroprudential policy measure	Overall index	Bank index	Borrower index
		+1 if tightening and −1 if loosening		
2008Q3	current year profits excluded from regulatory capital	1	1	0
2008Q3	banks must consider the interest and exchange rate risk in setting the indebtedness ceiling (set on a case by case basis using internal risk models)	1	0	1
2008Q4	reserve requirementes on domestic currency liabilities reduced from 20% to 18%	−1	−1	0
2009Q1	requirement to take into calculation interest rate risk and currency risk when setting the indebtedness ratio for clients taking loans backed by mortgage on the home or the land within city limits removed	−1	0	−1
2009Q1	the minimum capital adequacy ratio set at 10% as long as multilateral financing arrangement with the EU, the IMF and other IFIs in place	1	1	0
2009Q2	reversal of August 2008 measure regarding capital (current year profits included in regulatory capital)	−1	−1	0
2009Q2	a fraction of the collateral value (less than 25%) can be deducted from the value of "loss" (i.e. 90+ days overdue) exposures to compute provisions (under the old regulation, no such deduction allowed)	−1	−1	0
2009Q2	launch of the "first home" mortgage subsidy government program	−1	−1	−1
2009Q2	reserve requirements on foreign currency liabilities with residual maturity greater than 2 years reduced from 40% to 0%.	−1	−1	0
2009Q3	reserve requirements on domestic currency liabilities reduced from 18% to 15%	−1	−1	0
2009Q3	reserve requirements on foreign currency liabilities with maturity less than 2 years were reduced from 40% to 25%	−1	−1	0
2009Q4	regulation 20/2009 allows inclusion of interim profits in capital	−1	−1	0
2009Q4	reserve requirements on foreign currency liabilities with maturity less than 2 years were reduced from 30% to 25%	−1	−1	0
2011Q2	reserve requirements on foreign currency liabilities with maturity less than 2 years reduced from 25% to 20%	−1	−1	0
2011Q4	introduce a loan-to-value ceiling by type of loan currency denomination, and specific foreign currency shocks to determine the maximum indebtedness level (for mortgage loans, LTV limit is 85% for local currency loans, 80% for foreign currency loans to hedged borrowers, 75% to EURO denominated loans to unhedged borowers; and 60% for other currency loans to unhedged borrowers. LTV limits do not apply to mortgages under the "first home" program. For consumer credit in foreign currency, the value of purchased goods shall not exceed 133%. Maturity of consumer credit set at maximum 5 years.	3	0	3
2012Q4	extension of regulatory measures to non-financial companies that are unhedged to currency risk by requiring lenders to apply tighter conditions on foreign currency-denominated loans	1	1	0

Table A2: Variable Definitions and Sources

Variable	Description	Source
CREDIT REGISTER DATA		
Loan amount (in local currency: RON)	Loan amount granted to an individual, expressed in local currency (Romanian New Leu, RON).	NBR
Borrower age (years)	Borrower age expressed in years at the time of loan granting.	NBR
Debt-to-income ratio (DTI)	Debt-service-to-income ratio at loan origination computed as the borrower's debt payments divided by wage income. Available for mortgage and consumer loans.	NBR and Ministry of Public Finances
First-home mortgage	Dummy variable that takes value 1 for mortgage loans granted under the first-time home ownership government program, 0 otherwise.	NBR
MACRO VARIABLES		
Macroprudential policy (MPP)—Overall	Macroprudential policy index computed coded based on the exhaustive list of macroprudential instruments employed by the NBR during 2004-2012 (Table A1). A tightening is coded as +1 and a loosening by -1. The index is computed as the running sum of macroprudential measures starting in 2004:Q1, such that higher values indicate a policy tightening (Cerutti et al., 2017).	Authors' calculations
Macroprudential policy index—Bank	Same as above, but based on bank-based macroprudential instruments. See Table A1 for coding.	Authors' calculations
Macroprudential policy index—Borrower	Same as above, but based on borower-based macroprudential instruments. See Table A1 for coding.	Authors' calculations
Monetary policy rate	NBR's 7-day repo rate at which the central bank conducts open market operations on the secondary government securities market.	NBR
GDP growth	Real (year on year) growth rate of seasonally-adjusted GDP	International Financial Statistics
Inflation	Year on year growth rate of overall CPI	International Financial Statistics
European VIX	Euro Stoxx 50 Volatility Index, which measures implied volatility of near-term options on the Euro Stoxx 50 Index.	STOXX
EONIA	Euro OverNight Index Average or one-day interbank interest rate for the Eurozone.	Reserve Bank of New Zealand
BANK VARIABLES		
Size	Logarithm of total assets.	NBR
Capital	Tier 1 capital in percent of total assets.	NBR
Liquidity	Liquid assets divided by required liquid assets.	NBR
Return on assets (ROA)	Net income divided by total assets.	NBR
Non-performing loans (NPL)	Non-performing loans divided by gross loans.	NBR
Risk profile	Risk weighted assets in percent of total assets.	NBR
Foreign funding	Foreign funding (non-resident deposits, mostly in EUR) scaled by total assets. Defined as all deposits with maturity less than 1 year before 2005, deposits of all maturities during 2005Q1-2009Q1, and deposits with maturity less than 2 years during 2009Q2-2012.	NBR
Foreign bank	Dummy variable for banks with majority foreign ownership.	NBR

Table A3: Local Macro Determinants of Macroprudential Policies

	Overall index (1)	Overall index (2)	Overall index (3)	Overall index (4)	Overall index (5)
Monetary policy rate	-0.0212				-0.1823
	(0.141)				(0.211)
GDP growth		0.3308***			0.4345***
		(0.103)			(0.122)
Inflation			0.0135		-0.0308
			(0.224)		(0.341)
VIX				-0.0329	0.0500
				(0.065)	(0.064)
Observations	36	36	36	36	36
R-squared	0.001	0.233	0.000	0.008	0.300

Notes: The estimates in this table come from OLS on quarterly data over the period 2004-2012. The dependent variable is the overall macroprudential policy index (MPP). All variables enter contemporaneously. Robust standard errors are reported in parentheses. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

Table A4: Macroprudential Policies and Household Credit—FX Loans—All Covariates

	Overall index (1)	Overall index (2)	Overall index (3)
Macroprudential policy	-0.0531***	-0.0388	
	(0.018)	(0.024)	
Macroprudential policy×FX		-0.0317**	-0.0500***
		(0.015)	(0.018)
FX loan	1.6617***	1.9455***	2.1067***
	(0.109)	(0.205)	(0.241)
GDP growth	-0.0136	-0.0117	
	(0.010)	(0.012)	
GDP growth×FX		-0.0117	-0.0146
		(0.023)	(0.020)
Monetary policy rate	-0.1079***	-0.1064***	
	(0.026)	(0.028)	
Inflation	0.0741***	0.0710***	
	(0.015)	(0.014)	
VIX	0.0044	0.0040	
	(0.006)	(0.006)	
Bank size	-0.5412**	-0.5190**	
	(0.233)	(0.233)	
Bank capital	-0.0334**	-0.0309*	
	(0.016)	(0.016)	
Bank liquidity	-0.0601**	-0.0621**	
	(0.027)	(0.027)	
Bank ROA	-0.1002	-0.1020	
	(0.079)	(0.081)	
Bank NPL	-0.1939**	-0.1912**	
	(0.076)	(0.078)	
Bank risk profile	-0.0162**	-0.0166**	
	(0.006)	(0.006)	
Bank foreign funding	0.0007	0.0007	
	(0.002)	(0.002)	
Foreign bank	-0.1909**	-0.2016**	
	(0.079)	(0.076)	
Borrower age	-0.0080***	-0.0081***	-0.0074***
	(0.003)	(0.003)	(0.003)
First-home mortgage	-0.0228	-0.0839	-0.2119
	(0.143)	(0.140)	(0.173)
Bank×Year FE	Yes	Yes	
County×Year FE	Yes	Yes	
Loan-type×Year FE	Yes	Yes	
Bank×Year-quarter FE			Yes
County×Year-quarter FE			Yes
Loan-type×Year-quarter FE			Yes
Observations	2,753,494	2,753,494	2,965,459
R-squared	0.219	0.219	0.263

Notes: The estimates in this table come from OLS over the period 2004-2012. Observations are at the bank-loan-quarter level. The dependent variable is log loan-volume L_{ijkt} extended by bank i to individual borrower j residing in county k during year t (columns 1-2) or respectively quarter t (column 3). All macro and bank variables taken as averages over the last two quarters. Standard errors are reported in parentheses and are clustered on bank. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

Table A5: Macroprudential Policies and Household Credit—FX Loans—By Currency

	Overall index (1)	Bank index (2)	Borrower index (3)
Macroprudential policy×FX×EUR	-0.0488**	-0.0301	-0.3552***
	(0.018)	(0.019)	(0.068)
Macroprudential policy×FX×CHF	-0.0551	-0.0416	-0.3191***
	(0.033)	(0.036)	(0.097)
Macroprudential policy×FX×OTHER	-0.1415**	-0.0941**	-0.7633***
	(0.054)	(0.046)	(0.201)
FX loan	2.1041***	1.9479***	2.5248***
	(0.241)	(0.211)	(0.249)
Loan, bank, and borrower controls	Yes	Yes	Yes
GDP growth interactions	Yes	Yes	Yes
Bank×Year-quarter FE	Yes	Yes	Yes
County×Year-quarter FE	Yes	Yes	Yes
Loan-type×Year-quarter FE	Yes	Yes	Yes
Observations	2,965,459	2,965,459	2,965,459
R-squared	0.263	0.263	0.264

Notes: The estimates in this table come from OLS over the period 2004-2012. Observations are at the bank-loan-quarter level. The dependent variable is log loan-volume L_{ijkt} extended by bank i to individual borrower j residing in county k during quarter t. In all columns macroeconomic variables and bank variables are spanned by the fixed effects so we only control for borrower age and loan variables (dummy for first-home mortgages). GDP growth interactions refer to GDP growth×FX×EUR, GDP growth×FX×CHF, and GDP growth×FX×OTHER. All macro and bank variables taken as averages over the last two quarters. Standard errors are reported in parentheses and are clustered on bank. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

Table A6: Macroprudential Policies and Household Credit—Borrower Riskiness—By Currency

	Overall index (1)	Bank index (2)	Borrower index (3)
Macroprudential policy×DTI×EUR	-0.0340***	-0.0312***	-0.1358***
	(0.007)	(0.006)	(0.028)
Macroprudential policy×DTI×CHF	-0.0239	-0.0334*	-0.0695
	(0.015)	(0.017)	(0.041)
Macroprudential policy×DTI×OTHER	-0.0536*	-0.0352*	-0.2797**
	(0.027)	(0.019)	(0.110)
Macroprudential policy×DTI×RON	0.0175***	0.0089*	0.0451***
	(0.004)	(0.005)	(0.011)
Borrower DTI	0.6504***	0.6700***	0.6622***
	(0.071)	(0.067)	(0.074)
FX loan	1.5616***	1.5118***	1.5907***
	(0.085)	(0.083)	(0.085)
Other controls	Yes	Yes	Yes
GDP growth interactions	Yes	Yes	Yes
Bank×Year-quarter FE	Yes	Yes	Yes
County×Year-quarter FE	Yes	Yes	Yes
Loan-type×Year-quarter FE	Yes	Yes	Yes
Observations	2,139,941	2,139,941	2,139,941
R-squared	0.273	0.272	0.273

Notes: The estimates in this table come from OLS over the period 2004-2012. Observations are at the bank-loan-quarter level. The dependent variable is log loan-volume L_{ijkt} extended by bank i to individual borrower j residing in county k during quarter t. The DTI ratio is divided by 100. In all columns macroeconomic variables and bank variables are spanned by the fixed effects so we only control for borrower age and loan variables (dummy for first-home mortgages). GDP growth interactions refer to GDP growth×DTI×RON, GDP growth×DTI×EUR, GDP growth×DTI×CHF, and GDP growth×DTI×OTHER. All macro and bank variables taken as averages over the last two quarters. Standard errors are reported in parentheses and are clustered on bank. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

Table A7: Spillovers of Global Risk Appetite on Household Credit—By Loan Type

	Overall index	Bank index	Borrower index	Overall index	Bank index	Borrower index
	Residential Mortgages			**Consumer Loans**		
	(1)	(2)	(3)	(4)	(5)	(6)
Macroprudential policy×Low VIX×FX	-0.0314***	-0.0390**	-0.0784***	-0.2564***	-0.3118***	-0.8438***
	(0.010)	(0.016)	(0.024)	(0.053)	(0.075)	(0.127)
Macroprudential policy×Low VIX×RON	0.0066	0.0290	-0.0370	-0.1984***	-0.2338***	-0.5558***
	(0.023)	(0.039)	(0.051)	(0.056)	(0.077)	(0.149)
Macroprudential policy×High VIX×FX	-0.0053	0.0103	-0.0392**	-0.1109**	0.0161	-0.6030***
	(0.015)	(0.024)	(0.017)	(0.041)	(0.075)	(0.064)
Macroprudential policy×High VIX×RON	-0.0272	0.0445	-0.1606	-0.1224***	0.0004	-0.5118***
	(0.020)	(0.056)	(0.097)	(0.041)	(0.074)	(0.078)
VIX	-0.0035	0.0006	-0.0065**	-0.0106	0.0059	-0.0263***
	(0.002)	(0.002)	(0.003)	(0.008)	(0.010)	(0.009)
FX loan	0.5604***	0.5657***	0.3428**	2.0168***	2.0021***	2.2373***
	(0.190)	(0.155)	(0.143)	(0.249)	(0.221)	(0.258)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
GDP growth interactions	Yes	Yes	Yes	Yes	Yes	Yes
Bank×Semester FE	Yes	Yes	Yes	Yes	Yes	Yes
County×Semester FE	Yes	Yes	Yes	Yes	Yes	Yes
Loan-type×Semester FE	Yes	Yes	Yes	Yes	Yes	Yes
P-value t-tests coefficient on MPP×Low VIX×FX greater than						
Macroprudential policy×Low VIX×RON	0.000	0.000	0.005	0.000	0.000	0.000
Macroprudential policy×High VIX×FX	0.000	0.000	0.006	0.000	0.000	0.000
Macroprudential policy×High VIX×RON	0.007	0.000	0.001	0.000	0.000	0.000
Observations	277,590	277,590	277,590	2,475,877	2,475,877	2,475,877
R-squared	0.197	0.197	0.198	0.185	0.186	0.186

Notes: The estimates in this table come from OLS over the period 2004-2012. Observations are at the bank-loan-quarter level. The dependent variable is log loan-volume L_{ijkt} extended by bank i to individual borrower j residing in county k during year t. In all columns, other controls refer to macroeconomic variables (local monetary policy, GDP growth, inflation), bank variables (size, capital, liquidity, ROA, NPL, risk profile, share of foreign funding, and foreign bank dummy), borrower age, and loan variables (dummy for first-home mortgages). GDP growth interactions refer to GDP growth×VIX×FX and GDP growth×VIX×RON. All macro and bank variables taken as averages over the last two quarters. Standard errors are reported in parentheses and are clustered on bank. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.