



Fixed rate versus adjustable rate mortgages: Evidence from euro area banks[☆]

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ABSTRACT

Why do residential mortgages carry a fixed or an adjustable interest rate? To answer this question we study unique data from 103 banks belonging to 73 different banking groups across twelve countries in the euro area. To explain the large cross-country and time variations observed, we distinguish between household conditions that determine the local demand for credit and the characteristics of banks that supply credit. As bank funding mostly occurs at the group level, we disentangle these two sets of factors by comparing the outcome observed for the same banking group across the different countries. Local household conditions dominate. In particular we find that the share of new loans with a fixed rate is larger when: (1) the historical volatility of inflation is lower, (2) the correlation between unemployment and the short-term interest rate is higher, (3) households' financial literacy is lower, and (4) the use of local mortgages to back covered bonds and of mortgage-backed securities is more widespread.

1. Introduction

Conventional mortgages can be classified in two main types: fixed rate mortgages and adjustable rate mortgages. Fixed rate mortgages (henceforth abbreviated as FRMs) charge a nominal interest rate that does not change during the entire life of the loan. Adjustable rate mortgages (henceforth, ARMs) charge an interest rate that is tied to a benchmark and varies over time. The volume of FRMs and ARMs extended to households in the economy depends on a broad set of factors that affect the demand by borrowers and the supply by lenders (ECB, 2009).

A striking feature of the credit market in the euro area is the very large heterogeneity across countries in the granting of FRMs versus ARMs. FRMs are dominant in Belgium, France, Germany and the Netherlands, while ARMs are prevailing in Austria, Greece,

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Italy, Portugal and Spain (ECB, 2009; Campbell, 2012). The time variation in the share of FRMs to total new mortgages differs across countries as well, with little variation over time in Germany and Portugal, but far more in Italy and Greece (ECB, 2009).

This observed variation across countries and over time has three major implications. First, the transmission of monetary policy is heterogeneous across countries and over time with relevant redistributive effects (Tzamourani, 2021; Pica, 2022). A prevalence of FRMs or ARMs in the economy entails a different interest rate exposure of the household sector. Being a major liability in the balance sheet of most households, mortgages likely play a key role in the transmission of monetary policy (Di Maggio et al., 2017). This is especially true in systems where ARMs are dominant because, on top of the traditional balance sheet channel and bank lending channel, also the cash-flow channel is at work, with significant macroeconomic effects (Garriga et al., 2017; Ippolito et al., 2018; Flodén et al., 2021; Tzamourani, 2021; Cumming, 2022; Pica, 2022).¹ This means that ARMs amplify the transmission mechanism of monetary policy through mortgage interest payments. Second, the allocation of interest-rate risk between the banking sector and the real sector differs across countries and over time, with direct consequences for financial stability. For example, in a context of rising interest rates, mortgage defaults are more likely when ARMs are prevalent (Campbell and Cocco, 2003). Third, the effectiveness of macroprudential policies in containing mortgage defaults varies across countries and over time, with potential repercussions for the financial system and the real economy (Stanga et al., 2017).² In light of that, investigating the determinants of the prevalent type of mortgage across countries and over time is crucial in order to derive normative insights.

In this paper we exploit unique bank-level information on lending activity in the euro area to analyze what drives the granting of FRMs versus ARMs. In particular, we investigate to what degree the wide cross-country heterogeneity in the interest rate type of mortgages is caused by salient differences in the characteristics of borrowing households and/or lending banks. The distinction between what is potentially attributable to household demand versus bank supply is crucial because the policy implications may differ substantially depending on the main drivers of the mortgage choice.

In general, household-specific factors include all features that make borrowers demand one or the other type of mortgage, as well as those that make a household more or less suitable to be financed at a fixed rate. Bank-specific factors include, instead, funding and liquidity conditions which may influence the ability of banks to supply FRMs.

Our empirical identification and estimation strategy rests on the availability of bank-level information on lending for a set of banks belonging to a banking group that operates in different markets and it relies on the assumption that funding of the banking group takes place at the consolidated level. Thus, the ability and willingness of a banking group to grant loans with certain features is also mainly determined at the consolidated level, particularly when the group operates in a monetary union, such as the euro area. Intuitively, this allows us to disentangle the impact of household-specific factors from that of bank-specific factors by comparing, on the one hand, the lending patterns observed for the same cross-border banking group in different economies and, on the other hand, the lending patterns observed in the same economy by different cross-border banking groups.

In practice, we decompose the variation of the share of FRMs to total new mortgages, henceforth abridged with “share of FRMs”, into “country-level household factors” and “bank factors”, by using fixed effects models and exploiting the wide-spread presence of cross-border banking groups. This approach is close in spirit to Amiti and Weinstein (2018) and Greenstone et al. (2020). Country-level household factors capture specific features of the borrowing country which are more related to loan demand, that is to the characteristics of the households in that country, whilst bank supply factors capture funding and liquidity conditions which are relevant for the lending supply by banks.

The main advantage of our approach is that we are able to jointly investigate the role played by household characteristics and bank conditions. Moreover, we are not bound to select a list of proxies for demand and supply factors, as typically done in the literature. Making such a selection is difficult as one cannot be sure that the list is exhaustive and, more importantly, that the variables under consideration truly capture only demand or only supply. On the down side, our estimated country-level household factors are not directly interpretable in economic terms, as they are likely to encompass a heterogeneous set of variables. Thus, in a second step, and similar to Ongena and Smith (2000), we adopt a two-stage approach whereby the estimated loadings on the country-level household factors are regressed on variables that are theoretically motivated.

Our main finding indicates a prominent role for country-level household factors which explain almost 72% of the total variation in the share of FRMs observed in the sample, as opposed to 19% associated with bank factors (the remaining 9% being the variation that the model is unable to explain).

In an extension of the baseline model we explore more in detail the time variation in the share of FRMs, which turns out to be strongly and negatively correlated with the term spread, that is the slope of the yield curve. In line with the main findings, the results of this exercise suggest that changes in the term spread mainly entail changes in the demand for FRMs, relatively to ARMs. Specifically, 79% of the variation in the share of FRMs driven by the term spread is ascribable to country-level household factors, although the elasticity of demand on the term spread differs across countries.

We more broadly explore the economic variables behind the cross-country differences in local household conditions, according to the two-stage procedure, as described above. The variables selected are taken from the existing literature, but we also put emphasis on a novel variable that has not been considered so far. We start from the observation that if households expect to be unemployed when interest rates are low, the ARM provides households with an insurance coverage (while the FRM does not). This simple (but at first sight somewhat counter-intuitive) observation leads us to check whether the share of FRMs is related to the correlation

¹ The cash-flow channel is the mechanism whereby conventional monetary policy actions are transmitted directly to borrowers' balance sheets via a change in the interest rate paid on outstanding (indexed) loans.

² Stanga et al. (2017) show that restrictive macroprudential policies are negatively associated with mortgage delinquencies in countries where FRMs are prevalent.

between the unemployment rate and the short-term interest rate. This correlation turns out to be highly significant and economically relevant in explaining the component of the share of FRMs associated to country-level household factors. Specifically, an increase in the correlation between the unemployment rate and the short-term interest rate by one standard deviation (an increase of 0.49) leads to an increase of 14 percentage points in the average share of FRMs per country explained by household conditions.

Concerning the statistical significance of the other (more standard) economic factors underlying the country-level household factors (having controlled for bank factors), we document a role for financial literacy, whose effect turns out to be negative, in line with the notion that more educated borrowers can better understand complex financial products such as ARMs.

Households in countries where the covered bonds market is more developed are more likely to borrow at a fixed rate, given that such bank funding instruments backed by mortgages are typically issued at long maturities and at fixed rates. For a similar reason, also the volume of securitized mortgages entails a higher likelihood of households selecting a FRM. An increase in the outstanding amount of mortgage covered bonds and residential mortgage-backed securities, scaled by GDP, by one standard deviation (corresponding to 6 percentage points for both) leads to an increase of 32 and 17 percentage points, respectively, in the average share of FRMs per country explained by the demand.

Finally, high historical volatility of inflation is strongly and negatively related to the share of FRMs, consistent with the idea that the macroeconomic history of a country affects households' mortgage choices. A one standard deviation increase in the historical inflation volatility (an increase of 9 basis points) entails a decrease of 59 percentage points in the average share of FRMs per country.

We complete our study adopting a similar approach to explain prices instead of quantities, that is considering as dependent variable the spread between FRMs and ARMs interest rates, rather than the share of FRMs. Our findings indicate that also the spread between FRMs and ARMs interest rates is mainly driven by country-level household conditions.

The remainder of the paper is organized as follows. The next section reviews the existing literature and explains the contribution of our work. Section 3 discusses the identification strategy, while Section 4 describes the dataset. Section 5 presents the methodology and the results of the empirical analysis. Section 6 concludes.

2. Literature and contribution

2.1. Demand and supply factors

The existing literature provides both theoretical modeling and empirical evidence on the determinants of the prevalent type of mortgage. A wide range of household factors and bank factors may drive the choice between FRMs and ARMs.

Household factors consist in all conditions affecting households' preference for one or the other type of mortgage, as well as their ability to be financed at a fixed rate. The risk profile of the lending exposure determines if a mortgage can be financed through long-term funds at a fixed rate, for example, by issuing covered bonds or mortgage-backed securities.

In general, an important role is ascribed to borrower's financial condition and level of education. In a pioneering work, [Campbell and Cocco \(2003\)](#) derive relevant theoretical predictions by treating mortgage choice as a problem in household risk management. In their framework, households subject to binding borrowing constraints at the time of the loan application, such as low income and low level of savings, are likely to choose the loan with the lowest interest rate. In general, this is then an adjustable rate as a fixed interest rate will include a term premium and the cost of the prepayment option.³ Yet, an ARM exposes households to the income risk of short-term variability in the periodic payments. Thus, households with a limited income risk bearing capacity, for example in case of high loan-to-income ratio and low financial wealth, are likely to select a FRM.

Several empirical papers have extensively investigated the role of income, savings, indebtedness and financial wealth in the choice of housing loans relying on households' income and wealth surveys ([Paiella and Pozzolo, 2007](#); [Fornero et al., 2011](#); [Cocco, 2013](#); [Ehrmann and Ziegelmeier, 2017](#)). These studies provide a general support for the predictions of [Campbell and Cocco \(2003\)](#).

Borrowers' education, especially the degree of financial literacy, is an important driver of mortgage choice as well ([Agarwal et al., 2010](#); [Fornero et al., 2011](#); [Gathergood and Weber, 2017](#)). In general, more educated borrowers have a deeper understanding of the intrinsic features of ARMs and FRMs. On the one hand, they are aware that, unconditionally, a FRM is more expensive than an ARM, due to the term premium and the cost of the prepayment option mentioned above. For this reason, they are more likely to select an ARM ([Agarwal et al., 2010](#); [Gathergood and Weber, 2017](#)). On the other hand, they are also mindful of the potential exposure to income risk if they choose an ARM ([Fornero et al., 2011](#)).

Bank factors consist in bank funding and liquidity conditions. In general, the composition of liabilities affects, and is affected, by the type of loan a bank is more willing to offer ([Kirti, 2020](#)). Since bank liabilities have typically a short duration, banks have a preference in originating ARMs.⁴ However, a few empirical studies show that low bank bond spreads, low deposit pass-through, low exposure to interest rate risk and high access to securitization make banks more prone to extend fixed rate loans ([Fuster and Vickery, 2014](#); [Foà et al., 2019](#); [Basten et al., 2017](#)).

³ The interest rate on an ARM is close to the short-term interest rate. The interest rate on a FRM is related, instead, to the long-term interest rate. The existence of a term premium and a cost of early repayment means that the interest rate on a FRM is not equivalent to the expectation of the future short-term interest rate. As a consequence, at inception of a loan the interest rate on an ARM and the interest rate on a FRM are not equivalent.

⁴ This holds true as long as banks can bear the exposure to interest rate risk, as documented by [Hoffmann et al. \(2019\)](#). Indeed, if banks were to fully hedge, they would be equally willing to supply FRMs and ARMs.

Beside these rather intuitive factors, there exist a set of macroeconomic factors that exert their effects either through demand or supply. These include current and future expected interest rates, as well as the unemployment rate and the macroeconomic history of a country.

The current spread between the interest rates on FRMs and ARMs is a leading factor of mortgage choice (Paiella and Pozzolo, 2007; Koijen et al., 2009; Fornero et al., 2011; Badarinza et al., 2018). This suggests that households behave myopically, selecting the type of loan that requires the lowest payments at the time of the loan application. However, households' expectations on the future interest rate applied on ARMs play a role as well, but only over the short horizon of one year (Koijen et al., 2009; Foà et al., 2019; Badarinza et al., 2018).

The difference between long-term and short-term interest rates is a component of the spread between FRMs and ARMs interest rates. As such, the current term spread is also a determinant of mortgage choice (Koijen et al., 2009; Basten et al., 2017; Ehrmann and Ziegelmeier, 2017). Since in the literature on the bank lending channel the level of interest rates is recognized to be able to shift both the demand and the supply of credit, one can surmise that the term spread may act as a shifter of both the demand and the supply of FRMs, relatively to ARMs.

The historic volatility of inflation plays an important role in the choice of mortgages as well. Countries with a history of high volatility of inflation show a prevalence of ARMs (Campbell, 2012; Badarinza et al., 2018). This is because the supply of FRMs is low when inflation is volatile and prepayment penalties are low, as lenders are more exposed to inflation risk than borrowers through a FRM. In fact, if inflation rises, the real value of payments declines, hereby favoring the borrower at the expense of the lender. Conversely, if inflation declines, the real value of payments increases, but the borrower often has the option to prepay and refinance at lower rates (Campbell and Cocco, 2003; Campbell, 2012; Badarinza et al., 2018). The dominance of ARMs in countries with a history of high inflation persists even after the adoption of the euro (i.e., after the national inflation rates converged), suggesting a substantial inertia in households' behavior (Campbell, 2012).

The volatility of the unemployment rate, as a proxy for households' expected income, is an additional driver of the prevalent type of mortgage. In countries with high volatility of the unemployment rate households are more likely to select a FRM, as future income is expected to be unstable (Ehrmann and Ziegelmeier, 2017).

Guren et al. (2021) emphasize the prominent role in mortgage choice of the monetary policy reaction function to aggregate shocks. If the central bank decreases interest rates in response to a crisis, an ARM provides households with higher insurance benefits allowing a higher degree of consumption smoothing. We are the first to test empirically this prediction including among our country demand factor a novel variable, namely the correlation between the unemployment rate and the short-term interest rate.

Table A1 in Appendix A.1 summarizes all the determinants of mortgage choice identified in the literature, as well as those analyzed in this study.

2.2. Contribution

The existing literature investigates the plethora of factors driving the choice between FRMs and ARMs, mainly focusing on one specific country and without providing information on the relative importance of household and bank factors. To the best of our knowledge, the works of Ehrmann and Ziegelmeier (2017) and Badarinza et al. (2018) are the only two papers to examine the determinants of mortgage choice across countries.

Using a new household wealth survey, the Eurosystem household finance and consumption survey, Ehrmann and Ziegelmeier (2017) provide a deep investigation of the household-specific factors, but ignore bank-specific factors. Relying on monthly country-level information, Badarinza et al. (2018) analyze how current and future expected interest rates affect the time variation in the share of ARMs to total new mortgages. They partially investigate the cross-country variation as well, but look exclusively at the role played by the historic volatility of inflation. Both these studies are not able to investigate jointly the broad spectrum of household and bank factors driving mortgage choice, neither to disentangle their impact.

We are able to overcome these limitations by using unique granular bank-level information on a sample of intermediaries operating in twelve countries in the euro area. The structure of our dataset allows us to take a step towards identifying the role of household and bank conditions in shaping the demand and supply of FRMs, relatively to ARMs. Assessing the relative importance of household-specific factors and bank-specific factors is crucial because the policy implications may differ substantially depending on what is the actual driver. Eventually, we are the first to explore the role of households' and banks' conditions also on the relative price of FRMs and ARMs.

3. Identification

Our identification strategy builds on the idea that funding takes place at the consolidated bank level. This allows us to disentangle country-level household factors from bank factors by comparing the lending behavior of the same cross-border banking group in different countries, as well as the lending behavior in the same economy by different cross-border banking groups operating there.

Our identification strategy is supported by several facts. First, lending policies are mainly driven by bank funding and liquidity conditions. In a cross-border banking group funding is defined at the consolidated level as to minimize the cost of capital. For example, Gu et al. (2015) show that international banks raise debt through subsidiaries operating in countries with a more favorable tax system. In general, cross-country differences in terms of taxation, regulation, bureaucracy, services and infrastructure, as well as

the development of capital markets play a crucial role in the way banks issue long-term funding instruments. Additionally, in a cross-border banking group funding mainly occurs at the consolidated level. Although international banks have progressively adopted a more decentralized funding model after the recent financial crisis, Gambacorta et al. (2019) show that cross-border banks' liabilities from foreign branches and subsidiaries represent, even recently, only 41% of total funds raised abroad. For similar reasons, also liquidity conditions are defined at the consolidated level. As a consequence, the ability and willingness of a cross-border banking group to grant loans with given characteristics is also mainly determined at the consolidated level. This is especially true if the group operates in a monetary union, such as the euro area, characterized by homogeneous regulations and integrated capital markets.

Second, when looking at cross-border banks, investors and regulators are mainly focused on consolidated balance sheets. For example, the "core principles for effective banking supervision" depicted by the Basel Committee on Banking Supervision pointedly refer to the assessment of consolidated balance sheet conditions, also regarding the exposure to interest rate risk (BCBS, 2012). These principles are broadly confirmed by the ECB guide to banking supervision (ECB, 2014). Additionally, the design of banks' surveys is typically aimed at gauging lending standards at the consolidated level. This is the case, for example, of the Euro Area Bank Lending Survey and the Senior Loan Officer Opinion Survey, run by the Eurosystem and by the Federal Reserve System, respectively.

Third, our identification assumption is consistent with the literature on cross-border banks as shock propagators. This literature shows that funding and liquidity shocks to the holding of a cross-border banking group affect local lending supply (Cetorelli and Goldberg, 2011, 2012; Schnabl, 2012; C el erier et al., 2020).

While it is reasonable to argue that lending policies are mainly driven by funding and liquidity conditions of the banking group, we cannot exclude that local funding or other factors may affect bank supply at the country level. For example, local subsidiaries may experience a certain degree of flexibility, which would be subsumed in our country-level household factors. However, the fact that fund-raising and liquidity conditions are prominent determinants of lending supply, as well as the fact that they are mostly defined at the consolidated level, ensures that our identification strategy is reliable.

More importantly, we cannot exclude that cross-border banks define local lending policies taking into account the household conditions that are specific to each country in which they operate. For example, it could be the case that a bank is less willing to extend ARMs in an economy characterized by high default rates (if it thinks that granting ARMs would entail even higher default rates). Our methodology includes such component of lending decisions that varies with borrowers' characteristics within the broad category of country-level household factors. In this respect, our analysis shares exactly the same advantages and limitations of studies exploiting more granular data to identify household conditions. Even in studies relying on, e.g., credit register data, factors that shape the risk-profile of households, and hence their borrowing capacity, are often subsumed by (time invariant or time varying) borrower fixed effects, which are typically meant to capture household (demand) conditions (Khwaja and Mian, 2008; Amiti and Weinstein, 2018).

4. Data

This paper uses the Individual Monetary and Financial Institution Interest Rates (IMIR) dataset held by the Bank of Italy. This dataset includes monthly bank-level information on a representative sample of 103 monetary and financial institutions (MFIs),⁵ which we will henceforth simply call "banks", acting in twelve countries in the euro area. In particular our panel includes banks operating in Austria, Belgium, France, Germany, Greece, Italy, Latvia, Luxembourg, Portugal, Slovenia, Spain and the Netherlands. Data cover the period that goes from July 2007 to December 2015.

The available information encompasses the amount granted and the weighted average interest rate applied to adjustable rate and fixed rate mortgage contracts. ARMs are identified as loans to households for house purchase with a floating rate and interest fixation period of up to one year, whereas FRMs are identified as mortgages with an interest fixation period of over one year. For FRMs we also have information on the volume and price of loans with a fixation period over 10 years. While the typical length of a FRM may vary across countries, loans with an interest fixation period of over 10 years represent, on average, half of FRMs extended in a given country in our sample. This ensures a certain comparability of FRMs across different jurisdiction. We caveat, though, that we do not have information on prepayment penalties and other specific contract terms.

Overall, we have 103 banks associated to 73 banking groups. The latter include 5 cross-border banking groups with 19 affiliated banks out of the 103 in total. Detailed information on the composition of banks in our dataset is exposed in Table 1. While the supervisory of our data is per se a guarantee of representativeness, we note that new mortgages extended by banks in our sample correspond, on average, to 34.2% of total mortgage origination in each country and each month.

Fig. 1 shows the average share of FRMs, the average spread between FRMs and ARMs interest rates, and the term spread computed as the difference between the 10-year Interest Rate Swap rate and the 3-month Overnight Index Swap rate at the semi-annual level. Looking at the average share of FRMs, we find a substantial cross-country heterogeneity. We can divide countries in two main groups. France, Germany and the Netherlands exhibit a large proportion of FRMs over the entire time period of our analysis. All the other countries exhibit more time variation and for most of them the average share looks negatively related to the average spread. Looking at the spread between FRMs and ARMs interest rates, some differences are observable as well, although for this metric the heterogeneity seems contained. The time patterns of the average spread largely reflect those of the slope of the term structure as measured by the term spread.

⁵ According to the European Central Bank monetary and financial institutions are resident credit institutions as defined in European Union law, and other resident financial institutions whose business is to receive deposits and/or close substitutes for deposits from entities other than MFIs and, for their own account (at least in economic terms), to grant credits and/or make investment in securities.

Table 1

Overview of Banks and Banking Groups, by Country The table reports summary statistics on the distribution of the 103 banks belonging to 73 banking groups in our sample by country. The first two columns distinguish between banks with a domestic top holder and banks with a foreign top holder. The third column reports the distribution across countries of the 19 banks affiliated to a cross-border banking group. The last two columns splits the 73 banking groups into those that operate only in one country (domestic) and those that operate in multiple countries (cross-border).

Country	Banks with a domestic top holder	Banks with a foreign top holder	Banks belonging to a cross-border banking group	Domestic banking groups	Cross-border banking groups
Germany	35	1	5	26	1
Italy	16	2	3	12	1
France	13	0	4	2	3
Spain	10	1	1	9	0
Austria	3	1	1	3	0
Slovenia	2	2	2	2	0
Belgium	3	1	1	3	0
Greece	4	0	0	4	0
The Netherlands	0	3	0	3	0
Portugal	3	0	0	3	0
Luxembourg	0	2	2	0	0
Latvia	1	0	0	1	0
Total	93	10	19	68	5

Fig. 2 displays the evolution of the share for domestic and foreign banks within countries, for the two representative group of economies. The heterogeneity across banks within (these groups of) countries is non negligible, but still much smaller than what is observable across such (groups of) countries. In both groups of economies foreign banks behave consistently with the domestic banks of the country in which they operate. This evidence suggests that country-level household factors may play a major role than bank factors.

Table 2 reports basic statistics for the share of FRMs and the spread between FRMs and ARMs interest rates for each country in our data set.

5. Empirical analysis

5.1. Baseline model

Our methodology relies on the approach proposed by Amiti and Weinstein (2018), although applied to our unique dataset, and exploits cross-border banking groups to decompose the share of FRMs into country-level household factors and bank factors.⁶ More specifically, we estimate the following type of regression:

$$\text{share}(b, c, t) = \alpha(c, t) + \beta(h(b), t) + \varepsilon(b, c, t) \quad (1)$$

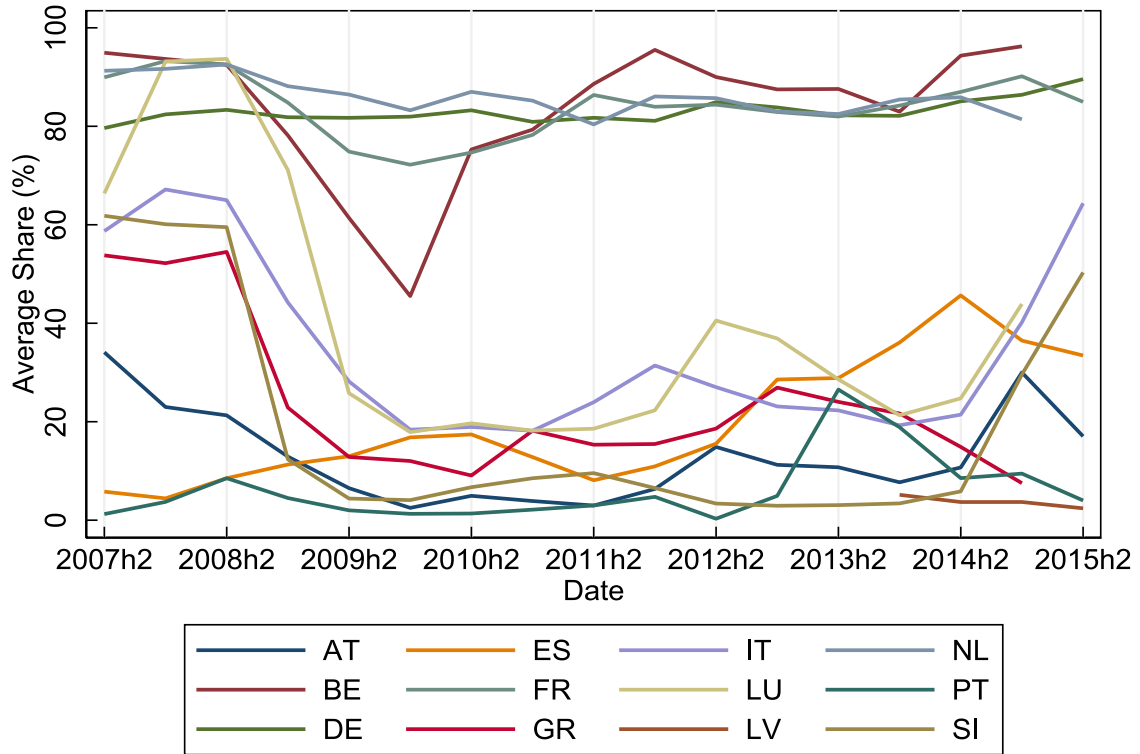
In Eq. (1) the share of FRMs extended by a given bank b operating in a given country c at time t is regressed on a set of different fixed effects. The terms $\alpha(c, t)$ represent month-country fixed effects. They capture all observable and unobservable time varying and time invariant characteristics of country c and, as such, they are meant to capture the household conditions prevailing in that economy. Obviously, no other country specific controls can be added to the specification, as these would be subsumed in the month-country fixed effects. This means that the inclusion of month-country fixed effects in Eq. (1) is equivalent to the use of an arbitrarily large set of country macroeconomic controls, which is why we argue that we are effectively capturing country-level household factors. Nonetheless, their limitation in this context is related to the inability to control for borrower conditions that are specific to individual intermediaries. As most of our analysis focuses on cross-border banks, and since these are typically large banks operating on a national scale and with a diversified set of borrowers, we consider our approach appropriate. The terms $\beta(h(b), t)$ represent month-banking group fixed effects, $h(b)$ denoting the holding of bank b . They consist in all observable and unobservable time varying and time invariant characteristics of banking group h and, as such, they are aimed at capturing bank conditions. In light of the fact that lending policies are usually defined at the consolidated level taking into account the financing conditions of the entire group, we argue that this set of fixed effects reasonably accounts for bank supply factors.⁷

By construction, Eq. (1) can only be estimated in the subsample of observations pertaining to cross-border banking groups. In this sample, Eq. (1) provides the upper limit of the R^2 that is achievable by regressing the share of FRMs on any set of variables capturing (time varying) characteristics of the borrowing country c and (time varying) characteristics of the lender h . Ideally, we

⁶ Greenstone et al. (2020) adopt a similar methodology, but they decompose the variation of their dependent variable using time invariant rather than time varying fixed effects.

⁷ Cross-border banks may sort themselves in countries that share similar characteristics. Even within a country, they may specialize in lending to households that demand a certain type of mortgage. If this is the case, our banking-group fixed effects may capture demand rather than supply factors. Nevertheless, the set of cross-border banks that we exploit in our regression analysis includes big universal banks which operate in countries that show a significant difference in the prevalent type of mortgage. Such big players are likely to operate on a national scale without specializing in a specific type of mortgage.

(a) Average share of FRMs



(b) Average spread of FRMs-ARMs interest rates (left) and term spread (right)

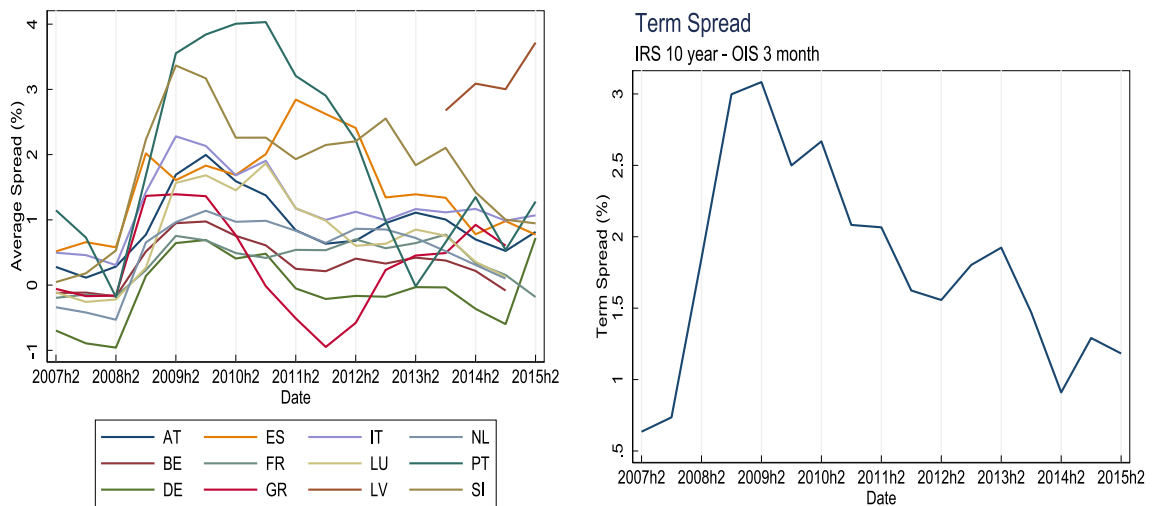


Fig. 1. Share of FRMs and spread between FRMs and ARM interest rates. The figure shows the average share of FRMs by country (a), the average spread between FRMs and ARMs interest rates by country (b-left), and term spread computed as the difference between the 10-year Interest Rate Swap rate and the 3-month Overnight Index Swap rate (b-right) at the semi-annual level.

would control for supply factors at the bank level, as we cannot exclude the possibility that some of these intermediaries experience some degree of autonomy (Houston et al., 1997). We investigate whether this is the case by estimating alternative specifications to model (1) where we can say something about the role of bank-specific factors defined at the individual bank level. Of course this comes at some cost, as it requires to abandon the use of time varying fixed effects. We evaluate the size of costs associated with this

Share of FRMs 1st group (left) and share of FRMs 2nd group (right)

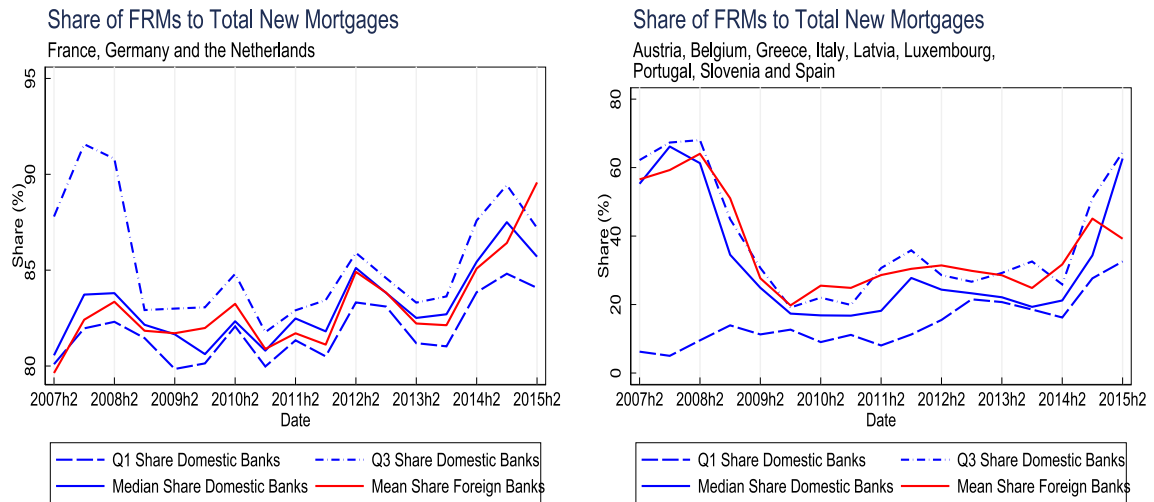


Fig. 2. Share of FRMs for groups of countries. The figure shows different statistics (first quartile, median, second quartile and average) for the share of FRMs of domestic banks and foreign banks for two groups of countries at the semi-annual level. The first group (left) includes France, Germany and the Netherlands. The second group (right) includes Austria, Belgium, Greece, Italy, Latvia, Luxembourg, Portugal, Slovenia and Spain. Domestic banks are banks with a domestic bank holding. Foreign banks are banks with a foreign bank holding. Q1 and Q3 stand for first quartile and third quartile, respectively. Share of FRMs 1st group (left) and share of FRMs 2nd group (right)

approximation. Eventually, in order to exploit the information available in the entire sample, we also explore simpler specifications where the set of controls is less fine than what is implied in model (1).

5.2. Baseline results

Models 1-3 of Table 3 report three specifications in which the share of FRMs is regressed on, respectively, month-country fixed effects, month-banking group fixed effects and both of these sets of fixed effects jointly. The latter is exactly the model specified in Eq. (1). Month-country fixed effects explain a significant fraction of the variation in the share (84%), suggesting a prominent role of country-level household factors. When considered alone, month-banking group fixed effects also explain some of the variation in the dependent variable (32%), but significantly less than month-country fixed effects. If taken together these two sets of fixed effects can explain 91% of total variation in the share. By decomposing the R^2 of model 3 according to the Shorrocks-Shapely approach, we find that the component of R^2 related to month-country fixed effects (72%) is considerably higher than the component related to month-banking group fixed effects (19%), confirming that country-level household conditions play a prominent role.⁸

When saturating the previous specification by including also bank (time invariant) fixed effects, as in model 4, we are able to explain almost the entire variation in the dependent variable. Even if we interpret these dummies as (time invariant) supply factors at the bank level, we would still conclude that overall bank conditions explain only a minor portion of the total variation in the share of FRMs.

To limit concerns that month-country fixed-effects capture to some extent bank factors that are specific to each country where the banking group operates, in model 5, we focus on a subset of banking groups whose holding company plays a more prominent role in driving the supply of FRMs versus ARMs. If we rely on heteroscedasticity robust standard errors, the estimates of model 2 reveal that about half of the coefficients of the month-banking group dummies are statistically significant and these observations pertain to three banking groups. Intuitively, these are exactly the banking groups where credit decisions are more centralized. We, thus, re-estimate model 3 on the subset of these three banking groups. Results are virtually unchanged compared to model 3.

One may be concerned whether the specific sample over which we are able to conduct our exercise, which is given by all observations (bank-month pairs) pertaining to cross-border banking groups, is representative enough. As shown in Table 3, this sample comprises 1644 observations, corresponding to about one fourth of the overall sample. On average, each cross-border banking

⁸ In the fixed-effect decomposition of model 3 we have 688 month-country dummies versus 480 month-banking group dummies. Although the number of the former is 28% larger than the number of the latter, the two sets of fixed effects are quite balanced. As will we show in the next section, results remain virtually unchanged when we re-estimate the model on a subsample of 1085 observations covering countries and time periods for which we have information on a set of macroeconomic characteristics of the country (model 3 of Table A2). The econometric specification of this subsample encompasses 360 month-country dummies and 393 month-banking group dummies. Although, in this case, the set of month-banking group fixed effects is somewhat larger than the set of month-country fixed effects, we still find that country-level household conditions have a much higher explanatory power than bank factors. This means that our results are not driven by the relative size of the two sets of fixed effects included in the model.

Table 2

Overview of the Share of FRMs and the Spread between FRMs and ARMs interest rates, by Country The table reports summary statistics on i) the share of FRMs and ii) the spread between the interest rates charged on FRMs and ARMs by country. Statics are calculated starting from our dataset at the bank-month level.

Country	N	Share of FRMs (%)				Spread FRMs - ARMs interest rates (%)			
		Average	Median	Minimum	Maximum	Average	Median	Minimum	Maximum
Austria	223	12.66	7.74	0.09	74.30	0.90	0.84	-0.54	3.49
Belgium	377	84.17	91.48	21.10	99.99	0.34	0.35	-1.04	1.70
France	812	84.37	93.14	6.25	100.00	0.44	0.38	-4.75	3.47
Germany	2565	82.78	85.93	14.95	99.96	-0.09	-0.04	-3.34	2.67
Greece	261	26.73	17.05	0.26	88.71	0.34	0.50	-2.08	3.39
Italy	1614	33.77	25.90	0.17	98.15	1.21	1.15	-1.12	3.43
Latvia	24	3.74	3.28	1.85	7.57	3.12	3.05	2.45	4.09
Luxembourg	161	36.39	28.50	1.58	97.95	0.86	0.77	-0.42	2.49
Portugal	183	4.50	1.99	0.05	39.93	1.94	1.83	-1.75	6.08
Slovenia	254	16.78	4.86	0.09	94.10	1.85	1.91	-0.33	4.13
Spain	605	19.10	8.37	0.09	90.84	1.49	0.93	-1.57	7.47
The Netherlands	248	86.30	86.01	71.43	98.47	0.50	0.72	-1.14	1.70
Sample	7327	57.44	71.26	0.05	100.00	0.62	0.55	-4.75	7.47

Table 3

Baseline model. The table reports the R^2 of various fixed effects decompositions of the share of FRMs. The sample includes cross-border banking groups only and the unit of observation is at the bank-country-month level. The dependent variable is the share of FRMs. The estimation method is OLS. Specification (3) reports the results of the baseline model of Eq. (1). Specification (5) is estimated on the subsample of three banking groups whose month-banking group dummies are largely statistically significant in model (2). Standard errors are not adjusted. A Shorrocks-Shapely decomposition of the R^2 is reported for model (3) and model (5). The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)
Month-country FE	YES	-	YES	YES	YES
Month-banking group FE	-	YES	YES	YES	YES
Bank FE	-	-	-	YES	-
N	1644	1644	1644	1644	839
R^2	0.843	0.319	0.908	0.973	0.906
Adjusted R^2	0.731	0.038	0.746	0.924	0.168
R^2 month-country FE			0.716		0.689
R^2 month-banking group FE			0.191		0.217
F-test statistic	7.493***	1.137**	5.616***	19.897***	1.230
degrees of freedom	(688,956)	(480,1164)	(1046,598)	(1057,587)	(743, 95)

group accounts for 13.2% of new mortgages extended in the countries where it operates and 50.5% of total originations covered by our sample in those countries.⁹ Therefore, cross-border banking groups in our sample encompass a set of large and representative institutions.

A second concern is whether the lending activity of cross-border banking groups in foreign countries is large enough to ensure a meaningful analysis. It could be the case that those banking groups originate only a small volume of loans outside of their borders, implying a volatile share of FRMs extended in foreign countries. Since month-banking group fixed effects are equally weighted, this may contribute to the limited explanatory power of month-banking group dummies. However, new mortgages extended by cross-border banking groups in non-home countries represent, on average, 44.4% of their total originations, hereby corroborating our methodological approach. While this figure is reassuring, to help further softening any concern, we check that our findings are not driven by any specific banking group (which, e.g., may conduct only a marginal mortgage business in foreign countries). To this end, we replicate the estimation of the baseline model of Eq. (1) by excluding each of the 5 cross-border banking groups in our sample one at the time. This robustness test is presented in Table A6 of Appendix A.5. Irrespective of which cross-border banking group is excluded from the sample, the estimates are virtually unchanged compared to those of model 4 in Table 3. We conclude that our baseline results are not driven by the lending behavior one specific institution.

Lastly, since cross-border banking groups encompass a rather homogeneous set of lenders, typically the largest players in the industry, our analysis may underestimate the relevance of bank-specific factors as a determinant of mortgage choice. For instance, it could be the case that large banks can more easily access financial markets to buy protection against interest rate risk or to

⁹ The average volume of new mortgages extended by a banking group (either cross-border or not) in a country in a month is EUR 255 mln in our sample, while the standard deviation is EUR 414 mln. By comparison, the average volume of new mortgages originated in a country in a month is EUR 5156 mln, with a standard deviation of EUR 5451 mln. If we focus the attention on the cross-border banking groups where the baseline model of Eq. (1) is estimated, the average volume of new mortgages originated by those banking groups in a country in a month is EUR 387 mln, whereas the standard deviation is EUR 452 mln.

raise long-term funds at fixed rate via covered bonds. If this is the case, focusing only on cross-border banking groups may lead to neglect part of the role played by lender conditions. To tackle this issue we conduct an exercise that requires a departure from our identification setup. In particular, we consider time invariant country fixed effects and banking group fixed effects to capture household-specific and bank-specific factors, respectively. In this way we are able to estimate similar regressions to those in Table 3, but run on the entire sample of banking groups, which is likely to be more heterogeneous than the subset of cross-border banking groups. This robustness exercise, illustrated in Appendix A.5, corroborates our conclusions drawn on the subsample of cross-border banking groups, emphasizing the role played by country-level household factors.

5.3. Two-stage model

Regressions reported in previous tables provide a useful breakdown of the contribution of country-level household factors and bank factors in explaining the share of FRMs. This breakdown is powerful, as it relies on reasonable identifying assumptions. However, its main limitation is that it consists in a mere statistical decomposition, which prevents from providing a meaningful economic interpretation. In particular, as discussed earlier, our results suggest that country-level household factors play a prominent role, but these may include a rather heterogeneous set of borrower-specific characteristics. The normative conclusions may be quite different depending on what is the actual driver.

A natural way to investigate which country-level household factors are more relevant would be to estimate a modified version of Eq. (1) where the time varying country fixed effects are replaced by a set of variables capturing different country demand conditions. The results of this exercise, presented in Appendix A.2, reveal that our selection of variables largely explains month-country fixed effects and that real disposable income and macroeconomic conditions play a prominent role in explaining the share of FRMs. While this represents a simple approach to shed some light on the determinants of the wide cross-country heterogeneity in the share of FRMs, it suffers from a major flaw. Our sample is characterized by significant differences in the number of banks operating in each country. Over-represented countries in the sample may drive the results and, hence, prevent from identifying the real mechanisms behind the observed heterogeneity in the prevalent type of mortgage across countries.

We, thus, consider a different approach. To ensure that we draw conclusions by giving an equal weight to the observations pertaining to each country, we adopt a two-stage model, as in Ongena and Smith (2000). In particular, we regress the estimated coefficients of the month-country fixed effects in the full specification of Eq. (1) on a set of explanatory variables.¹⁰ Unfortunately, 147 out of 393 month-country dummies in model 3 of Table 3 are omitted because of collinearity. As a consequence, performing the second stage regression with only 246 dependent variables would prevent us to get reliable results. To circumvent this issue, we estimate a similar regression to the one of Eq. (1), in which we substitute month-banking group fixed effects with quarter-banking group fixed effects. In this way, we are able to estimate 344 out of 393 month-country dummies and to perform the second stage regression accordingly. To be more specific, our two-stage regression looks as follows:

$$share(b, c, t) = \alpha(c, t) + \beta(h(b), t) + \varepsilon(b, c, t)$$

$$\hat{\alpha}(c, t) = \mathbf{x}'(c, t)\boldsymbol{\gamma} + v(c, t) \quad (2)$$

The terms $\beta(h(b), t)$ represent quarter-banking group fixed effects, while $\mathbf{x}'(c, t)$ denotes the vector of explanatory variables capturing country-level household conditions. These variables include a set of metrics suggested by the literature (those described in Section 2) plus a novel variable. In particular, we consider the following variables: financial literacy, indebtedness, gross disposable income per capita, historical volatility of inflation, correlation between unemployment and the short-term interest rate, outstanding amount of mortgage covered bonds to gross domestic product (GDP) and outstanding amount of residential mortgage-backed securities (RMBS) to GDP.

Our measure of *Financial Literacy* is obtained from the S&P Global FinLit Survey performed in 2014 (Klapper et al., 2015). The survey is based on interviews with more than 150,000 adults in over 140 countries. It provides information on the degree of knowledge of four basic concepts in finance: risk diversification, inflation, numeracy and interest compounding. Financial literacy is measured as the percentage of 3 out of 4 answers correctly given by adults interviewed in each country. Table 5 and Figure A1 in Appendix A.2 show that the level of financial education increases as we move from southern countries to northern countries.

To measure households' *Indebtedness* we use the ratio of total outstanding debt as percentage of gross disposable income provided by the OECD on a quarterly frequency. Table 5 and Figure A1 in Appendix A.2 display important differences in the level of households' indebtedness across countries. We consider the indebtedness ratio as a suitable proxy for households' income risk bearing capacity over the duration of the mortgage.

As a measure of *Real Disposable Income Per Capita* we use the gross disposable income (adjusted for social transfers in kind) of households (and non-profit institutions serving households) expressed in purchasing power standard (PPS) per inhabitant, obtained from Eurostat on an annual basis. Table 5 and Figure A1 in Appendix A.2 show a marked heterogeneity in households' real disposable income across countries over our sample period.

It is recognized in the literature that the unemployment rate plays a role in the mortgage choice (Ehrmann and Ziegelmeyer, 2017). A related aspect which has not been emphasized so far is that borrowers choosing between FRMs and ARMs should care not

¹⁰ To perform the second stage regression we only need that the estimated coefficients of the month-country fixed effects are unbiased. We argue that this condition is satisfied as the time varying country fixed effects and banking group fixed effects included in the first stage regression span all the possible factors determining the dependent variable.

Table 4
Description of Country Demand Variables.

Variable	Description
Financial Literacy	Percentage of 3 out of 4 answers correct given by adults interviewed in each country, as results from the S&P Global FinLit Survey (Klapper et al., 2015).
Indebtedness	Ratio of total outstanding debt as a percentage of gross disposable income provided by the OECD on a quarterly frequency. Data are missing for Latvia and Luxembourg, and partially available for Greece, Italy and the Netherlands.
Real Disposable Income Per Capita	Gross disposable income (adjusted for social transfers in kind) of households (and non-profit institutions serving households) expressed in purchasing power standard (PPS in thousands) per inhabitant, obtained from Eurostat on an annual basis. Data are missing for Luxembourg.
Historical Inflation Volatility	Realized standard deviation of the monthly month-on-month inflation rate during the period 1970–1999. Because of a lack in the available data, Historical Inflation Volatility is computed over the period 1991–1999 for Latvia and 1980–1999 for Slovenia. Monthly data on the inflation rate are retrieved from the OECD.
ρ (Unemployment, Short-term IR)	Realized correlation between the unemployment rate and the short-term interest rate, calculated on a rolling window approach with a window of 7 years. Monthly data on unemployment rates and short-term interest rates are retrieved from the ECB and the OECD, respectively.
Outstanding Covered Bonds to GDP	Average over the last four years of the amount outstanding of mortgage covered bonds as a percentage of GDP. Annual data on outstanding covered bonds are retrieved from the European Covered Bond Council (ECBC). Data are missing for Slovenia.
Outstanding RMBS to GDP	Average over the last four quarters of the amount outstanding of RMBS as a percentage of GDP. Quarterly data on outstanding residential mortgage-backed securities are retrieved from the Securities Industries and Financial Markets Association (SIFMA). Data are missing for Latvia, Luxembourg and Slovenia and not available for all other countries in 2007.

Table 5
Overview of Country Demand Variables, by Country.

	Financial literacy (%)		Indebtedness (%)		Real disposable income per capita (PPS in thousands)		Historical inflation volatility (b.p.)		Correlation unemployment short-term interest rate		Outstanding covered bonds to GDP (%)		Outstanding RMBS to GDP (%)	
	Avg.	Std. Dev.	Avg.	Std. Dev.	Avg.	Std. Dev.	Avg.	Std. Dev.	Avg.	Std. Dev.	Avg.	Std. Dev.	Avg.	Std. Dev.
Austria	53.00	–	85.73	1.70	24.75	1.07	44.68	–	–0.63	0.13	3.40	1.96	0.66	0.10
Belgium	55.00	–	91.73	7.53	22.62	1.14	38.38	–	–0.64	0.15	0.50	0.81	14.00	4.58
France	52.00	–	98.36	3.77	23.10	1.07	39.73	–	–0.89	0.09	6.71	2.77	0.88	0.49
Germany	66.00	–	89.45	3.05	25.26	1.86	32.39	–	0.04	0.59	8.39	0.83	0.63	0.17
Greece	45.00	–	104.29	3.26	17.00	1.87	152.30	–	–0.69	0.19	4.91	3.70	3.08	0.56
Italy	37.00	–	83.37	0.78	20.93	0.36	57.32	–	–0.70	0.24	2.74	2.88	6.17	1.77
Latvia	48.00	–	–	–	12.37	0.55	1015.10	–	0.10	0.22	0.02	0.03	–	–
Luxembourg	53.00	–	–	–	–	–	40.46	–	–0.36	0.16	0.13	0.14	–	–
Portugal	26.00	–	134.46	4.59	16.34	0.42	146.49	–	–0.47	0.36	12.28	7.22	17.56	3.14
Slovenia	44.00	–	52.70	2.22	16.01	0.47	859.02	–	–0.40	0.50	–	–	–	–
Spain	49.00	–	132.03	8.35	18.22	0.40	70.06	–	–0.66	0.26	28.92	5.56	13.64	2.41
The Netherlands	66.00	–	263.55	3.53	22.87	0.32	44.36	–	–0.70	0.09	5.41	3.10	35.85	8.30
Sample	49.50	11.15	109.97	50.93	20.53	3.7	211.69	342.87	–0.54	0.39	7.18	8.68	10.09	11.35

only about the expected evolution in labor market conditions, but also about how unemployment will correlate with the level of interest rates (Statman, 1982). Risk-averse households expecting to be unemployed in a context of low interest rates tend to prefer, ceteris paribus, an ARM, as this implies a higher degree of consumption smoothing (mortgage installments decrease when income goes down and vice versa). Guren et al. (2021) provide a theoretical support for this argument. Usually a crisis unfolds because of an aggregate shock to the demand, leading to a drop in income and inflation. In such situation, interest rates may decline due to the monetary policy reaction of the central bank. Guren et al. (2021) show that, if the central bank reduces interest rates in response to an aggregate shock, households should select an ARM rather than a FRM. If, instead, interest rates increase during a downturn, for example because of an aggregate shock to the supply, households should prefer a FRM.

In light of that, the correlation between interest rates and unemployment depends on different factors including the slope of the Phillips curve and the monetary policy rule adopted. A full discussion of these aspects is outside the scope of this paper. Here we limit ourselves to highlight that, whenever such correlation is negative, the mortgage contract providing more protection against income fluctuations is, somewhat counterintuitively, the ARM and the insurance motive attached to it is stronger the smaller the correlation. We postulate that households make their expectations looking at the past. Then, to capture this effect we introduce a novel variable, namely the correlation between unemployment and the short-term interest rate.

We calculate $\rho(\text{Unemployment, Short-term IR})$ as the realized correlation between the unemployment rate and a short-term interest rate,¹¹ relying on a rolling window approach with a window of 7 years. We opt for a window of 7 years for two reasons: First, we assume that households make long-term expectations;¹² second, we make sure that, at the beginning of our sample period in 2007, we measure the correlation between these two variables after the introduction of the euro.¹³ Table 5 and Figure A2 in Appendix A.2 show that the correlation between unemployment and the short-term interest rate is negative in most countries over our sample period. This suggests that in periods of economic growth unemployment is low and the short-term interest rate is high as a result of a tight monetary policy aimed at containing inflation. Conversely, in bad times, such as the recent double-dip European recession, unemployment is high and the short-term interest rate is low due to an expansionary monetary policy. However, there are some exceptions. For example, Germany exhibits a positive correlation from the end of 2010 on-wards. That is because the unemployment rate in Germany started to decrease in 2009, revealing a substantial improvement in economic fundamentals.¹⁴

We include as an indicator of the macroeconomic history of a country the volatility of the inflation rate over a period of 30 years prior to the introduction of the euro. We calculate *Historical Inflation Volatility* as the realized standard deviation of the monthly month-on-month inflation rate during the period 1970–1999 expressed in basis points.¹⁵ While a metric for the historical volatility of inflation constructed using a rolling window approach may allow to capture adaptive expectations on inflation across generations of households, our variable has a different interpretation. Before 1999, inflation rates in Europe were characterized by a strong variability and heterogeneity across countries. As soon as the Euro was adopted (in 1999 for most countries), national inflation rates sharply converged and became less volatile due to the common monetary policy set by the European Central Bank. As in Campbell (2012), we estimate our measure on a pre-euro period in order to emphasize differences across countries. This metric is aimed at capturing the stickiness in households' mortgage choice given the macroeconomic history of their country prior to the birth of the eurozone.

In Table 5 and Figure A1 in Appendix A.2 we see that the periphery economies of the euro area have experienced a substantial higher inflation volatility than central countries in the past. High variability of inflation is typically related to a high share of ARMs, because FRMs become very expensive when inflation is volatile. Countries with a history of high inflation volatility before 1999 still exhibit a prevalence of ARMs even after the introduction of the euro. Following Campbell (2012) and Badarinsa et al. (2018), we interpret this fact as evidence of a sticky demand, meaning that households tend to select the type of mortgage they are more familiar with.

We label the variables listed so far as pure demand factors, as they relate to specific characteristics affecting households' preference for FRMs vis-à-vis ARMs. We take into account also two additional variables, namely *Outstanding Covered Bonds to GDP* and *Outstanding RMBS to GDP*. The size of the covered bond market and the RMBS market of a country results from the interaction of two main forces. On the one hand, investors' demand for covered bonds and RMBS, and, hence, the ability of lenders to fund mortgages using these instruments. On the other hand, the extent to which local mortgages are suitable to back covered bonds or asset-backed securities based on, e.g., the credit quality of borrowers and the dynamics of the housing market. The former force represents funding conditions that affect the supply of FRMs. The latter, instead, represents demand conditions that affect the ability of households to be financed at a fixed rate.¹⁶ Our identification strategy builds on cross-border banking groups, which are typically large and have access to global financial markets. This means that a cross-border banking group can fund FRMs originated in a certain country by issuing covered bonds purchased by investors elsewhere.¹⁷ While we cannot exclude that mortgages, covered bonds and RMBS are jointly issued locally to meet investors' demand for these securities in a given country, our time varying banking group fixed effects should capture to a large extent the reliance of cross-border banking groups on these funding instruments. Hence, conditional on bank financing conditions and demand factors affecting households preferences for one type of mortgage, the covered bonds to GDP ratio and the RMBS to GDP ratio should capture the extent to which mortgages originated in a country are suitable to back covered bonds or RMBS.

¹¹ Data on short-term interest rates are retrieved from the OECD. For euro area countries the 3-month European Interbank Offer Rate is used from the date the country joined the euro. For the other countries the short-term interest rate is either the 3-month interbank offer rate or the yield on short-term Treasury bills, Certificates of Deposits or similar instruments with a maturity of three months.

¹² Usually long-term expectations have an horizon of at least five years (ECB, 2016, 2017).

¹³ In this way we ensure that households expectations are made taking into account that monetary policy is defined by the ECB for the entire euro area. This clearly implies that we estimate the correlation between unemployment and short term interest rate having the same short-term interest rate for all countries (with the only exception of Greece, Latvia and Slovenia before their access to the euro area respectively in 2001, 2014 and 2007).

¹⁴ This reflects, in turn, a flight-to-quality episode in the context of a monetary union. When economic conditions worsen due, e.g., to a global financial crisis, policy rates drop by the same extent for every economy in the monetary union, but flight to quality makes unemployment increase more in peripheral countries.

¹⁵ Because of a lack in the available data, the historical volatility of inflation is computed over the period 1991–1999 for Latvia and 1980–1999 for Slovenia.

¹⁶ For example, covered bonds regulations in most European countries specify that only mortgages having a loan-to-value below a certain threshold are eligible to be used as collateral for covered bonds (ECBC Covered Bond Comparative Database; ECB, 2008; ECBC, 2016).

¹⁷ Indeed, legislations on issuance of covered bonds in most European countries allow to include mortgages originated abroad in the covered pool (ECBC Covered Bond Comparative Database; ECB, 2008; ECBC, 2016).

We retrieve annual data on outstanding covered bonds from the European Covered Bond Council (ECBC). Our variable is the average over the last four years of the outstanding amount of mortgage covered bonds issued in a given country as percentage of GDP. Table 5 and Figure A2 in Appendix A.2 show that mortgage covered bonds are particularly popular in Portugal and Spain. As for residential mortgage-backed securities, we get quarterly data from the Securities Industries and Financial Markets Association (SIFMA). Our variable is the average over the last four quarters of the outstanding amount of RMBS by country of collateral scaled by GDP. Table 5 and Figure A2 in Appendix A.2 show that RMBS are common in the Netherlands and Portugal. Table 4 summarizes all the explanatory variables that we use to model country-specific factors, whilst Table 5 reports basic statistics. Both the summary statistics and the time series plots Appendix A.2, reveal that all the time varying country demand variables, except for $\rho(\text{Unemployment, Short-term IR})$, exhibit a much stronger variation in the cross section than in the time series.

5.4. Two-stage results

We now present the results of the two-stage model of Eq. (2). Model 1 of Table 6 reports the estimates of the first stage regression where we include month-country fixed effects and quarter-banking group fixed effects. In this specification we drop observations where the explanatory variables used in the second stage are missing. The R^2 is close to that of model 3 of Table 3.

In models 2-3, the coefficients of month-country fixed effects estimated by running model 1 are regressed over the set of explanatory variables capturing demand conditions. In order to make sure that our regressors are predetermined, we include lagged values for those variables that are available on a lower frequency than monthly.¹⁸ To have a reliable basis for inference, both in model 2 and in model 3, we rely on standard errors clustered by country and quarter.¹⁹ Given the different nature of the two groups of variables that we take into account, we first consider those capturing pure demand only and then integrate with the other country-level institutional factors. Model 2 shows the results for the specification including pure demand factors only. We find a negative and significant coefficient for Historical Inflation Volatility, which confirms our prior. Our result is consistent with that of Campbell (2012) and Badarinza et al. (2018), showing that households' are more likely to select the type of loan they are more familiar with based on the macroeconomic history of their country. As expected, the sign of the coefficients for Financial Literacy, Indebtedness and $\rho(\text{Unemployment, Short-term IR})$ are, respectively, negative, positive and positive, but neither of the three is statistically significant.

Model 3 extends the preceding including the whole set of regressors. Historical Inflation Volatility maintains its sign and significance. The coefficient of Financial Literacy turns out to be negative and statistically significant. This is consistent with the idea that financially educated households are more willing to select an ARM, as they are able to understand that, unconditionally, an ARM is cheaper than a FRM. Statistically significant is also the coefficient of $\rho(\text{Unemployment, Short-term IR})$. The positive sign corroborates our view that the smaller such correlation, the stronger the insurance protection provided by an ARM. This suggests that households make expectations on what would be the macroeconomic environment in which a labor shock may occur. In particular, households that expect to be unemployed in a context of low interest rates are more willing to select an ARM, while households that envisage to be unemployed in a context of high interest rates, are more prone to choose a FRM. This result confirms the theoretical prediction of Guren et al. (2021). The coefficients of Outstanding Covered Bonds to GDP and Outstanding RMBS to GDP are both positive and significant, suggesting that, in countries where the characteristics of borrowers ease the issuance of covered bonds and asset-backed securities, FRMs are relatively more appealing.

To obtain relevant normative insights, we do not limit ourselves to merely identifying the country-level household factors that play a role in mortgage choice, but we also provide an economic assessment of their magnitude. Table 7 reports the magnitude effects of the seven variables included in model 3 of Table 6. Focusing the attention on those that are statistically significant, we find that the Historical Inflation Volatility exhibits the strongest effect. One standard deviation increase leads to a decrease of 59 percentage points in the average share of FRMs per country cleaned of variation due to bank-specific factors. Sizable is also the effect of Financial Literacy. A rise of one standard deviation corresponds to a drop of 42 percentage points in the average share of FRMs per country ascribable to country-level household factors. Moreover, a one standard deviation increase in Outstanding Covered Bonds to GDP and in Outstanding RMBS to GDP determines a rise, respectively, of 32 and 17 percentage points in the dependent variable. Finally, a one standard deviation increase in $\rho(\text{Unemployment, Short-term IR})$ leads to a rise of 14 percentage points in the average share of FRMs per country left unexplained by bank-specific factors.

To ensure the soundness of our results, we perform a battery of robustness tests that challenge the design of our two-stage model. Appendix A.6 provides a comprehensive summary of those tests. Given the large magnitude effects identified for some of the explanatory variables in Table 6, as a first step, we check if our findings are driven by outliers. While some of the macro variables used in the second stage of Eq. (2) exhibit extreme values (e.g., the historical inflation volatility for Latvia and Slovenia), model 3 of Table 6 is effectively estimated on a subsample of six countries at the core of the euro area (Austria, Belgium, France, Germany, Italy and Spain), due to the inclusion of quarter-banking group fixed effects and to the lack of data on some variables for specific country-month pairs. Despite this reassuring fact, we still may want to dig into the drivers of our results and shed some light on the role played by outliers. To this end, we re-estimate the two-stage model of Eq. (2) by excluding each of the six countries one at the time. Results are reported in Table A9. We find that excluding Germany, France, Spain or Belgium does not have a major impact on

¹⁸ These are all the explanatory variables except for $\rho(\text{Unemployment, Short-term IR})$.

¹⁹ This conservative two-way clustering has been selected according to the procedure suggested by Petersen (2009), Cameron et al. (2011), and Cameron and Miller (2015). To tackle the issue that we may have few clusters, we adopt a small-sample correction for both standard errors and test statistics, as suggested by Cameron et al. (2011), and Cameron and Miller (2015).

Table 6

Two-stage model. The table reports (i) the R^2 of the first stage regression of Section 5.3 in model (1), and (iii) the coefficients and standard errors (in parentheses) of the second stage regression of Eq. (2) in models (2)-(3). The sample includes cross-border banking groups only and the unit of observation is at the bank-country-month level. The dependent variable is the share of FRMs in model (1), and the estimated coefficients of month-country fixed effects obtained from the first specification in models (2)-(3). Country variables include Financial Literacy, Indebtedness, Real Disposable Income Per Capita, Historical Inflation Volatility, ρ (Unemployment, Short-term IR), Outstanding Covered Bonds to GDP and Outstanding RMBS to GDP. All country variables except ρ (Unemployment, Short-term IR) are lagged of one period. The estimation method is OLS. Standard errors are not adjusted for model (1), and two-way clustered by country and quarter in models (2)-(3). The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	1st stage		2nd stage	
	(1)	(2)	(2)	(3)
Financial Literacy		-2.693 (2.26)		-5.386** (1.72)
Indebtedness		1.558 (0.99)		0.206 (0.78)
Real Disposable Income Per Capita		0.137 (4.26)		1.979 (3.65)
Historical Inflation Volatility		-3.847** (1.48)		-6.482*** (0.87)
ρ (Unemployment, Short – termIR)		33.128 (18.53)		28.726** (9.79)
Outstanding Covered Bonds to GDP				5.754*** (0.80)
Outstanding RMBS to GDP				2.756*** (0.50)
Quarter-banking group FE	YES			
Month-country FE	YES			
Two-way cluster	-	country, quarter	country, quarter	country, quarter
N	1085	344	344	344
R ²	0.847	0.337	0.337	0.503
Adjusted R ²	0.733	0.327	0.327	0.492
F-test statistic regressors pure demand degrees of freedom				50.57*** (5,5)
F-test statistic regressors institutional factors degrees of freedom				26.83*** (2,5)
F-test statistic fixed effects degrees of freedom	7.437*** (464,621)			

Table 7

Magnitude effects. The table reports the magnitude effects of the explanatory variables capturing demand conditions in model (4) of Table 6. In the third column the magnitude effect is computed as the product between the estimated coefficient and the standard deviation of the corresponding explanatory variable in the subsample where the model is estimated. In the last column the magnitude effect is computed as the product between the estimated coefficient and the interquartile range of the corresponding explanatory variable in the subsample where the model is estimated.

Variable	Coefficients	Standard deviation	Magnitude effect (sd)	Interquartile range	Magnitude effect (ir)
Financial Literacy	-5.386**	7.837	-42.213	3.000	-16.159
Indebtedness	0.206	11.097	2.291	12.870	2.657
Real Disposable Income Per Capita	1.979	2.216	4.386	3.260	6.453
Historical Inflation Volatility	-6.482***	9.064	-58.758	6.305	-40.872
ρ (Unemployment, Short-term IR)	28.726**	0.491	14.111	0.439	12.608
Outstanding Covered Bonds to GDP	5.754***	5.535	31.854	7.246	41.699
Outstanding RMBS to GDP	2.756***	6.330	17.445	9.652	26.603

our results, meaning that the estimates are to a large extent similar to those of model 3 of Table 6. Instead, Italy and Austria seem to be critical for our results, but not because they exhibit outliers. The reason lies in the fact that these two countries differ from the others along two dimensions: (i) they are both characterized by a marked variability in the share of FRMs over time, especially Italy, and (ii) Austria shows the strongest prevalence of ARMs throughout the sample.

Next, we test if our results are robust to the inclusion of different metrics capturing country-level household factors. We show that our findings remain virtually unchanged (i) if we replace ρ (Unemployment, Short-term IR) with the correlation between the number hours worked per capita and the short term interest rate to use an alternative metric for employment conditions (Table A11), and (ii) if we include the house price to income ratio in the set of regressors to capture housing affordability (Table A10). In addition, our main takeaways (in particular with respect to the role of the historical inflation volatility and the size of the covered bonds and the RMBS markets) are confirmed (i) when we replace Historical Inflation Volatility with a rolling-based metric to capture

adaptive expectations on inflation (Table A12), and (ii) when we use the ratio of public debt to GDP to capture investors' demand for securities such as RMBS (Table A13).

Finally, our results are confirmed even when we use sampling weights based on the relative size of the mortgage market in each country to further ensure that we estimate the two-stage model by equally weighting each country (Table A14).

5.5. Time variation

Some useful indications can be obtained by exploring more closely the variation across time in the share of FRMs. As noted in Fig. 1, for those countries in which the share of FRMs changes over time, the variability seems to be related to the spread between FRMs and ARMs interest rates. Since the term spread is a component of the spread between the interest rate applied on fixed rate and adjustable rate loans, the time variation in the share is related to the term spread as well. We aim to investigate whether the sensitivity of the share of FRMs to the term spread is mainly driven by household-specific or bank-specific factors. To this end we estimate the following type of regression:

$$\begin{aligned} \text{share}(b, c, t) = & \alpha(c) + \alpha(c) \times \text{tspread}(t) \\ & + \beta(h(b)) + \beta(h(b)) \times \text{tspread}(t) + \varepsilon(b, c, t) \end{aligned} \quad (3)$$

The terms $\alpha(c)$ represent country fixed effects, $\beta(h(b))$ denotes banking group fixed effects and $\text{tspread}(t)$ is the term spread at time t .

In this model, country fixed effects and banking group fixed effects capture the average level of the share for each country and each banking group. Their interactions with the term spread capture, instead, the sensitivity (slope) of each country and each banking group to changes in the term spread. This regression allows us to model the time variation in the share of FRMs using the term spread and assuming that the relation between these two is linear. As before, to disentangle shifts in household conditions from shifts in bank conditions, we focus the attention on cross-border banking groups.

It is important to stress that, differently from other studies, we regress the share of FRMs on the term spread rather than the spread between FRMs and ARMs interest rates, as we want to draw causal inference. While the former can be considered to a large extent exogenous, the latter is inherently endogenous. Indeed, the spread between FRMs and ARMs interest rates is simultaneously determined with the quantities of FRMs and ARMs extended in equilibrium.

In estimating this model we use the term spread computed at the European level as the difference between the 10-year Interest Rate Swap rate and the 3-month Overnight Index Swap rate. We adopt this measure for the slope of the yield curve rather than the term spread for each country obtained on the basis of the respective government bonds. The reason is that, especially for those country that were more affected by the sovereign debt crisis, the interest rate charged on FRMs is more closely related to the 10-year Interest Rate Swap rate rather than the yield on 10-year government bonds. This can be explained by the fact that, during most of the time period under analysis, sovereign default risk in several countries was sensibly higher than credit risk associated with local mortgages.

Table 8 reports six different specifications. Model 1 includes country fixed effects only, while model 4 includes both country fixed effects and their interaction with the term spread. Country fixed effects explain alone 58% of the variation in the share of FRMs. When we add the interaction of country fixed effects with the term spread the coefficient of determination rises to 66%. This value is quite far from the 84% achieved in our baseline model with month-country fixed effects. However, while in the baseline model we allow country fixed effects to vary in a discretionary way over time, in model 4 we constrain the share of fixed rate mortgages to evolve linearly with the term spread. Of course, since the share is bounded between 0 and 100, it is likely that this relation is not linear. In fact, if we add an additional interaction term with the term spread squared, we experience an increase in the R^2 (71%). So, we conclude that the term spread is able to explain the time variation in the share of FRMs and that the relation between these two is not perfectly linear. A similar argument applies also to the two specifications with banking group fixed effects, namely model 2 and model 5.

Consistently with the evidence in Fig. 1, we find that most of the coefficients of the interaction terms in model 4 are negative and significant. However, the sensitivity of the share of FRMs to the term spread differs significantly across countries. In particular, Belgium, Greece, Italy, Luxembourg and Slovenia are those countries where the share of FRMs is more reactive to changes in the term spread.

We have already pointed out that changes in the term spread can shift both the demand and the supply. On the one hand, an increase in the term spread, driven by an increase in inflation risk, may lead banks to decrease the supply of fixed rate loans, by making them relatively more expensive than adjustable rate ones. On the other hand, a rise in the spread between FRMs and ARMs interest rates due to an increase in the term spread may induce households to reduce their demand for fixed rate loans, which could signal either some form of myopic behavior (households choose ARMs when the term spread is high because they tend to give too much importance to the first installments), as well as the presence of financial constraints (matched with expectations of an increase in income). To assess whether (country-level) household-specific or bank-specific conditions are more sensitive to changes in the slope of the yield curve, we include a specification in which we interact both country fixed effects and banking group fixed effects with the term spread. Relying on the Shorrocks-Shapely decomposition, we are able to detect the contribution of each interaction to the R^2 . Model 6 shows that the fraction of R^2 ascribable to the interaction between country fixed effects and the term spread is much higher than the fraction attributable to the other interaction. Thus, we conclude that changes in the slope of the yield curve shifts mainly country-level household demand.

Table 8

Time variation. The table reports the results of the analysis investigating the sensitivity of the share of FRMs to the term spread. The term spread is calculated as the difference between the 10-year Interest Rate Swap rate and the 3-month Overnight Index Swap rate. The sample includes cross-border banking groups only and the unit of observation is at the bank-country-month level. The dependent variable is the share of FRMs. The estimation method is OLS. Specification (6) reports the results of the model of Eq. (3). Standard errors are not adjusted. A Shorrocks-Shapely decomposition of the R^2 is reported for model (6). The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Austria x term spread				-9.124** (3.73)		-9.643 (5.87)
Belgium x term spread				-24.195*** (2.47)		-36.813*** (4.47)
Germany x term spread				-2.031* (1.10)		-9.536** (4.83)
Spain x term spread				-2.260 (3.91)		-11.414* (6.00)
France x term spread				-7.693*** (1.24)		-23.565*** (4.17)
Italy x term spread				-8.795*** (1.42)		-16.524*** (4.43)
Luxembourg x term spread				-14.020*** (2.05)		-18.195*** (2.46)
Slovenia x term spread				-27.161*** (2.32)		-46.651*** (4.87)
Country FE	YES	-	YES	YES	-	YES
Banking group FE	-	YES	YES	-	YES	YES
Banking group FE x term spread	-	-	-	-	YES	YES
N	1644	1644	1644	1644	1644	1644
R ²	0.580	0.1458	0.6199	0.657	0.206	0.709
Adjusted R ²	0.578	0.1437	0.6173	0.654	0.201	0.705
R ² country FE						0.303
R ² country FE x term spread						0.279
R ² banking group FE						0.054
R ² banking group FE x term spread						0.073
F-test statistic	322.089***	69.927***	241.939***	207.597***	46.976***	171.713***
degrees of freedom	(7,1636)	(4,1639)	(11,1632)	(15,1628)	(9,1634)	(23,1620)

5.6. Additional analyses

The quantity of FRMs and ARMs, as well as their interest rates, are simultaneously determined on the market by the interaction between demand and supply. No bank should be able to individually set the share of FRMs granted neither the price of FRMs and ARMs. If this is the case, the variation in the spread between FRMs and ARMs interest rates should be explained by the same factors driving the share of FRMs. We explore this possibility by performing the same set of reduced-form regressions exposed in Section 5.1 through Section 5.5 using this time as dependent variable the spread between FRMs and ARMs interest rates, henceforth abridged simply with “spread”. The results presented in Appendix A.4 reveal that all our findings are confirmed when we look at prices rather than quantities, but they are somewhat weaker.

Finally, the econometric analyses presented so far are performed using linear regressions. Our main dependent variable, the share of FRMs, is a percentage bounded between 0 and 100. Using a linear model in this setting leads to inconsistent estimates. For this reason, we perform a battery of robustness tests by replicating all our econometric specifications by using Tobit regression models. As documented in Appendix A.7, all our results are virtually unchanged.

6. Conclusions

Using granular bank level information from 103 banks belonging to 73 banking groups across twelve countries in the euro area, we provide a comprehensive analysis of the determinants of mortgage choice in the euro area. In particular, by exploiting cross-border banking groups, we investigate to what degree the wide cross-country heterogeneity in the share of fixed rate mortgages to total new mortgages is driven by differences in household-specific or bank-specific conditions.

Country-level household factors seem to have a prominent role in driving the prevalence of mortgages extended at a fixed rate. Factors such as the historical volatility of inflation rates, the correlation between unemployment and the short-term interest rate, households’ financial literacy, and the volume of outstanding mortgage covered bonds and mortgage-backed securities exhibit a high correlation with the estimated household-specific component of the share of fixed rate mortgages relative to adjustable rate ones.

A predominant role for country-level household factors is documented also when focusing on the sensitivity of the share of fixed rate mortgages to the slope of the yield curve, as well as when analyzing lending conditions, that is the spread between the interest rate on fixed rate mortgages and that on adjustable rate mortgages.

By showing the relevance of country-level household factors, a policy implication of our analysis is that it would not make sense to try to influence the share of fixed rate mortgages by pressing banks to take on more duration risk. This would be ineffective and, presumably, not even be desirable. Indeed, the heterogeneity in the share of fixed rate mortgages across economies seems to reflect an optimal allocation of interest rate risk, given the asynchronous business cycles and the expectations that monetary policy will operate in a way that stabilizes disposable income net of housing costs.

Data availability

The data that has been used is confidential.

Appendix A. Literature review, country variable definition, advanced model estimates, spread analysis and 3 robustness exercises

Supplementary material related to this article can be found online at <https://doi.org/10.1016/j.eurocorev.2023.104643>.

References

- Agarwal, S., Amromin, G., Ben-David, I., Chomsisengphet, S., Evanoff, D.D., 2010. Learning to cope: Voluntary financial education and loan performance during housing crisis. *Am. Econ. Rev.: Pap. Proc.* 100, 495–500.
- Amiti, M., Weinstein, D.E., 2018. How much do idiosyncratic bank shocks affect investment? Evidence from matched bank-firm loan data. *J. Polit. Econ.* 126 (2), 525–587.
- Badarınza, C., Campbell, J.Y., Ramadorai, T., 2018. What calls to ARMs? International evidence on interest rates and the choice of adjustable-rate mortgages. *Manage. Sci.* 5 (64), 2275–2288.
- Basten, C., Guin, B., Koch, C., 2017. How Do Banks and Households Manage Interest Rate Risk? Evidence from the Swiss Mortgage Market. *Cesifo Working Paper No.* 6649.
- BCBS, 2012. Core Principles for Effective Banking Supervision. Technical Report.
- Cameron, A.C., Gelbach, J.B., Miller, D.L., 2011. Robust inference with multiway clustering. *J. Bus. Econom. Statist.* 29 (2), 238–249.
- Cameron, A.C., Miller, D.L., 2015. A practitioner's guide to cluster-robust inference. *J. Hum. Resour.* 50 (2), 317–372.
- Campbell, J.Y., 2012. Mortgage market design. *Rev. Finance* 17, 1–33.
- Campbell, J.Y., Cocco, J.F., 2003. Household risk management and optimal mortgage choice. *Q. J. Econ.* 118 (4), 1449–1494.
- C el erier, C., Kick, T., Ongena, S., 2020. Taxing Bank Leverage: The Effects on Bank Capital Structure, Credit Supply and Risk-Taking. Working Paper.
- Cetorelli, N., Goldberg, L.S., 2011. Global banks and international shock transmission: Evidence from the crisis. *IMF Econ. Rev.* 59 (1), 41–76.
- Cetorelli, N., Goldberg, L.S., 2012. Banking globalization and monetary transmission. *J. Finance* 67 (5), 1811–1843.
- Cocco, J.F., 2013. Evidence on the benefits of alternative mortgage products. *J. Finance* 68 (4), 1663–1690.
- Cumming, F., 2022. Mortgage cash-flows and employment. *Eur. Econ. Rev.* 144, 104019.
- Di Maggio, M., Kermani, A., Keys, B.J., Piskorski, T., Ramcharan, R., Seru, A., Yao, V., 2017. Interest rate pass-through: Mortgage rates, household consumption, and voluntary deleveraging. *Amer. Econ. Rev.* 107 (11), 3550–3588.
- ECB, 2008. Covered Bonds in the EU Financial System. Technical Report.
- ECB, 2009. Housing Finance in the Euro Area. Technical Report, ECB Occasional Paper Series n. 101.
- ECB, 2014. Guide to Banking Supervision. Technical Report.
- ECB, 2016. Economic Bulletin. Technical Report, Issue 6.
- ECB, 2017. The ECB Survey of Professional Forecasters. Technical Report, Third quarter of 2017.
- ECBC, 2016. 2016 ECBC European Covered Bond Fact Book. Technical Report.
- Ehrmann, M., Ziegelmeyer, M., 2017. Mortgage choice in the euro area: Macroeconomic determinants and the effect of monetary policy. *J. Money Credit Bank.* 49 (2-3), 469–494.
- Flod en, M., Kilstr om, M., Sigurdsson, J., Vestman, R., 2021. Household debt and monetary policy: Revealing the cash-flow channel. *Econom. J.* 131, 1742–1771.
- Fo a, G., Gambacorta, L., Guiso, L., Mistrulli, P.E., 2019. The supply side of household finance. *Rev. Financ. Stud.* 32 (10), 3762–3798.
- Fornero, E., Monticone, C., Trucchi, S., 2011. The effect of financial literacy on mortgage choice. *CEPR Working Paper n.* 121/11.
- Fuster, A., Vickery, J., 2014. Securitization and the fixed-rate mortgage. *Rev. Financ. Stud.* 28 (1), 176–211.
- Gambacorta, L., van Rixtel, A., Schiaffi, S., 2019. Changing business models in international bank funding. *Econ. Inq.* 57 (2), 1038–1055.
- Garriga, C., Kydland, F.E.,  ustek, R., 2017. Mortgages and monetary policy. *Rev. Financ. Stud.* 30 (10), 3337–3375.
- Gathergood, J., Weber, J., 2017. Financial literacy, present bias and alternative mortgage products. *J. Bank. Financ.* 78, 58–83.
- Greenstone, M., Mas, A., Nguyen, H.-L., 2020. Do credit market shocks affect the real economy? Quasi-experimental evidence from the great recession and “normal” economic times. *Am. Econ. J.: Econ. Policy* 12 (1), 200–225.
- Gu, W.G., de Mooij, R., Poghsyan, T., 2015. Taxation and leverage in international banking. *Int. Tax Public Finance* 22, 177–200.
- Guren, A.M., Krishnamurthy, A., McQuade, T.J., 2021. Mortgage design in an equilibrium model of the housing market. *J. Finance* 76, 113–168.
- Hoffmann, P., Langfield, S., Pierobon, F., Vuillemeys, G., 2019. Who bears interest rate risk?. *Rev. Financ. Stud.* 32 (8), 2921–2954.
- Houston, J., James, C., Marcus, D., 1997. Capital market frictions and the role of internal capital markets in banking. *J. Financ. Econ.* 46, 135–164.
- Ippolito, F., Ozdagli, A.K., Perez-Orive, A., 2018. The transmission of monetary policy through bank lending: The floating rate channel. *J. Monetary Econ.* 95, 49–71.
- Khwaja, A.I., Mian, A., 2008. Tracing the impact of bank liquidity shocks: Evidence from an emerging market. *Amer. Econ. Rev.* 98 (4), 1413–1442.
- Kirti, D., 2020. Why do bank-dependent firms bear interest-rate risk? *J. Financ. Intermediation* 41, 1–14.
- Klapper, L., Lusardi, A., van Oudheusden, P., 2015. Financial literacy around the world: Insights from the standard & poor's ratings services global financial literacy survey. Available at https://gflec.org/wp-content/uploads/2015/11/3313-Finlit_Report_FINAL-5.11.16.pdf?x87657.
- Koijen, R.S., Hemert, O.V., Nieuwerburgh, S.V., 2009. Mortgage timing. *J. Financ. Econ.* 93, 292–324.
- Ongena, S., Smith, D.C., 2000. What determines the number of bank relationships? Cross-country evidence. *J. Financ. Intermediation* 9, 26–56.
- Paiella, M., Pozzolo, A.F., 2007. In: Ambrose, B., Agarwal, S. (Eds.), *Household Credit Usage*. Palgrave Macmillan, pp. 219–235, Chapter Choosing Between Fixed and Adjustable Rate Mortgages.

- Petersen, M.A., 2009. Estimating standard errors in finance panel data sets: Comparing approaches. *Rev. Financ. Stud.* 22 (1), 435–480.
- Pica, S., 2022. Housing Markets and the Heterogeneous Effects of Monetary Policy Across the Euro Area. Working Paper.
- Schnabl, P., 2012. The international transmission of bank liquidity shocks: Evidence from an emerging market. *J. Finance*.
- Stanga, I., Vlahu, R., de Haan, J., 2017. Mortgage Arrears, Regulation and Institutions: Cross-Country Evidence. DNB Working Paper n. 580.
- Statman, M., 1982. Fixed rate or indexed-linked mortgages from the Borrower's point of view: A note. *J. Financ. Quant. Anal.* 17 (3), 451–457.
- Tzamourani, P., 2021. The interest rate exposure of euro area households. *Eur. Econ. Rev.* 132, 103643.