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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 variation observed, we distinguish between the 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 outcomes observed for the same banking group across the different countries. Local demand 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 mortgage-backed securities is more widespread.

Keywords: mortgages, interest rate fixation, cross-border banks.
JEL: F23, G21, G41.

Non-technical summary

A striking feature of the credit market in the euro area is the very large heterogeneity across countries in the granting of fixed versus adjustable rate mortgages. Fixed rate mortgages (FRMs) are dominant in Belgium, France, Germany and the Netherlands, while adjustable rate mortgages (ARMs) are prevailing in Austria, Greece, Italy, Portugal and Spain.

This heterogeneity has two major implications. First, the transmission of monetary policy is heterogeneous across countries. Being a major liability in the balance sheet of most households, mortgages likely play a key role in the transmission of monetary policy. This is especially true in systems where ARMs are dominant because, on top of the traditional bank lending channel, also the floating rate channel is at work, with significant macroeconomic effects. Second, the allocation of interest-rate risk between the banking sector and the real sector differs across countries, with direct consequences for financial stability.

In light of that, investigating the determinants of the prevalent type of mortgage across countries and over time is crucial. The analysis considers factors both on the demand side, related to the preferences and characteristics of the borrowers requesting such loans, and on the supply side, related to the ability of banks to issue a certain type of loan. Our identification strategy disentangles the influence of borrower demand factors from bank supply 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 across different cross-border banking groups operating in the same economy.

Our main finding indicates a prominent role for country demand 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 supply factors (the remaining 9% being the variation that the model is unable to explain). On the negative side, our estimated country demand factors are not directly interpretable in economic terms, as they are likely to encompass a heterogeneous set of variables. Thus, as a second step, we adopt a two-stage approach whereby the estimated demand factors are regressed on variables that are economically motivated. The results suggest that the (demand component of the) ratio of variable-rate mortgages to total mortgages tends to be positively influenced by: (i) a historically high inflation volatility; (ii) a relatively high degree of economic and financial literacy; (iii) the absence of regulations to facilitate the use of such loans as collateral for bank funding instruments, such as covered bonds and MBS; and (iv) a marked negative correlation between the unemployment rate and short-term interest rates.

We conclude that at least part of 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 (loan) costs.

1 Introduction

Conventional mortgages can be classified in two main types: fixed rate mortgages and adjustable rate mortgages. Fixed rate mortgages (FRMs) charge a nominal interest rate that does not change during the entire life of the loan. Adjustable rate mortgages (ARMs) charge an interest rate that is tied to a benchmark and varies over time. Households that select an ARM are exposed to the short-term variability in the periodic payments required by this type of mortgage (Campbell and Cocco, 2003). The volume of FRMs and ARMs extended to households in the economy depends on a broad set of factors that affect the demand of borrowers and the supply of 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 fixed versus adjustable rate mortgages. FRMs are dominant in Belgium, France, Germany and the Netherlands, while ARMs are prevailing in Austria, Greece, Italy, Portugal and Spain (ECB, 2009; Campbell, 2012). The 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. 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 bank lending channel, also the floating rate channel is at work, with significant macroeconomic effects.[1] Second, the allocation of interest-rate risk between the banking sector and the real sector differs across countries, with direct consequences for financial stability. Third, the effectiveness of macroprudential policies in containing

[1]Ippolito et al. (2017) define the floating rate channel as the mechanism whereby conventional monetary policy actions are transmitted directly to borrowers' balance sheet via a change in the interest rate paid on outstanding (indexed) loans.

mortgage defaults varies across countries, 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 in order to understand what drives the prevalence of FRMs or ARMs. In particular, we investigate to what degree the wide cross-country heterogeneity in the prevalent interest rate type of mortgage is caused by differences in demand or supply conditions. The distinction between demand and supply is crucial because the policy implications may differ substantially depending on what is the main driver.

From a methodological perspective, we distinguish the role played by borrower specific characteristics from that of bank specific factors. Under the (plausible) assumption that bank equity holders are less risk adverse than the bank's mortgagors, basic risk-tolerance considerations would suggest that borrowers are more concerned than banks in limiting their exposure to interest rate risk.[3] In these circumstances, the observed heterogeneity in the prevalence of a given mortgage type should reflect differences in borrowers' characteristics, that is in demand conditions. If supply factors play a significant role, this would indicate that some frictions, for example related to bank funding, are affecting the efficient allocation of interest rate risk.

In general, demand factors include all features that make borrowers demand one or the other type of mortgage, as well as those that make a borrower more or less suitable to be financed at a fixed rate.[4] Supply factors include instead mainly banks' funding and liquidity conditions, which may influence the ability of banks to supply

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

[3]Assuming that the demand side of the mortgage market is more risk averse than the supply side does not necessarily mean that all mortgages should be at a fixed rate. As emphasized by Guren et al. (2019), an ARM provides a better hedge against income risk to a household whenever the correlation between its income and the short-term interest rate is negative and strong enough.

[4]The riskiness of the lending exposure determines whether a mortgage can be financed through long-term funds at a fixed rate, for example, by issuing covered bonds or mortgage-backed securities. If a loan can be used to back covered bonds or mortgage-backed securities, the bank can offer a more convenient fixed interest rate.

FRMs.[5]

Our identification strategy is made possible by the availability of bank-level information on lending for a set of banks that operate in different markets and it relies on the assumption that the funding of a banking group takes place at the consolidated level.[6] 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. Similar considerations apply to bank liquidity. Our assumption is in line with the focus of market investors and regulators on consolidated bank balance sheets and with the literature on cross-border banks as shock propagators, where local lending conditions are affected by shocks to the consolidated balance sheet (Cetorelli and Goldberg, 2011, 2012; Schnabl, 2012; Célérier et al., 2019).[7]

Intuitively, this allows us to disentangle borrower demand from bank supply 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 across different cross-border banking groups operating in the same economy.

In practice, we decompose the variation of the share of FRMs to total new mortgages, henceforth abridged with "share of FRMs", into "country demand factors" and "bank supply factors", using a fixed effects model and exploiting cross-border

[5]Typically, banks rely on short-term funding at adjustable rate. A natural consequence is that banks are more willing to supply ARMs. But to the extent that they can raise long-term funds at fixed rate, banks are also able to supply FRMs. This holds true as long as banks keep an 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. Analysing bank specific characteristics allows us also to shed light on banks' exposure to interest rate risk.

[6]Cross-border banks define their funding mix as to minimize the cost of capital (Gu et al., 2015). Long-term funding instruments are issued taking into account differences across countries in terms of taxation, regulation, quality of required services and infrastructures, as well as development of capital markets. For example, banks can raise funds through cross-border securitisation or concentrating covered bonds issuance in certain countries. Despite cross-border banks can select different funding models, funding mainly occurs at the consolidated level. While showing a shift towards a more decentralized funding at the onset of the recent financial crisis, Gambacorta et al. (2019) document that cross-border banks' liabilities from foreign affiliates amount only to 41% of total funds raised overseas.

[7]Bank supervision activity almost exclusively focuses on consolidated balance-sheet conditions, including the level of interest rate risk (BCBS, 2012; ECB, 2014). Additionally, the design of banks' surveys is typically aimed at gauging lending standards at the consolidated level.

banking groups. This approach is close in spirit to Amiti and Weinstein (2018) and Greenstone et al. (2019). Country demand factors capture specific features of the borrowing country which are more related to loan demand, that is to the characteristics of borrowers in that country, whilst bank supply factors capture funding and liquidity conditions which are relevant for lending supply.

One main advantage of our approach is that we are able to jointly investigate the role played by demand and supply 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.[8] On the down side, our estimated country demand factors are not directly interpretable in economic terms, as they are likely to encompass a heterogeneous set of variables. Thus, as a second step, and similar to Ongena and Smith (2000), we adopt a two-stage approach whereby the estimated demand factors are regressed on variables that are economically motivated.

Our main finding indicates a prominent role for country demand 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 supply factors (the remaining 9% being the variation that the model is unable to explain). A number of robustness exercises show that this result is confirmed when we use a larger dataset including smaller and domestic institutions, as well as when we adopt a non-linear model specification.

In a first extension of the baseline regressions 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

[8]There exist factors that in principle may exert a role in shaping both demand and supply conditions of FRMs, relative to ARMs. This is the case, for example, for legislation on issuance of covered bonds. Namely, if its effect is to allow banks to issue such instruments, then it is exerting an effect on the supply of FRMs. If instead its effect is to make a mortgage issued locally eligible to be used as collateral for covered bonds, for instance due to specific requirements in terms of loan-to-value (ECBC Covered Bond Comparative Database; ECB, 2008; ECBC, 2016), then it is exerting an effect on the demand of FRMs. For these reasons, it is difficult to separate demand from supply based on pre-selected lists of proxies for the two sides of the market.

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 demand factors. 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 demand 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 counterintuitive) remark leads us to check whether the share of FRMs is related to the correlation between the unemployment rate and the short-term interest rate. This correlation turns out to be highly significant and economically relevant in explaining the demand component of the share of FRMs. Specifically, an increase in the correlation between the unemployment rate and 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 demand conditions.

Concerning the statistical significance of the other (more standard) economic factors underlying the demand (having controlled for supply side 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.[9] A one standard deviation increase in financial literacy (an increase of 8 percentage points) entails a decrease of 42 percentage points in the average share of FRMs per country. Households in countries where the covered bonds market is more

[9]Financially educated borrowers are more familiar with the concepts of fixed interest rate, adjustable interest rate and interest compounding. As such, they are able to grasp that the interest rate applied on an ARM and that of a FRM are not equivalent at the inception of the loan. Indeed, the interest rate on a FRM embeds not only the expectation of the future short-term interest rate, but also a term premium and the cost of the prepayment option (Campbell and Cocco, 2003). Selecting an ARM rather than a FRM allows to avoid these add-ons.

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.[10] For a similar reason, also the volume of securitized mortgages entails a higher likelihood of households selecting a FRM.[11] 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, consistently with the idea that the macroeconomic history of a country affects households' mortgage choice.[12] A one standard deviation increase in the historical inflation volatility (an increase of 9 percentage 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 demand conditions.

The remainder of the paper is organized as follows. Next section reviews the

[10]Funding via covered bonds is a factor that could clearly indicate both shifts in demand (i.e., borrower specific) and shifts in supply (i.e., lender specific). Although the supply side might play a stronger role, what are we capturing in our setting is whether households' characteristics in a given country make mortgages more ore less eligible to secure covered bonds. As such, we are focusing on the demand component of this factor.

[11]Banks engagement in loan securitization can be driven both by demand and supply conditions. Since we control for the supply side, our factor catches only the demand component that is of major interest.

[12]Countries with higher volatility of inflation before the introduction of the euro were characterized by a strong prevalence of ARMs. This is in line with the idea that, if a FRM can be prepaid without penalties, high inflation risk leads banks to reduce the supply of FRMs by increasing the interest rate applied on such loans. As a consequence households are more likely to select ARMs (Campbell, 2012; Badarinza et al., 2018). Alternatively, this may signal the existence of a stronger insurance motive attached to ARMs (countries with higher inflation risk are those where households are more likely to be unemployed when the short-term interest rate is very low). The fact that ARMs continue to dominate the mortgage market of these countries even after the entry to the eurozone suggests a certain stickiness in households' behavior (Campbell, 2012).

existing literature and explains the contribution of this work. Section 3 discusses the identification strategy. Section 4 describes the dataset. Section 5 presents the methodology and the results of the analysis on the share of FRMs. Section 6 integrates the preceding with some robustness checks. Section 7 presents the results of the analysis on the spread between FRMs and ARMs interest rates. Section 8 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 demand factors and supply factors may drive the choice between FRMs and ARMs.

As for demand factors, 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.[13] 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'

[13]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.

income and wealth surveys (Paiella and Pozzolo, 2007; Fornero et al., 2011; Ehrmann and Ziegelmeyer, 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).

Supply 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 and thus the quoted interest rates (Kirti, 2017). A few empirical studies indeed show that lower bank bond spreads, lower deposit pass-through, lower exposure to interest rate risk and higher access to securitization make banks more prone to extend fixed rate loans (Fuster and Vickery, 2014; Foà et al., 2015; Basten et al., 2017).

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., 2015; 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 Ziegelmeyer, 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 prior to the introduction of the euro show a prevalence of ARMs (Campbell, 2012; Badarinza et al., 2018). This persists even after the adoption of the euro, 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 Ziegelmeyer, 2017).

Guren et al. (2019) 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 1 summarizes all the determinants of mortgage choice identified in the literature, as well as those analysed 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 demand and supply factors. To the best of our knowledge, the works of Ehrmann and Ziegelmeyer (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 Ziegelmeyer (2017) provide a deep investigation of the demand side, but ignore completely the supply side. Relying on monthly country-level information, Badarinza et al. (2018) analyse 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 demand and supply factors driving mortgage choice, neither to disentangle them.

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 demand and supply of FRMs, relatively to ARMs. Specifically, we rely on an identification strategy that utilizes cross-border banking groups to disentangle country demand factors from bank supply factors. In this way we are able to rigorously examine to what extent the wide cross-country heterogeneity and time variation in the prevalent interest rate type of mortgage is driven by demand or supply conditions.

Assessing the relative importance of demand and supply 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 demand and supply also on the relative price of FRMs and ARMs.

Table 1: **Determinants of the Share of FRMs and/or the Probability of a FRM Choice Identified in the Literature.** The table provides an overview of the literature analyzing the various factors driving the share of FRMs or the probability of a FRM choice. ↑ and ↓ denote a positive and a negative effect, respectively. ***,** and * stand for statistical significance at 1%, 5% and 10%. 0 denotes a variable included in the specification which is not significant. Papers are indicated by numbers from 1 to 14 as follows: [1] Paiella and Pozzolo (2007), [2] Koijen et al. (2009), [3] Agarwal et al. (2010), [4] Fornero et al. (2011), [5] Campbell (2012), [6] Fuster and Vickery (2014), [7] Foà et al. (2015), [8] Badarinza et al. (2017), [9] Basten et al. (2017), [10] Ehrmann and Ziegelmeyer (2017), [11] Gathergood and Weber (2017), [12] Campbell and Cocco (2003), [13] Kirti (2017), [14] Guren et al. (2018). Statistical significance is not reported for the variables investigated by Agarwal et al. (2010) and Campbell (2012), as well as for the historical inflation volatility analysed by Badarinza et al. (2018), as they do not perform a regression analysis. The variables reported for Badarinza et al. (2017) refer to the analysis on 3-year (left) and 1-year (right) expectations of the future ARM rate.

		Empirical papers																	
	Paper	[1]	[2]		[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]				**This paper**	
	Country	IT	US		US	IT	EU, US, CA	US	IT	EU, US, AU	CH	Euro Area	UK				Euro Area	
	Sample Years	1995-2004	1985-2006		2005-2007	2005-2008		1996-2009	2004-2010	1990-2013	2010-2013	<1980-2010	2013	**Theoretical papers**			2007-2015	
	Variable of interest	Prob. FRM	Prob. FRM	Share FRM	Prob. FRM	Prob. FRM	Share FRM	Prob. FRM	Prob. FRM	Share FRM	Prob. FRM	Prob. FRM	Prob. FRM	[12]	[13]	[14]	Our variable	Share FRM
Borrower Variables Demand	Age	↑**				0					↓***							
	Gender	0				0												
	Married	0																
	Children	↑**																
	Income	0										↓***		↑			Real disposable income per capita	0
	N. income recipients	0				0												
	Nondurable expenditures	↓**																
	Financial wealth	0				0					↑***			↑				
	Education	0				0												
	Financial literacy				↓	↑**							↓***				Financial literacy	↓**
	Type of employment	0				0												
	Mobility	0												↓				
	Risk aversion					0							0	↑				
	Volaility of labor income													↑				
	Other debt										↓**							
	Credit score		↑***															
Loan Variables Demand/Supply	Duration											↓***						
	Mortgage to income					↑***							0	↑			Indebtedbeness	0
	House price	↓***																
	House price to income	↑***																
	Debt service to income										0	↓***						
	Loan to value		↓***								↓**		↓**					
	Loan balance		↑***															
Bank Variables Supply	Deposits to total liabilities								↑***									
	Deposits to total assets										↓**							
	Equity to total assets										↓*							
	Floating rate liabilities														↓			
	Bond spread								↓*									
	Exposure to interest rate risk										↓***							
	Derivatives usage										0							
	Size										↑***							
	Competition	↓**																
Macroeconomic and Institutional Variables Demand/Supply	Securitisation							↑***	↑***								Outstanding RMBS to GDP	↑***
	Covered bonds																Outstanding covered bonds to GDP	↑***
	Spread FRM-ARM interest rates	↓***		↓***		↓***				↓***/0								
	FRM rate minus expected ARM rate		↓***	↓***					↓***	0/↓***								
	ARM interest rate	↓**																
	Long-term interest rate	0	↑***	↓***								0		↓				
	Term spread		↓***	0							↓***	↓***		↓			Term spread	↓*,**,***
	Inflation rate											↑**						
	Inflation rate volatility											0						
	Historical inflation volatility						↓			↓							Historical inflation volatility	↓***
	Unemployment rate											0						
	Unemployment rate volatility											↑**						
	GDP growth					↑*						↓***						
	GDP growth volatility											0						
	Correlation aggregate shocks short-term interest rate															↑	Correlation unemployment short-term interest rate	↑**

3 Identification

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

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 development of capital markets have a crucial role in the way banks issue long-term funding instruments. For instance, international banks can raise funds relying on cross-border securitisation or concentrating covered bonds issuance in certain countries. Indeed, covered bonds legislations in most European countries, with the exception of Greece and the Netherlands, allow to include mortgages originated abroad (typically in the European Economic Area and in Switzerland, or more broadly in OECD countries) in the covered pool (ECBC Covered Bond Comparative Database; ECB, 2008; ECBC, 2016). 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, still 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 homogenous regulations and integrated capital markets.

Second, when looking at cross-border banks, market 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 markedly 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; Célérier et al., 2019).

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 demand 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 demand 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 characterised by high default rates (if it thinks that

granting ARMs would entail even higher default rates). Our methodology is not able to isolate such component of lending supply that varies with borrowers' characteristics; nonetheless, it can effectively identify supply conditions driven by bank funding, sometimes referred to as pure supply factors, which is the objective of our analysis. In this respect, our analysis shares exactly the same advantages and limitations of studies exploiting more granular data to control for credit demand conditions.[14]

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),[15] 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 a weighted average of the interest rate applied to new mortgages. Overall, we have 103 banks associated to 73 banking groups. The latter include five cross-border banking groups. Detailed information on our dataset is exposed in Table 2.

Figure 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. Looking at the average share of FRMs, we find a substantial cross-country heterogeneity. We can

[14]For example, if banks apply tighter lending criteria to small size borrowers, such extra tightening is captured by borrowers-time fixed effects, which are typically meant to control for demand conditions.

[15]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 2: **Overview of Banks and Banking Groups, by Country**

Country	Banks with a domestic bank holding	Banks with a foreign bank holding	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

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.

Figure 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 factors may play a major role than bank supply factors.

Table 3 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

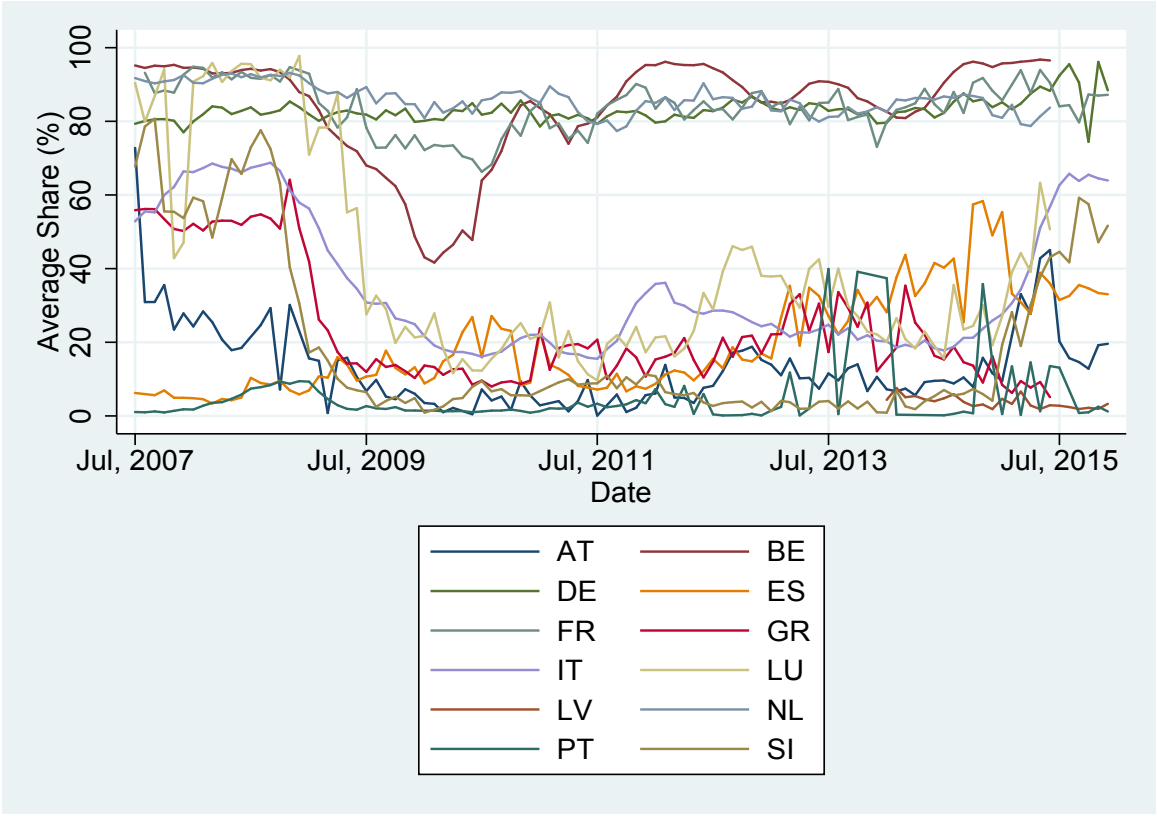
Our methodology relies on the approach proposed by Amiti and Weinstein (2018), although applied to our unique dataset, and exploits cross-border banking groups to decompose the share of FRMs into demand and supply components.[16] More specifically, we estimate the following type of regression:

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

[16] Greenstone et al. (2019) adopt a similar methodology, but they decompose the variation of their dependent variable using time invariant rather than time varying fixed effects.

Figure 1: **Share of FRMs and spread between FRMs ands ARM interest rates.** The figure shows the average share of FRMs (a), the average spread between FRMs and ARMs interest rates (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).

(a) Average share of FRMs



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

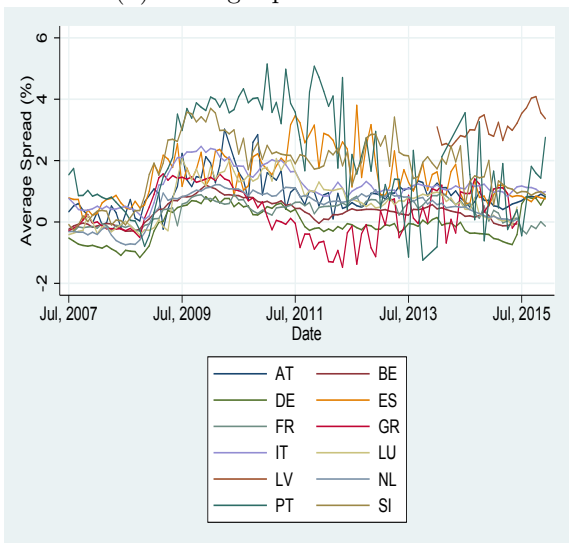


Figure 2: **Share of FRMs for groups of countries**. The figure shows the share of FRMs of domestic banks and foreign banks for two groups of countries. The first group (left) includes France, Germany and the Netherlands. The second group (right) includes Austria, Belgium, Greece, Italy, Latvia, Luxembourg, 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)

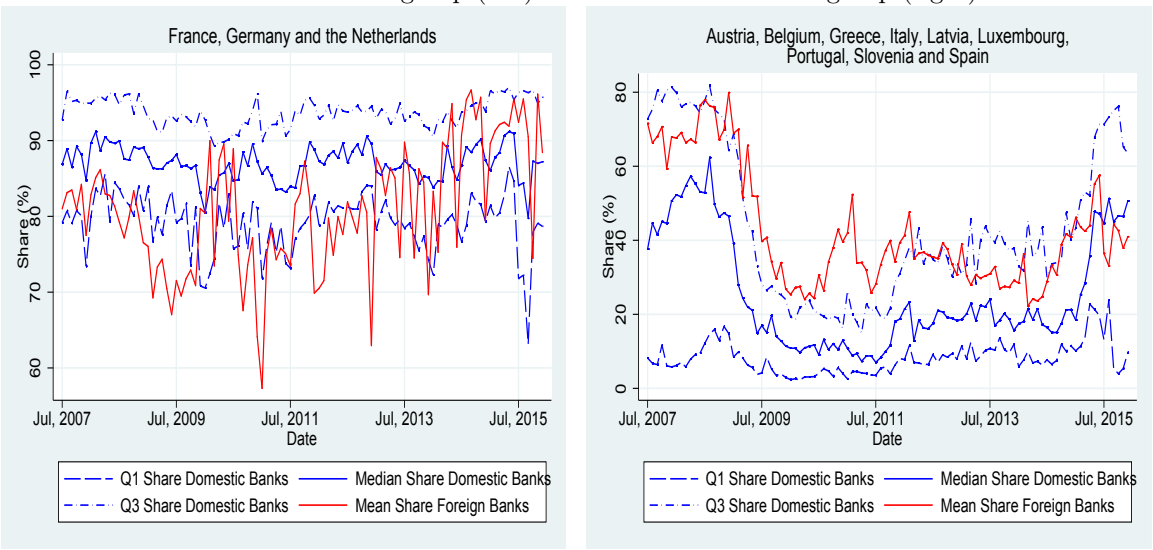


Table 3: **Overview of the Share of FRMs and the Spread between FRMs and ARMs interest rates, by Country**

		Share of FRMs (%)				Spread FRMs - ARMs interest rates (%)			
Country	N	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

In equation 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 consist in all observable and unobservable time varying and time invariant characteristics of country c and, as such, they are meant to capture the demand 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 equation 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 demand factors. Nonetheless, their limitation in this context is related to the inability to control for demand 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 supply 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.[17]

By construction, equation 1 can only be estimated in the subsample of observations pertaining to cross-border banks. In this sample, equation 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)

[17] 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.

characteristics of the lender h. Ideally, we 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 supply 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 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 that what is implied in model 1.

5.2 Baseline Results

Models 1-3 of Table 4 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 equation 1. Month-country fixed effects explain a significant fraction of the variation in the share (84%), suggesting a prominent role of demand 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 demand conditions play a prominent role.[18] 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

[18] In the fixed-effect decomposition of model 3 we have 360 month-country dummies versus 393 month-banking group dummies. The two sets of fixed effects are well balanced, meaning that the results are not driven by a higher number of dummy variables for one of the two groups. Additionally, 147 out of 360 month-country dummies are omitted because of collinearity, while no month-banking group dummy is omitted. Notwithstanding of that, month-country fixed effects have a higher explanatory power than month-banking group fixed effects.

dependent variable. Even if we interpret these dummies as (time invariant) supply factors at the bank level, we would still conclude that overall supply conditions explain only a minor portion of the total variation in the share of FRMs.

Table 4: **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. The dependent variable is the share of FRMs. The estimation method is OLS. Specification (3) reports the results of the baseline model of equation 1. Standard errors are not adjusted. A Shorrocks-Shapely decomposition of the R^2 is reported for model (3). The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

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

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 4, this sample comprises 1644 observations, corresponding to about one fourth of the overall sample. Moreover, it encompasses a rather homogenous set of lenders, typically the largest players of the banking industry. As such, our analysis may underestimate the relevance of supply 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 raise long-term funds at fixed rate via covered bonds. If this is the case, focusing only on cross-border banks may lead to neglect part of the role played by supply conditions. To tackle this issue we conduct

an exercise that requires a minor departure from our empirical setup. In particular, we consider time invariant country fixed effects and banking group fixed effects to capture demand and supply factors, respectively. In this way we are able to estimate similar regressions to those in Table 4, but run on the entire sample. We start with the specification shown in model 1 of Table 5 including only time dummies, which turn out to explain only a negligible portion of the total variation in the dependent variable (3%). Broadly speaking, this suggests that, in our sample, the cross section is a much more important dimension than the time series. Interestingly, by simply plugging country fixed effects, the R^2 raises to a surprising 70%. Model 3 displays instead the equation where the share of FRMs is regressed just on the set of banking group fixed effects. Despite the fact that these are largely collinear with the set of country fixed effects and significantly more granular,[19] the coefficient of determination not only does not change, but actually slightly diminishes (69%) with respect to model 2. When we combine country dummies and bank dummies, as in model 4, we are able to explain almost 78% of the variation in the share. Using a Shorrocks-Shapely decomposition of the R^2, we find that country fixed effects exhibit a higher explanatory power than banking group fixed effects. The same applies in the two corresponding specifications also including month fixed effects, although, by construction, the R^2 raises somewhat. These considerations corroborate our conclusions drawn on the subsample of cross-border banks, emphasizing the role played by demand factors. As a further exercise, Table A1 in the Appendix shows the results of regressions including time invariant fixed effects run on the subsample of cross-border banking groups. Again, the role of time dummies is rather limited. Country fixed effects capture a sizable part of the variation in the share of FRMs, while banking group fixed effects have a much smaller explanatory power, as in Table 4.

[19] The two sets of fixed effects coincide in all observations related to banking groups operating only in one country, which represent the vast majority of the sample. Moreover, the dataset includes 73 banking groups as opposed to only 12 countries.

Table 5: **Fixed effects decomposition with time invariant fixed effects.** The table reports the R^2 of various fixed effects decompositions of the share of FRMs. The sample includes all banks. The dependent variable is the share of FRMs. The estimation method is OLS. Standard errors are not adjusted. A Shorrocks-Shapely decomposition of the R^2 is reported for models (4)-(7). The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Month FE	YES	-	-	-	YES	YES	YES
Country FE	-	YES	-	YES	YES	-	YES
Banking group FE	-	-	YES	YES	-	YES	YES
N	7327	7327	7327	7327	7327	7327	7327
R^2	0.026	0.697	0.687	0.779	0.735	0.724	0.818
Adjusted R^2	0.012	0.696	0.684	0.776	0.730	0.717	0.813
R^2 month FE							0.034
R^2 country FE				0.394			0.397
R^2 banking group FE				0.385			0.387
F-test statistic	1.879***	1528.181***	221.414***	323.015***	178.15***	108.512***	178.425***
degrees of freedom	(102,7225)	(12,7315)	(73,7254)	(80,7247)	(113,7214)	(174,7153)	(181,7146)

5.3 Advanced Model

Regressions reported in previous tables provide a useful breakdown of the contribution of demand and supply 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 demand 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. We tackle this issue by adopting a hybrid approach. As in equation 1, we use month-banking group fixed effects to control for supply conditions. However, instead of introducing time varying country fixed effects to capture the demand, we directly model country-specific factors by including a set of variables suggested in the existing literature 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. The survey is based on interviews with more than 150000 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 7 and Figure A1 in the Appendix show that the level of financial education increases as we move from southern countries to northern countries. Financial literacy may have two opposite effects on the choice of FRMs versus ARMs. On the one hand, more educated borrowers understand that, unconditionally, a FRM is more expensive than an ARM and, hence,

they are more likely to select an ARM (Agarwal et al., 2010; Gathergood and Weber, 2017). On the other hand, these educated borrowers may be more willing to choose a FRM, as they are aware of the risks related to the uncertain stream of payments of an ARM (Fornero et al., 2011).

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 7 and Figure A1 in the Appendix displays 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. Consistently with Campbell and Cocco (2003) and Fornero et al. (2011), we expect this ratio to have a positive effect on the share of FRMs.

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 7 and Figure A1 in the Appendix show a marked heterogeneity in households' real disposable income across countries over our sample period. The effect of disposable income on mortgage choice is rather ambiguous. It can capture either a current costs minimization effect (Campbell and Cocco, 2003), or an income risk bearing capacity effect (Ehrmann and Ziegelmeyer, 2017). If the first is prevalent, households with low income are more likely to select an ARM in order to minimize the current payment required by the loan. On the contrary, if the latter dominates, borrowers with low income are more prone to choose a FRM, because they may be concerned of not being able to face the future stream of payments required from an adjustable rate loan.

It is recognized in the literature that the unemployment rate plays a role in mortgage choice as well. For example, Ehrmann and Ziegelmeyer (2017) include among demand conditions the unemployment rate and its volatility, mainly as proxy for current and expected income. We believe that the unemployment rate is an important

country demand factor, but we are aware that it may have opposite effects depending on whether households are mainly focused on current costs minimization or future income risk reduction.

A related aspect which has not been emphasized so far is that borrowers choosing between FRMs and ARMs should care not only about the expected evolution in labor market conditions, but also about how unemployment will correlate with the level of interest rates. Risk-averse households expecting to be unemployed in a context of low interest rates tend to prefer, everything else equal, an ARM, as this implies a higher degree of consumption smoothing (mortgage installments decrease when income goes down and vice versa). Guren et al. (2019) provide a theoretical support for this argument. Usually a crisis unfolds because of a aggregate shock to the demand, leading to a drop in income and inflation. In such situation interest rates decrease, due to a possible decrease in expected inflation and especially to the monetary policy reaction of the central bank. Guren et al. (2019) show that, if the central bank reduces interest rates in response to a aggregate shock, households should select an ARM rather than a FRM. If, instead, interest rates increase during a downturn, for example because of a 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 clearly 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 *ρ(Unemployment, Short-term IR)* as the realized correlation between the unemployment rate and a short-term interest rate,[20] relying on a rolling window

[20]Data on short-term interest rates are retrieved from the OECD. For euro area countries the

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;[21] 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.[22] Table 7 and Figure A2 in the Appendix 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, as the recent double-dip European recession, unemployment is high and the short-term interest rate is low due to an expansionary monetary policy. Nevertheless, there are some exceptions. For example Germany exhibits a positive correlation from the end of 2010. The reason is that in 2009 the unemployment rate in Germany started to decrease, revealing a substantial improvement in economic fundamentals.[23]

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 percentage points.[24] As in Campbell (2012), we estimate our measure on a pre-euro

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.

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

[22] 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).

[23] This reflects, in turn, a flight-to-quality episode in the context of a monetary union. When economic conditions worsens due, as for example in the recent past, to a global financial crisis, policy rates go down to the same extent for every economy in the monetary union, but flight to quality makes unemployment raise more in peripheral countries. This also can explain why Germany is an outlier.

[24] 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.

period in order to emphasize differences across countries. In Table 7 and Figure A1 in the Appendix we see that the periphery economies of the eurozone have experienced a substantial higher inflation volatility than central countries. High volatility of inflation is related to a higher share of ARMs. In order to understand why, the following considerations can be made. As mentioned above, when the correlation between unemployment and the short-term interest rate is negative, ARMs provide higher protection to borrowers. Economies where mortgages are predominantly at adjustable rate tend to be characterized by both a higher historical volatility of inflation and a larger, in magnitude, (negative) correlation between unemployment and the short-term interest rate, at least if compared to Germany (Table 7 and Figure A2 in the Appendix). Therefore, in these economies, the insurance provided by an ARM tends to be large and both factors, high inflation risk and a large, in magnitude, (negative) unemployment-interest rate correlation, contribute to it. Alternatively, Campbell (2012) and Badarinza et al. (2018) point out that a high volatility of inflation leads banks to set the interest rate on fixed rate loans at a relatively high level to protect them from inflation risk.[25] As a consequence, households are less willing to select a FRM. The fact that countries with a history of high inflation volatility still exhibit a prevalence of ARMs even after the introduction of the euro can only be interpreted as evidence of a sticky demand, suggesting that households tend to select the type of mortgage they are more familiar with (Campbell, 2012; Badarinza et al., 2018).

We label the variables listed so far as pure demand factors, as they relate to strictly specific households' characteristics. We take into account also two additional variables, namely *Outstanding Covered Bonds to GDP* and *Outstanding RMBS to GDP*. These are aimed to capture borrowers' characteristics that make mortgages extended locally suitable to back covered bonds or asset-backed securities. In principle these variables could capture both demand and supply factors. On the one hand,

[25] In particular, high inflation volatility entails a high cost of the prepayment option embedded in the interest rate charged on a FRM.

they can capture the reliance of banks on such funding instruments, highlighting an effect on the supply of FRMs. On the other hand, they can capture the eligibility of a mortgage issued locally to be used to secure covered bonds and mortgage-backed securities, assessing an effect on the demand of FRMs.[26] Nevertheless, in our analysis these variables are mainly used to explain the demand, as supply conditions are captured by time-varying banking group fixed effects. 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 7 and Figure A2 in the Appendix 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 7 and Figure A2 in the Appendix show that RMBS are common in the Netherlands and Portugal. Table 6 summarizes all the explanatory variables that we use to model country-specific factors, whilst Table 7 reports basic statistics.

Table 8 displays the estimates of the regressions including country specific explanatory variables and month-banking group fixed effects. 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.[27] 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 demand factors. Model 1 shows the results for the specification including pure demand factors only. We find a negative and significant coefficient for Real Disposable Income Per Capita in line with Ehrmann and Ziegelmeyer (2017). They interpret this finding with the

[26] 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).

[27] These are all the explanatory variables except for ρ(Unemployment, Short-term IR).

Table 6: **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.
Indebtedness	Ratio of total outstanding debt as 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) 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 OECD.
Outstanding Covered Bonds to GDP	Average over the last four years of the amount outstanding of mortgage covered bonds as 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 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 7: **Overview of Country Demand Variables, by Country**

	Financial literacy (%)		**Indebtedness (%)**		**Real disposable income per capita (PPS)**		**Historical inflation volatility (%)**		**Correlation unemployment short-term interest rate**		**Outstanding covered bonds 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	24746.56	1065.49	44.68	-	-0.63	0.13	3.40	1.96	0.66	0.10
Belgium	55.00	-	91.73	7.53	22621.89	1140.56	38.38	-	-0.64	0.15	0.50	0.81	14.00	4.58
France	52.00	-	98.36	3.77	23103.56	1072.30	39.73	-	-0.89	0.09	6.71	2.77	0.88	0.49
Germany	66.00	-	89.45	3.05	25258.56	1862.56	32.39	-	0.04	0.59	8.39	0.83	0.63	0.17
Greece	45.00	-	104.29	3.26	16999.33	1870.32	152.30	-	-0.69	0.19	4.91	3.70	3.08	0.56
Italy	37.00	-	83.37	0.78	20926.00	355.69	57.32	-	-0.70	0.24	2.74	2.88	6.17	1.77
Latvia	48.00	-	-	-	12367.50	549.42	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	16340.56	415.05	146.49	-	-0.47	0.36	12.28	7.22	17.56	3.14
Slovenia	44.00	-	52.70	2.22	16011.22	466.54	859.02	-	-0.40	0.50	-	-	-	-
Spain	49.00	-	132.03	8.35	18220.56	404.43	70.06	-	-0.66	0.26	28.92	5.56	13.64	2.41
The Netherlands	66.00	-	263.55	3.53	22865.44	321.71	44.36	-	-0.70	0.09	5.41	3.10	35.85	8.30
Sample	49.50	11.15	109.97	50.93	20528.02	3686.80	211.69	342.87	-0.54	0.39	7.18	8.68	10.09	11.35

view that households with higher income are more prone to select an adjustable rate loan, as they can comfortably face the income risk related to the uncertain stream of payments of an ARM. At the same time, and unlike what will be documented for Historical Inflation Volatility and ρ(Unemployment, Short-term IR), this finding is not robust to alternative specifications and should be considered with caution.

We find a negative and significant coefficient for the Historical Inflation Volatility, which confirms our priors. 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 used to. An alternative explanation is that higher inflation risk entails a higher insurance motive attached to an ARM. As expected, the sign of the coefficients for Financial Literacy, Indebtedness and ρ(Unemployment, Short-term IR) are, respectively, negative, positive and positive, but neither of the three is statistically significant.

In model 2 we extend the previous specification by adding the two additional demand factors: Outstanding Covered Bonds to GDP and Outstanding RMBS to GDP. The sign and statistical significance of the pure demand regressors remains unchanged if compared to model 1, with the exception of ρ(Unemployment, Short-term IR).

The coefficient of ρ(Unemployment, Short-term IR) turns out to be positive and statistically significant, corroborating our view that the smaller such correlation, the stronger the insurance protection provided by an ARM. This suggests that households actually 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. (2019).

The coefficients of the two additional variables are positive, but they result not

to be statistically significant. To have a reliable basis for inference, both in model 1 and in model 2, we rely on standard errors clustered by country and quarter.[28] 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). With such severe double clustering, Financial Literacy, Indebtedness and Outstanding Covered Bonds to GDP are not statistically significant.[29] However, most of them will recover significance in an alternative specification that overcomes the possible biases arising in this context, where we try to explain country demand factors relying on a sample with a heterogeneous coverage of banks across countries (analysis presented below).

In this type of exercise, we effectively control for bank supply conditions, but we cannot be entirely sure to capture at all country demand factors. We have relied on an exhaustive survey of existing papers in order to select a complete set of explanatory variables and we have actually enhanced it by introducing an additional (and novel) variable, i.e., ρ(Unemployment, Short-term IR). Nonetheless, we are aware that additional or alternative measures could be relevant in this setup. In order to assess whether our selection is reliable and comprehensive enough, we compare the quality of the fit obtained with the specification in model 2 with that obtained by replacing the explanatory variables with month-country fixed effects, but run on the sample used in model 2.[30] As shown in model 3, the latter amounts to 85% and represents the upper bound that can be reachable by including any arbitrarily large set of country-specific variables. The R^2 obtained by simply using our selection of

[28] In Table A3 in the Appendix we show the evidence that lead us to adopt this type of clustering. By clustering at progressively higher levels in the two dimensions of our panel, we detect a substantial serial correlation and a less pronounced, but not negligible, cross correlation. This is why we decide to cluster at both the country and the quarter level. These two levels of clustering have been selected according to the procedure suggested by Petersen (2009), Cameron et al. (2011), and Cameron and Miller (2015).

[29] Table A2 in the Appendix shows that these variables are statistically significant when standard errors are not adjusted.

[30] Model 3 of Table 8 is equivalent to model 3 of Table 4, with the only difference that, in the former, the regression is run over a smaller sample to make it comparable to model 2 of Table 8. This is necessary because some of the regressors in model 2 of Table 8 are not available over some time periods.

seven regressors results to be quite close (79%).

Finally, Table A3 in the Appendix displays the results when adopting all possible alternative choices for double clustering of standard errors. Results are virtually unchanged.

5.4 Two-Stage Model

The results exposed so far provide useful insights on the determinants of the wide cross-country heterogeneity in the share of FRMs. Our findings suggest a prominent role for country demand factors, with a special emphasis on Real Disposable Income Per Capita, Historical Inflation Volatility and ρ(Unemployment, Short-term IR). Nevertheless, our sample is characterized by important differences in the number of banks operating in each country. As a consequence, we may wonder whether these results fully explain the mechanism behind the heterogeneity across countries, or rather they are driven by those countries that are more represented in our sample. In order to guarantee that we draw conclusions giving an equal weight to the observations pertaining to each country, we adopt a two stage approach, as in Ongena and Smith (2000). In particular, we regress the estimated coefficients of the month-country fixed effects in the full specification of equation 1 on our set of explanatory variables.[31] Unfortunately, 147 out of 393 month-country dummies in model 3 of Table 4 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 equation 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:

[31] To perform the second stage regression we only need that the estimated coefficients of the month-county 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 8: **Advanced model.** The table reports (i) the coefficients and standard errors (in parentheses) of two regressions of the share of FRMs on a set of country variables and month-banking group fixed effects in models (1)-(2), and (ii) the R^2 of the baseline model of equation 1 run on the same sample of the second specification in model (3). The sample includes cross-border banking groups only. The dependent variable is the share of FRMs. 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. Standard errors are two-way clustered by country and quarter in models (1)-(2), and not adjusted in model (3). The estimation method is OLS. The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)
Financial Literacy	-0.509	-1.689	
	(1.84)	(1.47)	
Indebtedness	0.835	0.602	
	(0.48)	(0.55)	
Real Disposable Income Per Capita	-0.014***	-0.012**	
	(0.00)	(0.00)	
Historical Inflation Volatility	-5.221***	-5.799***	
	(1.14)	(0.68)	
ρ (Unemployment, Short-term IR)	20.473	24.170**	
	(11.23)	(8.18)	
Outstanding Covered Bonds to GDP		1.430	
		(1.31)	
Outstanding RMBS to GDP		0.319	
		(0.88)	
Month-banking group FE	YES	YES	YES
Month-country FE	-	-	YES
Two-way cluster	*country, quarter*	*country, quarter*	-
N	1085	1085	1085
R^2	0.785	0.789	0.852
Adjusted R^2	0.677	0.682	0.666
F-test statistic regressors	276.015***	-	
degrees of freedom	(5,5)	-	
F-test statistic regressors pure demand		158.955***	
degrees of freedom		(5,5)	
F-test statistic regressors institutional demand		1.829	
degrees of freedom		(2,5)	
F-test statistic fixed effects			4.572***
degrees of freedom			(606,479)

$$share(b,c,t) = \alpha(c,t) + \beta(h(b),t) + \varepsilon(b,c,t) \tag{2}$$

$$\hat{\alpha}(c,t) = \boldsymbol{x'(c,t)\gamma} + \upsilon(c,t) \tag{3}$$

The terms $\beta(h(b),t)$ represent quarter-banking group fixed effects, while $\boldsymbol{x'(c,t)}$ denotes the vector of explanatory variables capturing demand conditions.

Table 9 reports the results of the first stage and the second stage regressions. Model 1 consists in the regression in which we include month-country fixed effects and quarter-banking group fixed effects. To check if by substituting month-country fixed effects with our seven regressors we alter the findings exposed in Table 8, we include model 2 and everything remains virtually unchanged. In models 3-4, the coefficients of month-country fixed effects estimated by running model 1 are regressed over the set of explanatory variables capturing demand conditions. Model 3 includes pure demand factors only. As before, we find a negative and significant coefficient for Historical Inflation Volatility. Model 4 extends the preceding including all set of regressors. Historical Inflation Volatility maintains its sign and significance. Similarly to Table 8, ρ(Unemployment, Short-term IR) exhibits a positive and significant coefficient. As for the other variables, we detect important differences with respect to model 2 of Table 8. The coefficients of Outstanding Covered Bonds to GDP and Outstanding RMBS to GDP are both positive and significant, suggesting that these country demand factors actually matter. In countries where the characteristics of borrowers ease the issuance of covered bonds and asset-backed securities FRMs are relatively more appealing. Statistically significant is also the coefficient of Financial Literacy. The negative sign implies 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. In contrast to previous results, Real Disposable Income Per Capita loses its significance. Tables A4-A5 in the Appendix report the results of models 2-4 when adopting all possible alternative choices for double clus-

tering of standard errors. Results are virtually unchanged. Table A6 displays similar findings when the share of FRMs is decomposed in month-country fixed effects and year-banking group fixed effects.

To obtain relevant normative insights, we do not limit ourselves to merely identifying the country demand factors that play a role in mortgage choice, but we also provide an economic assessment of their magnitude. Table 10 reports the magnitude effects of the seven variables included in model 4 of Table 9. 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 supply 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 demand 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 ρ(Unemployment, Short-term IR) leads to a rise of 14 percentage points in the average share of FRMs per country left unexplained by bank supply factors.

5.5 Time Variation

Some useful indications can be obtained by exploring more closely the variation across time of the share of FRMs. As noted in Figure 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 the demand or the supply. To this end we perform the following type of regression:

Table 9: **Two-stage model.** The table reports (i) the R^2 of the first stage regression of equation 2 in model (1), (ii) the coefficients and standard errors (in parenthesis) of a regressions of the share of FRMs on a set of country variables and quarter-banking group fixed effects in model (2), and (iii) the coefficients and standard errors (in parentheses) of the second stage regression of equation 3 in models (3)-(4). The sample includes cross-border banking groups only. The dependent variable is the share of FRMs in models (1)-(2), and the estimated coefficients of month-country fixed effects obtained from the first specification in models (3)-(4). 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. The estimation method is OLS. Standard errors are not adjusted for model (1), and two-way clustered by country and quarter in models (2)-(4). The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	1ST STAGE		***2ND STAGE***	
	(1)	(2)	(3)	(4)
Financial Literacy		-1.634	-2.693	-5.386**
		(1.37)	(2.26)	(1.72)
Indebtedness		0.586	1.558	0.206
		(0.54)	(0.99)	(0.78)
Real Disposable Income Per Capita		-0.012**	0.000	0.002
		(0.00)	(0.00)	(0.00)
Historical Inflation Volatility		-5.772***	-3.847**	-6.482***
		(0.69)	(1.48)	(0.87)
ρ (Unemployment, Short-term IR)		23.764**	33.128	28.726**
		(7.87)	(18.53)	(9.79)
Outstanding Covered Bonds to GDP		1.436		5.754***
		(1.24)		(0.80)
Outstanding RMBS to GDP		0.314		2.756***
		(0.82)		(0.50)
Quarter-banking group FE	YES	YES		
Month-country FE	YES	-		
Two-way cluster	-	*country, quarter*	*country, quarter*	*country, quarter*
N	1085	1085	344	344
R^2	0.847	0.779	0.337	0.503
Adjusted R^2	0.733	0.750	0.327	0.492
F-test statistic regressors		-	-	-
degrees of freedom		-	-	-
F-test statistic regressors pure demand		129.047***		53.302***
degrees of freedom		(5,5)		(5,5)
F-test statistic regressors institutional demand		1.957		27.071***
degrees of freedom		(2,5)		(2,5)
F-test statistic fixed effects	7.437***			
degrees of freedom	(464,621)			

Table 10: **Magnitude effects.** The table reports the magnitude effects of the explanatory variables capturing demand conditions in model (4) of Table 9. 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 last column the magnitude effect is computed as the product between the estimated coefficient and the interquartile range of the corresponding explanatory variable.

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	0.002	2215.540	4.386	3260.000	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

$$share(b,c,t) = \alpha(c) + \alpha(c) \times tspread(t) + \beta(h(b)) + \beta(h(b)) \times tspread(t) + \varepsilon(b,c,t) \quad (4)$$

The terms $\alpha(c)$ represent country fixed effects, $\beta(h(b))$ denotes banking group fixed effects and $tspread(t)$ 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 demand from shifts in supply, 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 11 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 Figure 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 the demand or the supply is 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 shift mainly the demand.

6 Tobit Robustness Checks

The results exposed so far are obtained using linear regressions. Our 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, it should be more appropriate to use a censored Tobit model of the form:

$$y^* = \boldsymbol{x}\boldsymbol{\beta} + \varepsilon \tag{5}$$

$$y = \begin{cases} 0 & \text{if} \quad y^* < 0 \\ y^* & \text{if} \quad 0 \leq y^* \leq 100 \\ 100 & \text{if} \quad y^* > 100 \end{cases}$$

Nonetheless, most of our findings are drawn by comparing the coefficients of determination of different specifications. Unfortunately, Tobit models do not provide such measure. Alternative metrics known as pseudo-R^2 cannot be considered as meaningful as the coefficient of determination of linear models. Moreover, in the specifications where we model the demand relying on a set of explanatory variables, we control

Table 11: **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. The dependent variable is the share of FRMs. The estimation method is OLS. Specification (6) reports the results of the model of equation 4. 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**		-9.643
				(3.73)		(5.87)
Belgium x term spread				-24.195***		-36.813***
				(2.47)		(4.47)
Germany x term spread				-2.031*		-9.536**
				(1.10)		(4.83)
Spain x term spread				-2.260		-11.414*
				(3.91)		(6.00)
France x term spread				-7.693***		-23.565***
				(1.24)		(4.17)
Italy x term spread				-8.795***		-16.524***
				(1.42)		(4.43)
Luxembourg x term spread				-14.020***		-18.195***
				(2.05)		(2.46)
Slovenia x term spread				-27.161***		-46.651***
				(2.32)		(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)

for bank supply conditions including month-banking group fixed effects. It is well known that nonlinear models with fixed effects suffer from the so called "incidental parameters problem" (Neyman and Scott, 1948; Lancaster, 2000). This implies that the maximum likelihood estimator (MLE) is inconsistent. Greene (2004a,b) shows that, for the specific case of Tobit models with fixed effects, the slope coefficients are slightly affected by the incidental parameters problem. However, the bias can be sizable for the disturbance variance, with clear implications also on the estimation of the marginal effects. Therefore, either using linear or nonlinear models, we have to deal with relevant issues that can produce unreliable results. In light of the fact that our sample includes only four observations where the share of FRMs is exactly equal to one of the two bounds,[32] we believe that the issue related to linear regression models is less severe and, hence, we rely on them to derive our main results. Nonetheless, we perform a set of Tobit robustness checks in order to test whether our findings are robust to nonlinear specifications.

We start by replicating Table 4 using a censored regression model with lower bound 0 and upper bound 100. We calculate the pseudo R^2 according to the methodology suggested in Wooldridge (2010). In particular, we computed it as the square of the correlation coefficient between the dependent variable and the estimate of $\mathbb{E}[y|x]$. Table A7 in the Appendix shows that, as before, month-country fixed effects explain a larger fraction of the variation in the dependent variable than month-banking group fixed effects. We extend our analysis also including Tobit models with lower bound 1 and upper bound 99, in order to check whether our findings are affected by a more restrictive censoring. Results are virtually unchanged.

Tables A8-A9 in the Appendix replicate Table 5. In both tables the pattern of the R^2 across the different specifications is equal to the one displayed in Table 5. This confirms the prominent role of country demand factors, even when considering the whole sample of banks. However, in this setting we are not able to perform a

[32] In these four observations the value of the share is equal to the upper bound 100.

decomposition of the R^2 to get additional insights.

Table A10 in the Appendix shows the estimates of the censored regression models including country specific explanatory variables and month-banking group fixed effects. For each regressor we report the marginal effect of the censored variable $\mathbb{E}[y|x]$ at the sample means. Differently from Table 8, we cluster standard errors only by country, as the statistical software that we use does not allow to implement two-way clustering in the Tobit model that we employ. We consider this a minor limitation, as we detected a higher serial correlation than cross correlation in our data set. In the specifications with the full set of country variables, we find, as before, a negative and statistically significant coefficient for Real Disposable Income Per Capita and Historical Inflation Volatility, as well as a positive and statistically significant coefficient for ρ(Unemployment, Short-term IR).

As in the previous section, we improve our analysis making sure that we equally weight each country when explaining the cross-country heterogeneity in the share of FRMs. To this aim, we rely on a two-stage approach. In the first stage we perform a censored regression including month-country fixed effects and quarter-banking group fixed effects. In the second stage we regress the estimated coefficients of the month-country fixed effects, which correspond to the marginal effects of the latent variable y^*, on our set of explanatory variables. While in the first stage we use a Tobit model, in the second stage we employ a linear regression, as the dependent variable is not constrained between 0 and 100. Model 4 of Tables A11-A12 in the Appendix shows, as in Table 9, a negative and significant coefficient for Financial Literacy and Historical Inflation Volatility, as well as a positive and significant coefficient for ρ(Unemployment, Short-term IR), Outstanding Covered Bonds to GDP and Outstanding RMBS to GDP.

Finally, in Table A13 in the Appendix we investigate the time variation in the share of FRMs using censored regression models. As in Table 11, we find that the sensitivity of the share of FRMs to the term spread is quite heterogeneous across

countries. Moreover, the term spread captures an important fraction of the time variation in the dependent variable.

The Tobit robustness checks exposed above highlight that the results obtained using linear regression models are indeed robust to nonlinear specifications.

7 Empirical Analysis on the Spread

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 want to explore this possibility by performing the same set of reduced-form regressions exposed in section 5 using this time as dependent variable the spread between FRMs and ARMs interest rates, henceforth abridged simply with "spread".

Models 1-3 of Table A14 in the Appendix display three specifications in which the spread is regressed on, respectively, month-country fixed effects, month-banking group fixed effects and both sets of fixed effects jointly. Month-country fixed effects alone explain 60% of the variation in the spread, suggesting that, also in this case, country demand factors play a major role. Month-banking group fixed effects explain only 38% of the variation in the dependent variable, but the difference between the R^2 of model 1 and model 2 is smaller compared to what seen for the share of FRMs in Table 4. When taken together the two sets of fixed effects can explain 73% of the total variation in the spread. We conclude that also the spread is mainly driven by the demand, although here our model is somewhat less capable of describing the data. The supply plays a role as well and it seems to be slightly more relevant in explaining the spread than the share of FRMs.

The following step is to model month-country fixed effects with the selection of regressors that we used in section 5. We expect that these explanatory variables

have an effect also on the spread, but the relation should be of opposite sign with respect to the one observed in the analysis on the share of FRMs. To avoid possible distortions related to heterogeneous coverage of the dataset across countries (in terms of number of intermediaries) we directly look at the two-stage approach, as described above for quantities. Model 1 of Table A15 in the Appendix consists in the regression with month-country fixed effects and year-banking group fixed effects. We report the results of this specification including year-banking group fixed effects, instead of quarter-banking group fixed effects, because the results are not exactly the same under the two models. In light of that, we consider the specification with year-banking group fixed effects more reliable, as it allows us to perform the second stage regression having 381 out of 393 estimated coefficients of month-country fixed effects. As shown in model 4 of Table A15 in the Appendix, two factors turn out to be significant, at least when a two-way cluster by country and quarter is adopted, both with the expected sign: the ρ(Unemployment, Short-term IR) and the Outstanding RMBS to GDP. In general, the coefficients of all the explanatory variables are very little and sensibly lower than those displayed in Table 9. The weak effects of our regressors are hardly surprising though. In fact, as highlighted before, the cross-country variation in the spread is much lower than the variation in the share of FRMs across countries.

We extend our analysis looking at the time variation in the spread. Model 6 of Table A16 includes country fixed effects, banking group fixed effects, as well as their interaction with the term spread. The R^2 of this specification (58%) is relatively high but fifteen percentage points lower than the coefficient of determination of our baseline model with month-country fixed effects and month-banking group fixed effects (73%). As before, this suggests that the term spread is able to capture the time variation in the spread, but the relation with the dependent variable might be nonlinear. In Figure 1 we observed that the evolution of the spread over time is directly related to the evolution of the term spread. The positive and significant coefficients of the interactions between country fixed effects and the term spread confirm this evidence.

As for the share of FRMs, in Belgium, Greece, Italy, Luxembourg and Slovenia the spread is more sensitive to changes in the term spread. The Shorrocks-Shapley decomposition of the R^2 of model 6 eventually corroborates that the term spread is mainly able to shift the demand, although the effect it exerts on the supply is slightly higher than what is detected in Table 11.

8 Conclusions

Using granular bank level information from 103 banks belonging to 73 different 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, 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 demand or supply conditions.

Relying on a prudent identification strategy, we are able to explore the role of country demand and bank supply factors in determining households' mortgage choice. Specifically, we assume that lending policies are set at the consolidated level and can disentangle demand from supply by comparing the lending patterns observed for the same cross-border banking group in different euro area economies, as well as the lending patterns observed across different cross-border banking groups operating in the same economy. Country demand conditions results to have a prominent role in driving the prevalence of mortgages extended at a fixed rate. In particular, they are able to explain almost 72% of the total variation of the share of fixed rate to total new mortgages observed in the sample.

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 demand component of fixed rate mortgages, relative to adjustable rate ones.

A predominant role for demand 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 demand 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, even not 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.

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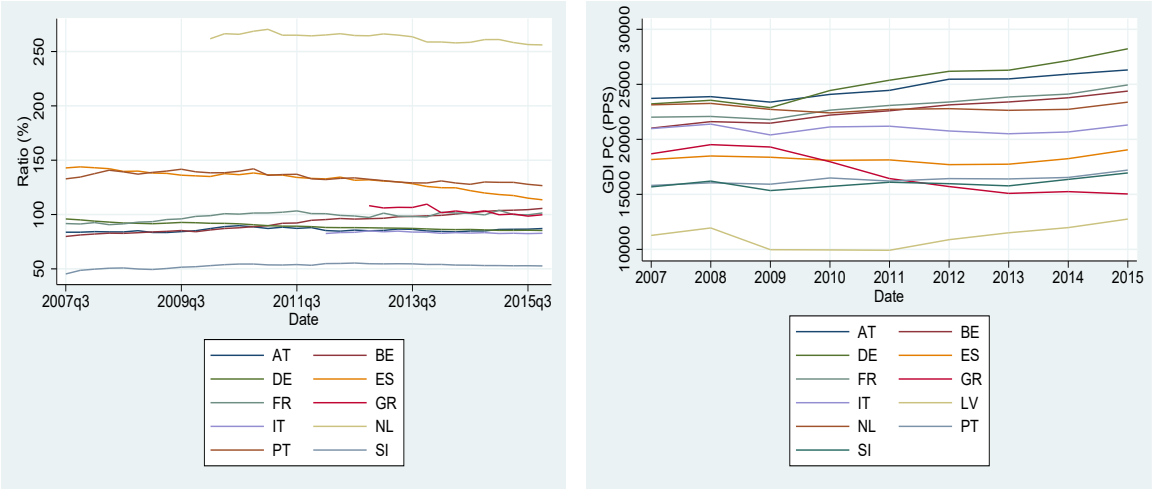
Figure A1: **Country variables.** The figure shows the time series of Indebtedness, Real Disposable Income Per Capita, Financial Literacy and Historical Inflation Volatility by country. Indebtedness is the ratio of total outstanding debt as percentage of gross disposable income provided by the OECD on a quarterly frequency. Data are missing for Latvia and Luxembourg, and partially available for Greece, Italy and the Netherlands. Real Disposable Income Per Capita is 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. Data are missing for Luxembourg. Financial Literacy is measured as the percentage of 3 out of 4 answers correct given by adults interviewed in each country, as results from the S&P Global FinLit Survey. Historical Inflation Volatility is the 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.

(a) Indebtedness (left) and Real Disposable Income Per Capita (right)



(b) Financial Literacy (left) and Historical Inflation Volatility (right)

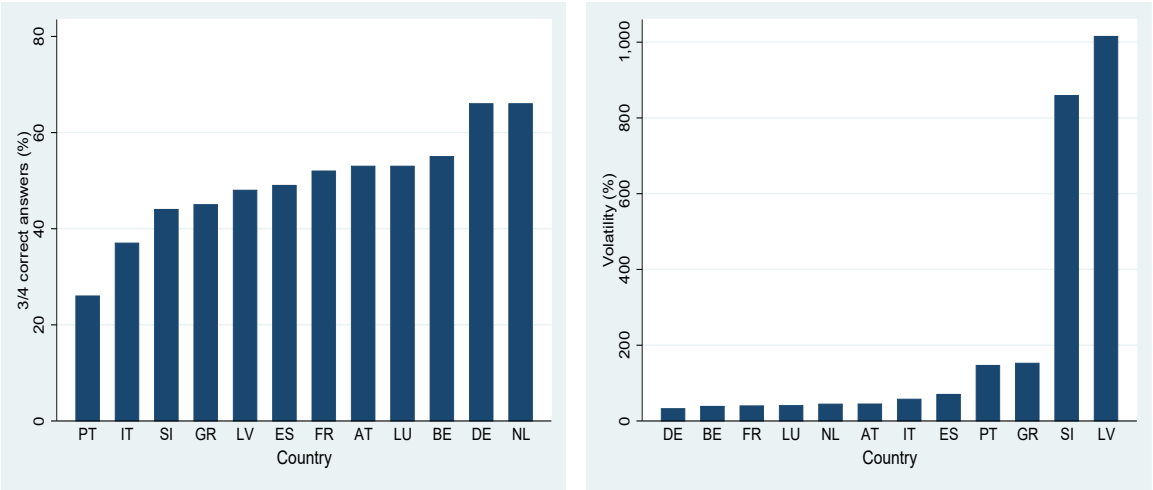
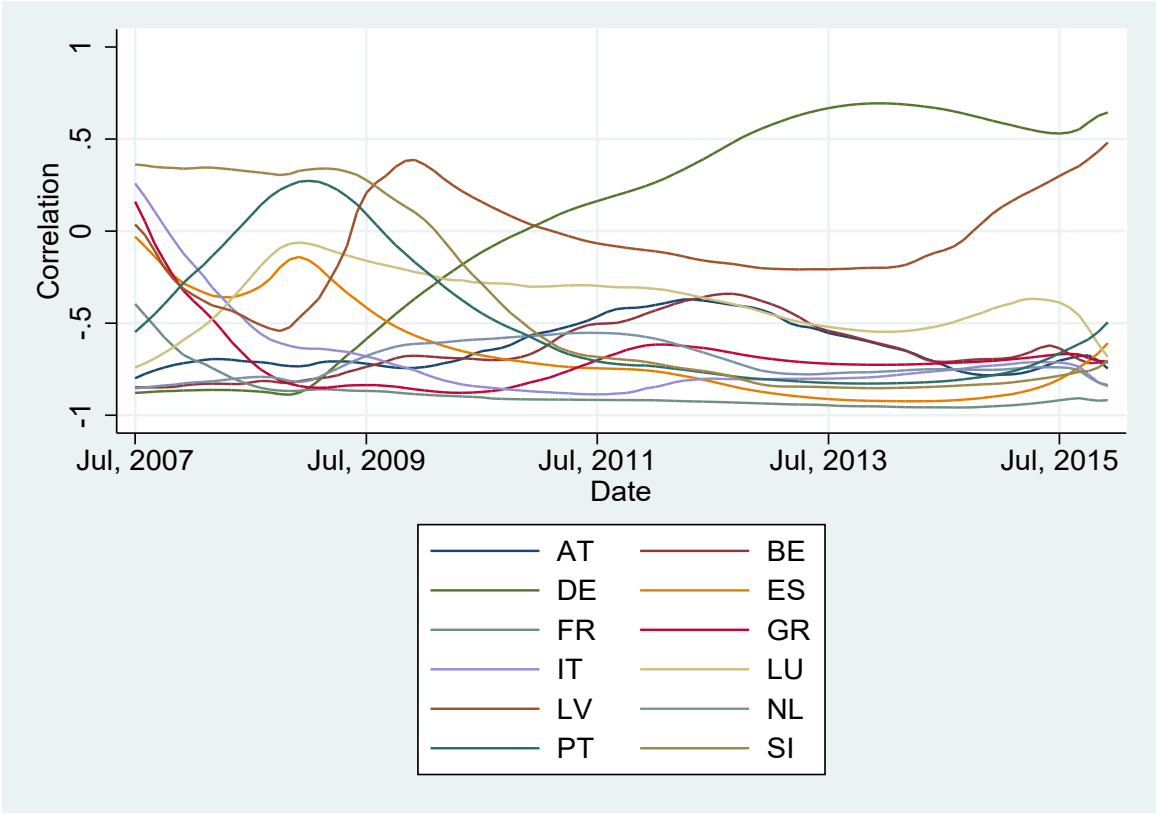
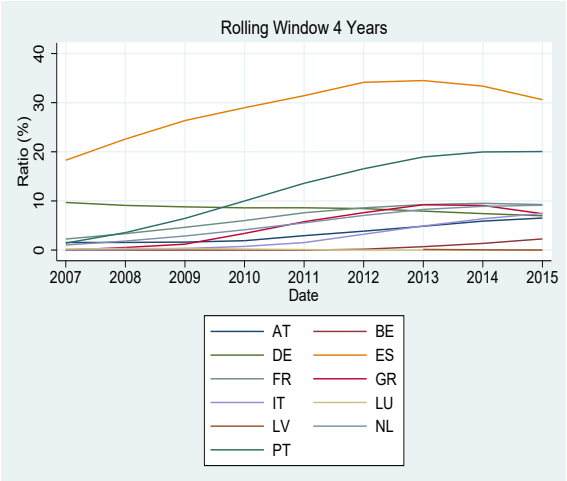


Figure A2: **Country variables.** The figure shows the time series of ρ(Unemployment, Short-term IR), Outstanding Covered Bonds to GDP and Outstanding RMBS to GDP by country. ρ(Unemployment, Short-term IR) is the realized correlation between the unemployment rate and the short-term interest rate, calculated on a rolling window approach with a window of 7 years. Outstanding Covered Bonds to GDP is the average over the last four years of the amount outstanding of mortgage covered bonds as percentage of GDP. Data are missing for Slovenia. Outstanding RMBS to GDP is the average over the last four quarters of the amount outstanding of RMBS as percentage of GDP. Data are missing for Latvia, Luxembourg and Slovenia and not available for all other countries in 2007.

(a) ρ(Unemployment, Short-term IR)



(b) Outstanding Covered Bonds to GDP (left) Outstanding RMBS to GDP (right)



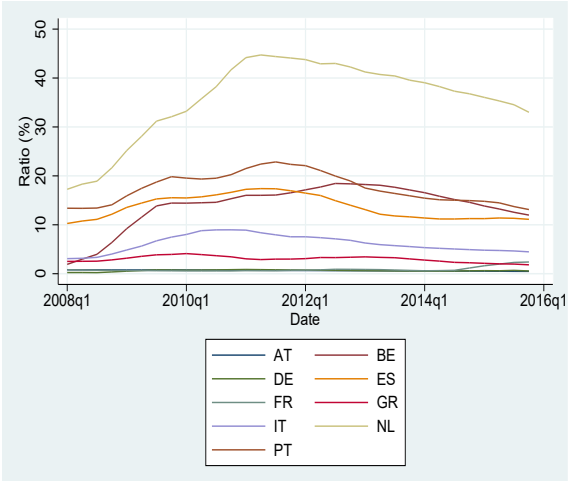


Table A1: **Fixed effects decomposition with time invariant fixed effects.** The table reports the R^2 of various fixed effects decompositions of the share of FRMs. The sample includes cross-border banking groups only. The dependent variable is the share of FRMs. The estimation method is OLS. Standard errors are not adjusted. The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Month FE	YES	-	-	-	YES	YES	YES
Country FE	-	YES	-	YES	YES	-	YES
Banking group FE	-	-	YES	YES	-	YES	YES
N	1644	1644	1644	1644	1644	1644	1644
R^2	0.080	0.580	0.146	0.620	0.669	0.223	0.708
Adjusted R^2	0.019	0.578	0.144	0.617	0.646	0.170	0.687
F-test statistic	1.319**	322.089***	69.927***	241.939***	28.712***	4.194***	33.198***
degrees of freedom	(102,1542)	(8,1636)	(5,1639)	(12,1632)	(109,1535)	(106,1538)	(113,1531)

Table A2: **Advanced model, one-way clustering.** The table reports the coefficients and standard errors (in parentheses) of various regressions of the share of FRMs on a set of country variables and month-banking group fixed effects. The sample includes cross-border banking groups only. The dependent variable is the share of FRMs. 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. Standard errors are not adjusted in models (1)-(2), and one-way clustered at different levels in models (3)-(14). The estimation method is OLS. The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Financial Literacy	-0.509	-1.689*	-0.509	-1.689	-0.509	-1.689*	-0.509	-1.689	-0.509	-1.689*	-0.509	-1.689	-0.509	-1.689
	(0.40)	(0.95)	(2.52)	(1.27)	(1.90)	(0.65)	(2.04)	(1.13)	(0.81)	(0.91)	(1.30)	(1.40)	(1.60)	(1.70)
Indebtedness	0.835***	0.602***	0.835	0.602	0.835	0.602	0.835	0.602	0.835***	0.602***	0.835***	0.602**	0.835*	0.602
	(0.12)	(0.15)	(0.92)	(0.88)	(0.43)	(0.51)	(0.56)	(0.52)	(0.14)	(0.16)	(0.24)	(0.27)	(0.37)	(0.38)
Real Disposable Income Per Capita	-0.014***	-0.012***	-0.014***	-0.012**	-0.014**	-0.012***	-0.014**	-0.012**	-0.014***	-0.012***	-0.014***	-0.012***	-0.014***	-0.012**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Historical Inflation Volatility	-5.221***	-5.799***	-5.221***	-5.799***	-5.221***	-5.799***	-5.221***	-5.799***	-5.221***	-5.799***	-5.221***	-5.799***	-5.221***	-5.799***
	(0.34)	(0.51)	(1.63)	(0.91)	(0.87)	(0.40)	(1.28)	(0.52)	(0.47)	(0.44)	(0.76)	(0.67)	(0.93)	(0.73)
ρ(Unemployment, Short-term IR)	20.473***	24.170***	20.473	24.170**	20.473	24.170*	20.473	24.170**	20.473***	24.170***	20.473***	24.170***	20.473**	24.170***
	(2.90)	(3.25)	(12.93)	(9.12)	(14.36)	(9.77)	(13.10)	(7.44)	(4.38)	(3.79)	(6.96)	(5.87)	(7.26)	(6.59)
Outstanding Covered Bonds to GDP		1.430**		1.430		1.430		1.430		1.430**		1.430		1.430
		(0.72)		(1.35)		(1.34)		(1.21)		(0.55)		(0.89)		(1.06)
Outstanding RMBS to GDP		0.319		0.319		0.319		0.319		0.319		0.319		0.319
		(0.48)		(1.41)		(0.67)		(0.71)		(0.44)		(0.71)		(0.99)
Month-banking group FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
One-way cluster		-	*bank*	*bank*	*group*	*group*	*country*	*country*	*month*	*month*	*quarter*	*quarter*	*year*	*year*
N	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085
R^2	0.785	0.789	0.785	0.789	0.678	0.684	0.785	0.684	0.785	0.789	0.785	0.789	0.785	0.789
Adjusted R^2	0.677	0.682	0.677	0.682	0.677	0.682	0.677	0.682	0.677	0.682	0.677	0.682	0.677	0.682
F-test statistic regressors	303.309***	222.139***	57.537***	66.989***	-	-	4160.566***	-	400.599***	300.034***	160.953***	124.126***	3094.012***	20598.318***
degrees of freedom	(5,720)	(7,718)	(5,14)	(7,14)	-	-	(5,5)	-	(5,92)	(7,92)	(5,30)	(7,30)	(5,7)	(7,7)

Table A3: **Advanced model, two-way clustering.** The table reports the coefficients and standard errors (in parentheses) of various regressions of the share of FRMs on a set of country variables and month-banking group fixed effects. The sample includes cross-border banking groups only. The dependent variable is the share of FRMs. 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. Standard errors are two-way clustered at different levels. The estimation method is OLS. The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Financial Literacy	-0.509	-1.689	-0.509	-1.689	-0.509	-1.689	-0.509	-1.689	-0.509	-1.689	-0.509	-1.689	-0.509	-1.689	-0.509	-1.689	-0.509	-1.689
	(2.11)	(1.16)	(2.17)	(1.28)	(2.25)	(1.24)	(1.90)	(0.75)	(1.88)	(0.86)	(1.85)	(1.22)	(1.74)	(1.29)	(1.84)	(1.47)	(1.93)	(1.64)
Indebtedness	0.835	0.602	0.835	0.602	0.835	0.602	0.835	0.602	0.835	0.602	0.835	0.602	0.835	0.602	0.835	0.602	0.835	0.602
	(0.75)	(0.71)	(0.75)	(0.71)	(0.75)	(0.74)	(0.43)	(0.51)	(0.42)	(0.51)	(0.39)	(0.50)	(0.47)	(0.53)	(0.48)	(0.55)	(0.50)	(0.56)
Real Disposable Income Per Capita	-0.014***	-0.012***	-0.014***	-0.012***	-0.014***	-0.012**	-0.014**	-0.012***	-0.014**	-0.012***	-0.014**	-0.012**	-0.014***	-0.012**	-0.014***	-0.012**	-0.014***	-0.012*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Historical Inflation Volatility	-5.221***	-5.799***	-5.221***	-5.799***	-5.221***	-5.799***	-5.221***	-5.799***	-5.221***	-5.799***	-5.221***	-5.799***	-5.221***	-5.799***	-5.221***	-5.799***	-5.221***	-5.799***
	(1.35)	(0.77)	(1.38)	(0.79)	(1.38)	(0.77)	(0.86)	(0.43)	(0.84)	(0.47)	(0.74)	(0.54)	(1.08)	(0.59)	(1.14)	(0.68)	(1.15)	(0.66)
ρ (Unemployment, Short-term IR)	20.473*	24.170***	20.473*	24.170***	20.473*	24.170**	20.473	24.170*	20.473	24.170*	20.473	24.170*	20.473	24.170**	20.473	24.170**	20.473	24.170**
	(10.73)	(7.72)	(10.94)	(8.03)	(10.26)	(7.71)	(14.28)	(9.81)	(14.13)	(9.82)	(13.39)	(9.59)	(10.93)	(7.78)	(11.23)	(8.18)	(10.51)	(7.95)
Outstanding Covered Bonds to GDP		1.430		1.430		1.430		1.430		1.430		1.430		1.430		1.430		1.430
		(1.11)		(1.09)		(0.78)		(1.32)		(1.29)		(1.28)		(1.25)		(1.31)		(1.30)
Outstanding RMBS to GDP		0.319		0.319		0.319		0.319		0.319		0.319		0.319		0.319		0.319
		(1.17)		(1.18)		(1.16)		(0.70)		(0.73)		(0.89)		(0.78)		(0.88)		(1.02)
Month-banking group FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Two-way cluster	*bank, month*	*bank, month*	*bank, quarter*	*bank, quarter*	*bank, year*	*bank, year*	*group, month*	*group, month*	*group, quarter*	*group, quarter*	*group, year*	*group, year*	*country, month*	*country, month*	*country, quarter*	*country, month*	*country, year*	*country, year*
N	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085
R^2	0.785	0.789	0.785	0.789	0.785	0.789	0.785	0.789	0.785	0.789	0.785	0.789	0.785	0.789	0.785	0.789	0.785	0.789
Adjusted R^2	0.677	0.682	0.677	0.682	0.677	0.682	0.677	0.682	0.677	0.682	0.677	0.682	0.677	0.682	0.677	0.682	0.677	0.682
F-test statistic regressors	77.266***	99.520***	70.149***	167.418***	-	-	-	-	-	-	-	-	226.419***	401.801***	276.015***	-	-	-
degrees of freedom	(5,14)	(7,14)	(5,14)	(7,14)	-	-	-	-	-	-	-	-	(5,5)	(7,5)	(5,5)	-	-	-
F-test statistic regressors pure demand		132.435***		155.015***		71489.080***		3270.95***		385.22***		83.07		233.589***		158.955***		690.636***
degrees of freedom		(5,14)		(5,14)		(5,7)		(4,3)		(4,3)		(4,3)		(5,5)		(5,5)		(5,5)
F-test statistic regressors institutional demand		1.234		1.314		3.111		8.1**		3.64***		2.76***		1.997		1.829		2.139
degrees of freedom		(2,14)		(2,14)		(2,7)		(2,3)		(2,3)		(2,3)		(2,5)		(2,5)		(2,5)

Table A4: **Advanced model, quarter-banking group fixed effects and two-way clustering.** The table reports the coefficients and standard errors (in parentheses) of various regressions of the share of FRMs on a set of country variables and quarter-banking group fixed effects. The sample includes cross-border banking groups only. The dependent variable is the share of FRMs. 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. Standard errors are two-way clustered at different levels. The estimation method is OLS. The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Financial Literacy	-1.634	-1.634	-1.634	-1.634	-1.634	-1.634	-1.634	-1.634	-1.634
	(1.17)	(1.21)	(1.17)	(0.76)	(0.82)	(1.17)	(1.27)	(1.37)	(1.54)
Indebtedness	0.586	0.586	0.586	0.586	0.586	0.586	0.586	0.586	0.586
	(0.75)	(0.71)	(0.73)	(0.50)	(0.51)	(0.49)	(0.56)	(0.54)	(0.55)
Real Disposable Income Per Capita	-0.012***	-0.012***	-0.012***	-0.012***	-0.012***	-0.012**	-0.012**	-0.012**	-0.012**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Historical Inflation Volatility	-5.772***	-5.772***	-5.772***	-5.772***	-5.772***	-5.772***	-5.772***	-5.772***	-5.772***
	(0.84)	(0.81)	(0.78)	(0.45)	(0.48)	(0.55)	(0.64)	(0.69)	(0.67)
ρ (Unemployment, Short-term IR)	23.764***	23.764***	23.764**	23.764*	23.764*	23.764*	23.764**	23.764**	23.764**
	(7.86)	(7.71)	(7.34)	(9.56)	(9.54)	(9.27)	(7.94)	(7.87)	(7.56)
Outstanding Covered Bonds to GDP	1.436	1.436	1.436*	1.436	1.436	1.436	1.436	1.436	1.436
	(1.11)	(1.02)	(0.73)	(1.31)	(1.27)	(1.27)	(1.27)	(1.24)	(1.24)
Outstanding RMBS to GDP	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314	0.314
	(1.18)	(1.12)	(1.11)	(0.69)	(0.71)	(0.87)	(0.77)	(0.82)	(0.96)
Quarter-banking group FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Two-way cluster	*bank, month*	*bank, quarter*	*bank, year*	*group, month*	*group, quarter*	*group, year*	*country, month*	*country, quarter*	*country, year*
N	1085	1085	1085	1085	1085	1085	1085	1085	1085
R^2	0.779	0.779	0.779	0.779	0.779	0.779	0.779	0.779	0.779
Adjusted R^2	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750
F-test statistic regressors	89.022***	172.875***	-	-	-	-	-	-	-
degrees of freedom	(7,14)	(7,14)	-	-	-	-	-	-	-
F-test statistic regressors pure demand	118.409***	151.116***	12457.165***	2254.51***	311.74***	80.4***	188.281***	129.047***	355.269***
degrees of freedom	(5,14)	(5,14)	(5,7)	(4,3)	(4,3)	(4,3)	(5,5)	(5,5)	(5,5)
F-test statistic regressors institutional demand	1.168	1.408	3.224	10.49**	4.360	2.96	1.948	1.957	2.148
degrees of freedom	(2,14)	(2,14)	(2,7)	(2,3)	(2,3)	(2,3)	(2,5)	(2,5)	(2,5)

Table A5: **Two-stage model, two-way clustering.** The table reports the coefficients and standard errors (in parentheses) of various specifications of the second stage regression of equation eq:eq3. The sample includes cross-border banking groups only. The dependent variable is the share of FRMs. 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. Standard errors are two-way clustered at different levels. The estimation method is OLS. The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Financial Literacy	-2.693	-5.386***	-2.693	-5.386***	-2.693	-5.386**	-2.693	-5.386**	-2.693	-5.386**	-2.693	-5.386**	-2.693	-5.386**	-2.693	-5.386**	-2.693	-5.386**
	(2.16)	(1.42)	(2.15)	(1.60)	(1.89)	(1.56)	(2.18)	(0.96)	(2.18)	(1.12)	(2.17)	(1.04)	(2.28)	(1.53)	(2.26)	(1.72)	(1.99)	(1.62)
Indebtedness	1.558	0.206	1.558	0.206	1.558	0.206	1.558	0.206	1.558	0.206	1.558	0.206	1.558	0.206	1.558	0.206	1.558	0.206
	(0.95)	(0.77)	(0.95)	(0.74)	(0.92)	(0.63)	(1.24)	(0.67)	(1.22)	(0.64)	(1.16)	(0.77)	(0.99)	(0.81)	(0.99)	(0.78)	(0.95)	(0.66)
Real Disposable Income Per Capita	0.000	0.002	0.000	0.002	0.000	0.002	0.000	0.002	0.000	0.002	0.000	0.002	0.000	0.002	0.000	0.002	0.000	0.002
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
Historical Inflation Volatility	-3.847**	-6.482***	-3.847**	-6.482***	-3.847**	-6.482***	-3.847	-6.482***	-3.847	-6.482***	-3.847	-6.482***	-3.847*	-6.482***	-3.847**	-6.482***	-3.847**	-6.482***
	(1.45)	(0.73)	(1.42)	(0.80)	(1.18)	(0.59)	(1.70)	(0.72)	(1.77)	(0.78)	(1.98)	(0.40)	(1.52)	(0.82)	(1.48)	(0.87)	(1.22)	(0.60)
ρ (Unemployment, Short-term IR)	33.128*	28.726**	33.128*	28.726**	33.128	28.726***	33.128	28.726**	33.128	28.726**	33.128	28.726***	33.128	28.726**	33.128	28.726**	33.128	28.726**
	(17.65)	(9.79)	(17.67)	(9.07)	(18.39)	(7.82)	(16.77)	(5.70)	(16.87)	(5.68)	(16.50)	(1.71)	(18.52)	(10.50)	(18.53)	(9.79)	(19.10)	(8.41)
Outstanding Covered Bonds to GDP		5.754***		5.754***		5.754***		5.754***		5.754***		5.754**		5.754***		5.754***		5.754***
		(0.88)		(0.89)		(0.95)		(0.71)		(0.78)		(1.48)		(0.80)		(0.80)		(0.75)
Outstanding RMBS to GDP		2.756***		2.756***		2.756**		2.756**		2.756**		2.756		2.756***		2.756***		2.756**
		(0.41)		(0.49)		(0.79)		(0.49)		(0.62)		(1.39)		(0.37)		(0.50)		(0.81)
Two-way cluster	*bank, month*	*bank, month*	*bank, quarter*	*bank, quarter*	*bank, year*	*bank, year*	*group, month*	*group, month*	*group, quarter*	*group, quarter*	*group, year*	*group, year*	*country, month*	*country, month*	*country, quarter*	*country, month*	*country, year*	*country, year*
N	344	344	344	344	344	344	344	344	344	344	344	344	344	344	344	344	344	344
R^2	0.337	0.503	0.337	0.503	0.337	0.503	0.337	0.503	0.337	0.503	0.337	0.503	0.337	0.503	0.337	0.503	0.337	0.503
Adjusted R^2	0.327	0.492	0.327	0.492	0.327	0.492	0.327	0.492	0.327	0.492	0.327	0.492	0.327	0.492	0.327	0.492	0.327	0.492
F-test statistic regressors	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
degrees of freedom	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F-test statistic regressors pure demand		41.924***		56.170***		521.38***		107.48***		42.37***		742.40***		44.792***		53.302***		1334.1***
degrees of freedom		(5,8)		(5,8)		(4,7)		(5,3)		(4,3)		(4,3)		(5,5)		(5,5)		(4,5)
F-test statistic regressors institutional demand		25.777***		21.543***		20.475***		44.29***		31.87***		26.64**		34.766***		27.071***		31.334***
degrees of freedom		(2,8)		(2,8)		(2,7)		(2,3)		(2,3)		(2,3)		(2,5)		(2,5)		(2,5)

Table A6: **Two-stage model, year-banking group fixed effect.** The table reports (i) the R^2 of the first stage regression of equation 2 in model (1), (ii) the coefficients and standard errors (in parenthesis) of a regressions of the share of FRMs on the a of country variables and year-banking group fixed effects in model (2), and (iii) the coefficients and standard errors (in parentheses) of the second stage regression of equation 3 in models (3)-(4). The sample includes cross-border banking groups only. The dependent variable is the share of FRMs in models (1)-(2), and the estimated coefficients of month-country fixed effects obtained from the first specification in models (3)-(4). 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. The estimation method is OLS. Standard errors are not adjusted for model (1), and two-way clustered by country and quarter in models (2)-(4). The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	1ST STAGE		***2ND TAGE***	
	(1)	(2)	(3)	(4)
Financial Literacy		-0.880	-3.772	-6.144***
		(1.30)	(2.06)	(1.38)
Indebtedness		0.566	1.580	0.423
		(0.54)	(0.89)	(0.63)
Real Disposable Income Per Capita		-0.014**	0.000	0.002
		(0.00)	(0.00)	(0.00)
Historical Inflation Volatility		-5.389***	-4.208**	-6.587***
		(0.57)	(1.50)	(0.73)
ρ (Unemployment, Short-term IR)		20.945**	41.719*	37.293***
		(6.53)	(18.38)	(8.91)
Outstanding Covered Bonds to GDP		1.053		5.094***
		(1.39)		(0.77)
Outstanding RMBS to GDP		0.026		2.680***
		(0.87)		(0.40)
Year-banking group FE	YES	YES		
Month-country FE	YES	-		
Two-way cluster	-	*country, quarter*	*country, quarter*	*country, quarter*
N	1085	1085	381	381
R^2	0.844	0.758	0.349	0.500
Adjusted R^2	0.748	0.749	0.341	0.490
F-test statistic regressors		-	-	-
degrees of freedom		-	-	-
F-test statistic regressors pure demand		295.46***		68.34***
degrees of freedom		(5,5)		(4,5)
F-test statistic regressors institutional demand		1.940		25.27***
degrees of freedom		(2,5)		(2,5)
F-test statistic fixed effects	8.809***			
degrees of freedom	(413,672)			

Table A7: **Baseline model, Tobit.** The table reports the pseudo R^2 of various fixed effects decompositions of the share of FRMs. The sample includes cross-border banking groups only. The dependent variable is the share of FRMs. The estimation method is Tobit with lower bound 0 and upper bound 100 in model (1)-(4), and lower bound 1 and upper bound 99 in models (5)-(8). Standard errors are not adjusted. The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Month-country FE	YES	-	YES	YES	YES	-	YES	YES
Month-banking group FE	-	YES	YES	YES	-	YES	YES	YES
Bank FE	-	-	-	YES	-	-	-	YES
N	1644	1644	1644	1644	1644	1644	1644	1644
Pseudo R^2	0.843	0.318	0.908	0.977	0.842	0.318	0.908	0.978
LR test statistic	3047.719***	630.833***	3914.214***	5927.208***	-	631.552***	-	-
degrees of freedom	687	479	1045	1052	-	479	-	-
lower bound	0	0	0	0	1	1	1	1
upper bound	100	100	100	100	99	99	99	99
left censored obs	0	0	0	0	9	9	9	9
right censored obs	0	0	0	0	8	8	8	8

Table A8: **Fixed effects decomposition with time invariant fixed effects, Tobit.** The table reports the pseudo R^2 of various fixed effects decompositions of the share of FRMs. The sample includes all banks. The dependent variable is the share of FRMs. The estimation method is Tobit with lower bound 0 and upper bound 100. Standard errors are not adjusted. The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Month FE	YES	-	-	-	YES	YES	YES
Country FE	-	YES	-	YES	YES	-	YES
Banking group FE	-	-	YES	YES	-	YES	YES
N	7327	7327	7327	7327	7327	7327	7327
Pseudo R^2	0.026	0.696	0.686	0.778	0.740	0.730	0.825
LR test statistic	191.219***	8740.390***	8515.165***	11051.019***	9714.870***	9436.297***	12483.017***
degrees of freedom	101	11	72	79	112	173	180
lower bound	0	0	0	0	0	0	0
upper bound	100	100	100	100	100	100	100
left censored obs	0	0	0	0	0	0	0
right censored obs	4	4	4	4	4	4	4

Table A9: **Fixed effects decomposition with time invariant fixed effects, Tobit.** The table reports the pseudo R^2 of various fixed effects decompositions of the share of FRMs. The sample includes all banks. The dependent variable is the share of FRMs. The estimation method is Tobit with lower bound 1 and upper bound 99. Standard errors are not adjusted. The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Month FE	YES	-	-	-	YES	YES	YES
Country FE	-	YES	-	YES	YES	-	YES
Banking group FE	-	-	YES	YES	-	YES	YES
N	7327	7327	7327	7327	7327	7327	7327
Pseudo R^2	0.025	0.697	0.687	0.779	0.741	0.732	0.827
LR test statistic	207.054***	8544.702***	8603.544***	10992.751***	9532.775***	9566.057***	12463.168***
degrees of freedom	101	11	72	79	112	173	180
lower bound	1	1	1	1	1	1	1
upper bound	99	99	99	99	99	99	99
left censored obs	187	187	187	187	187	187	187
right censored obs	214	214	214	214	214	214	214

Table A10: **Advanced model, Tobit.** The table reports (i) the marginal effects of the censored variable $\mathbb{E}[y|x]$ at the sample means and standard errors (in parentheses) of various regressions of the share of FRMs on a set of country variables and month-banking group fixed effects in models (1)-(2)-(4)-(5), and (ii) the pseudo R^2 of the baseline model of equation 1 run on the same sample of models (2)-(5) in the specifications (3)-(6). The sample includes cross-border banking groups only. The dependent variable is the share of FRMs. 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. Standard errors are one-way clustered by country in models (1)-(2)-(4)-(5), and not adjusted in models (3)-(6). The estimation method is Tobit with lower bound 0 and upper bound 100 in models (1)-(3), and lower bound 1 and upper bound 99 in models (4)-(6). The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Financial Literacy	-0.502	-1.666		-0.516	-1.677	
	(1.64)	(1.12)		(1.66)	(1.10)	
Indebtedness	0.823*	0.593		0.820*	0.588	
	(0.45)	(0.51)		(0.46)	(0.52)	
Real Disposable Income Per Capita	-0.014***	-0.012***		-0.014***	-0.012***	
	(0.00)	(0.00)		(0.00)	(0.00)	
Historical Inflation Volatility	-5.146***	-5.720***		-5.164***	-5.737***	
	(1.04)	(0.57)		(1.05)	(0.56)	
ρ(Unemployment, Short-term IR)	20.180*	23.842***		19.999*	23.665***	
	(10.56)	(7.35)		(10.64)	(7.39)	
Outstanding Covered Bonds to GDP		1.411			1.416	
		(1.20)			(1.18)	
Outstanding RMBS to GDP		0.314			0.309	
		(0.70)			(0.69)	
Month-banking group FE	YES	YES	YES	YES	YES	YES
Month-country FE	-	-	YES	-	-	YES
One-way cluster	*country*	*country*	-	*country*	*country*	-
N	1085	1085	1085	1085	1085	1085
Pseudo R^2	0.787	0.791	0.852	0.787	0.790	0.852
LR test statistic			2075.750***			-
degrees of freedom			605			-
F-test statistic regressors	6263.96***	2054.02***		3.9e+06***	1472.68***	
degrees of freedom	(5,721)	(7,719)		(5,721)	(5,719)	
F-test statistic regressors pure demand		433.93***			435.72***	
degrees of freedom		(5,719)			(5,719)	
F-test statistic regressors institutional demand		2.16			2.20	
degrees of freedom		(2,719)			(2,719)	
lower bound	0	0	0	1	1	1
upper bound	100	100	100	99	99	99
left censored obs	0	0	0	3	3	3
right censored obs	0	0	0	6	6	6

Table A11: **Two-stage model, Tobit.** The table reports (i) the pseudo R^2 of the first stage Tobit regression of equation 2 in model (1), (ii) the marginal effects of the censored variable $\mathbb{E}[y|x]$ at the sample means and standard errors (in parenthesis) of a Tobit regressions of the share of FRMs on a set of country variables and quarter-banking group fixed effects in model (2), and (iii) the coefficients and standard errors (in parentheses) of the second stage regression of equation 3 in models (3)-(4). The sample includes cross-border banking groups only. The dependent variable is the share of FRMs in models (1)-(2), and the estimated coefficients of month-country fixed effects obtained from the first specification in models (3)-(4). 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. The estimation method is Tobit with lower bound 0 and upper bound 100 in models (1)-(2), and OLS in models (3)-(4). Standard errors are not adjusted for model (1), one-way clustered by country in model (2), and two-way clustered by country and quarter in models (3)-(4). The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	1ST STAGE			***2ND TAGE***	
	(1)	(2)		(3)	(4)
Financial Literacy		-1.608		-2.693	-5.386**
		(1.08)		(2.26)	(1.72)
Indebtedness		0.576		1.558	0.206
		(0.51)		(0.99)	(0.78)
Real Disposable Income Per Capita		-0.012***		0.000	0.002
		(0.00)		(0.00)	(0.00)
Historical Inflation Volatility		-5.682***		-3.847**	-6.482***
		(0.60)		(1.48)	(0.87)
ρ (Unemployment, Short-term IR)		23.390***		33.128	28.726**
		(7.20)		(18.53)	(9.79)
Outstanding Covered Bonds to GDP		1.414			5.754***
		(1.16)			(0.80)
Outstanding RMBS to GDP		0.309			2.756***
		(0.67)			(0.50)
Quarter-banking group FE	YES	YES			
Month-country FE	YES	-			
Clustering	-	*country*		*country, quarter*	*country, quarter*
N	1085	1085	N	344	344
Pseudo R^2	0.847	0.780	R^2	0.337	0.503
LR test statistic	2038.38***		Adjusted R^2	0.327	0.492
degrees of freedom	463				
F-test statistic regressors		193.13***		-	-
degrees of freedom		(5,959)		-	-
F-test statistic regressors pure demand		493.94***			53.30***
degrees of freedom		(5, 959)			(5,5)
F-test statistic regressors institutional demand		2.36*			27.07***
degrees of freedom		(2, 959)			(2,5)
lower bound	0	0			
upper bound	100	100			
left censored obs	0	0			
right censored obs	0	0			

Table A12: **Two-stage model, Tobit.** The table reports (i) the pseudo R^2 of the first stage Tobit regression of equation 2 in model (1), (ii) the marginal effects of the censored variable $\mathbb{E}[y|x]$ at the sample means and standard errors (in parenthesis) of a Tobit regressions of the share of FRMs on a set of country variables and quarter-banking group fixed effects in model (2), and (iii) the coefficients and standard errors (in parentheses) of the second stage regression of equation 3 in models (3)-(4). The sample includes cross-border banking groups only. The dependent variable is the share of FRMs in models (1)-(2), and the estimated coefficients of month-country fixed effects obtained from the first specification in models (3)-(4). 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. The estimation method is Tobit with lower bound 1 and upper bound 99 in models (1)-(2), and OLS in models (3)-(4). Standard errors are not adjusted for model (1), one-way clustered by country in model (2), and two-way clustered by country and quarter in models (3)-(4). The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	1ST STAGE			***2ND TAGE***	
	(1)	(2)		(3)	(4)
Financial Literacy		-1.599		-2.904	-5.744**
		(1.05)		(2.33)	(1.73)
Indebtedness		0.572		1.506	0.087
		(0.51)		(1.03)	(0.79)
Real Disposable Income Per Capita		-0.012***		0.000	0.002
		(0.00)		(0.00)	(0.00)
Historical Inflation Volatility		-5.690***		-4.079**	-6.857***
		(0.59)		(1.53)	(0.88)
ρ(Unemployment, Short-term IR)		23.163***		33.141	28.596**
		(7.20)		(19.26)	(10.05)
Outstanding Covered Bonds to GDP		1.406			6.052***
		(1.13)			(0.84)
Outstanding RMBS to GDP		0.295			2.882***
		(0.65)			(0.51)
Quarter-banking group FE	YES	YES			
Month-country FE	YES	-			
Clustering	-	*country*		*country, quarter*	*country, quarter*
N	1085	1085	N	344	344
Pseudo R^2	0.847	0.780	R^2	0.337	0.509
LR test statistic	-		Adjusted R^2	0.327	0.499
degrees of freedom	-				
F-test statistic regressors		191.75***		-	-
degrees of freedom		(5,959)		-	-
F-test statistic regressors pure demand		511.37***			52.55***
degrees of freedom		(5, 959)			(5, 5)
F-test statistic regressors institutional demand		2.41*			27.65***
degrees of freedom		(2, 959)			(2, 5)
lower bound	1	1			
upper bound	99	99			
left censored obs	3	3			
right censored obs	6	6			

Table A13: **Time variation, Tobit.** 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. The dependent variable is the share of FRMs. The estimation method is Tobit with lower bound 0 and upper bound 100 in models (1)-(3), and lower bound 1 and upper bound 99 in models (4)-(6). The displayed coefficients represent the marginal effects of the censored variable $\mathbb{E}[y|x]$ at the sample means. Standard errors are not adjusted. The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Austria x term spread	-6.009***		0.249	-6.221***		-0.392
	(2.30)		(3.53)	(2.21)		(3.52)
Belgium x term spread	-21.005***		-24.816***	-20.683***		-24.485***
	(2.19)		(2.49)	(2.18)		(2.49)
Germany x term spread	-1.556*		0.252	-1.519*		0.256
	(0.84)		(1.19)	(0.82)		(1.16)
Spain x term spread	-1.755		-1.272	-2.199		-1.733
	(2.96)		(3.31)	(2.86)		(3.25)
France x term spread	-6.736***		-12.875***	-6.757***		-12.948***
	(1.08)		(1.73)	(1.07)		(1.73)
Italy x term spread	-8.706***		-6.58***	-8.687***		-6.536***
	(1.40)		(1.44)	(1.41)		(1.45)
Luxembourg x term spread	-13.716***		-7.159***	-13.663***		-6.96**
	(2.01)		(2.76)	(2.02)		(2.73)
Slovenia x term spread	-23.464***		-30.941***	-23.157***		-30.493***
	(2.02)		(2.44)	(2.00)		(2.43)
Country FE	YES	-	YES	YES	-	YES
Banking group FE	-	YES	YES	-	YES	YES
Banking group FE x term spread	-	YES	YES	-	YES	YES
N	1644	1644	1644	1644	1644	1644
Pseudo R^2	0.662	0.204	0.715	0.663	0.204	0.716
LR test statistic	1757.598***	378.309***	2030.115***	1752.183***	374.900***	2020.307***
degrees of freedom	15	9	23	15	9	23
lower bound	0	0	0	1	1	1
upper bound	100	100	100	99	99	99
left censored obs	0	0	0	9	9	9
right censored obs	0	0	0	8	8	8

Table A14: **Baseline model, spread.** The table reports the R^2 of various fixed effects decompositions of the spread between FRMs and ARMs interest rates. The sample includes cross-border banking groups only. The dependent variable is the spread between FRMs and ARMs interest rates. The estimation method is OLS. Standard errors are not adjusted. A Shorrocks-Shapely decomposition of the R^2 is reported for model (3). The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)
Month-country FE	YES	-	YES	YES
Month-banking group FE	-	YES	YES	YES
Bank FE	-	-	-	YES
N	1642	1642	1642	1642
R^2	0.605	0.378	0.729	0.873
Adjusted R^2	0.322	0.124	0.256	0.646
F-test statistic	2.139***	1.486***	1.540***	3.842***
degrees of freedom	(686,956)	(478,1164)	(1044,598)	(1055,587)

Table A15: **Two stage regression analysis, spread.** The table reports (i) the R^2 of the first stage regression of the spread between FRMs and ARMs interest rates on month-country fixed effects and year-banking group fixed effects in model (1), (ii) the coefficients and standard errors (in parenthesis) of a regressions of the spread between FRMs and ARMs interest rates on a set of country variables and year-banking group fixed effects in model (2), and (iii) the coefficients and standard errors (in parentheses) of the second stage regression of the estimated coefficients of month-country fixed effects obtained from the first specification on the set of country variables in models (3)-(4). The sample includes cross-border banking groups only. The dependent variable is the spread between FRMs and ARMs interest rates in models (1)-(2), and the estimated coefficients of month-country fixed effects obtained from the first specification in models (3)-(4). 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. The estimation method is OLS. Standard errors are not adjusted for model (1), and two-way clustered by country and quarter in models (2)-(4). The $*$, $**$, and $***$ marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	1ST STAGE		***2ND TAGE***	
	(1)	(2)	(3)	(4)
Financial Literacy		-0.044	0.041	0.014
		(0.03)	(0.04)	(0.02)
Indebtedness		-0.006	-0.010	-0.007
		(0.01)	(0.02)	(0.02)
Real Disposable Income Per Capita		-0.000	-0.000	-0.000
		(0.00)	(0.00)	(0.00)
Historical Inflation Volatility		0.008	0.042	0.015
		(0.02)	(0.03)	(0.01)
ρ (Unemployment, Short-term IR)		0.012	-0.411	-0.183***
		(0.25)	(0.26)	(0.04)
Outstanding Covered Bonds to GDP		0.045***		0.020
		(0.01)		(0.03)
Outstanding RMBS to GDP		-0.011		-0.039***
		(0.01)		(0.01)
Year-banking group FE	YES	YES		
Month-country FE	YES	-		
Two-way cluster	-	*country, quarter*	*country, quarter*	*country, quarter*
N	1085	1085	381	381
R^2	0.616	0.534	0.249	0.348
Adjusted R^2	0.380	0.517	0.239	0.336
F-test statistic regressors		-	-	-
degrees of freedom		-	-	-
F-test statistic regressors pure demand		34.62***		546.84***
degrees of freedom		(5,5)		(4,5)
F-test statistic regressors institutional demand		9.37**		8.95**
degrees of freedom		(2,5)		(2,5)
F-test statistic fixed effects	2.614			
degrees of freedom	(413,672)			

Table A16: **Time variation, spread.** The table reports the results of the analysis investigating the sensitivity of the spread between FRMs and ARMs interest rates 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. The dependent variable is the spread between FRMs and ARMs interest rates. The estimation method is OLS. 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				0.288*		0.206
				(0.16)		(0.25)
Belgium x term spread				0.454***		0.183
				(0.10)		(0.19)
Germany x term spread				0.308***		0.282
				(0.05)		(0.20)
Spain x term spread				0.353**		0.332
				(0.17)		(0.25)
France x term spread				0.319***		0.174
				(0.05)		(0.18)
Italy x term spread				0.605***		0.486***
				(0.06)		(0.19)
Luxembourg x term spread				0.644***		0.519***
				(0.09)		(0.11)
Slovenia x term spread				1.082***		1.132***
				(0.10)		(0.21)
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	0.377	0.198	0.456	0.496	0.294	0.581
Adjusted R^2	0.375	0.196	0.452	0.491	0.290	0.575
R^2 country FE						0.171
R^2 country FE x term spread						0.220
R^2 banking group FE						0.076
R^2 banking group FE x term spread						0.114
F-test statistic	141.490***	101.288***	124.139***	106.504***	75.335***	97.653***
degrees of freedom	(7,1634)	(4,1637)	(11,1630)	(15,1626)	(9,1632)	(23,1618)

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