

Interest Rate Changes and Borrower Search Behavior[☆]

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Abstract

Borrower search behavior regarding an outside lender is correlated with interest rate changes. The results of a survey among German households reveal that surprisingly few mortgage borrowers switch to an outside lender when refinancing in a period of declining interest rates although non-switching borrowers face significantly higher interest rates. A laboratory experiment which adds the case of rising interest rates reveals that borrowers' efforts to screen offers by outside lenders are significantly higher when interest rates rise than when they fall. This behavior cannot be reconciled with alternative explanations. Overall, several billion € p.a. are transferred to lenders.

JEL Classification: D12, D14, G21, C91

Keywords: Household Finance, Banking, Relationship Lending, Mortgages, Experimental Finance

[☆]The authors would like to thank the anonymous referees whose comments significantly improved the paper as well as Martin Brown, Michael Goedde-Menke, Mark Heitmann, Arvid Hoffmann, Lars Norden, Kay Peters, Hannes Wagner, participants of the 21st Annual Meeting of the German Finance Association (DGF) and the 13th Symposium on Finance, Banking, and Insurance 2014 in Karlsruhe, the 2014 RBFC at Erasmus University Rotterdam, the CFR Research Seminar at Macquarie University, the 2014 Banking Research Workshop at the University of Münster, the members of the Retail Banking Group of the Schmalenbach-Gesellschaft, participants of several UniCredit HypoVereinsbank research workshops, and various employees of a large retail bank in Germany for valuable comments.

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1. Introduction

Refinancing decisions are of prime importance for households with mortgage debt since they offer the opportunity to significantly lower the monthly costs of owning a house. Unfortunately, little is known about the drivers of mortgage borrowers' loyalty to their lenders and the determinants which make borrowers switch to an outside lender when refinancing. Our study shows that borrower loyalty is correlated with the recent development of interest rates.

The research on relationship lending (Petersen and Rajan, 1994, 1995; Boot, 2000) shows that while lending relationships might be beneficial for the borrower due to lower cost of credit, higher credit availability, lower collateral requirements, or longer maturities, some borrowers must accept a higher cost of credit compared to the offers of outside lenders if interbank competition is limited and switching to an outside lender is costly (Sharpe, 1990; Rajan, 1992). However, this literature cannot explain why borrowers might be loyal to their incumbent lenders when the cost of credit is relatively high, competition is intense, and no further advantages such as high credit availability or cost advantages in other products with the same lender are implicitly paid for with the higher interest rate. Based on our novel dataset obtained in a laboratory experiment, we offer an explanation for borrower loyalty to their lenders which is based on the development of credit interest rates.

In this respect, our paper extends the research examining the optimality of mortgage borrowers' refinancing decisions. Based on actual mortgage loan data, Campbell (2006), Agarwal, Rosen, and Yao (2016), Andersen, Campbell, Meisner-Nielsen, and Ramadorai (2018), and Johnson, Meier, and Toubia (2019) find that borrowers behave in suboptimal ways when refinancing their mortgages. Systematic errors in these decisions are primarily attributed to the low financial sophistication of some borrowers. The potential role of recent interest rates for borrowers' refinancing decisions has, however, not yet been explored. This aspect is important for policymakers with respect to regulation and consumer protection since it reveals that borrowers commit errors even in simplified financial decision environments.

With a survey among mortgage borrowers and a laboratory experiment, we are able to base our analysis on a novel dataset. Our survey, conducted in a period of declining interest rates, reveals that the majority of borrowers is loyal to their incumbent lender when refinancing. Importantly, on average, non-switching borrowers pay an annual interest rate that is almost 40 basis points (bps) higher than the interest rate paid by borrowers who switch to a new lender (after controlling for loan details and borrower demographics). These observations indicate that the results of the above-mentioned studies regarding actual US and Danish loan data also persist in survey data from Germany. Adding data on both falling *and* rising interest rates from a laboratory experiment, we find that the observed switching decisions of about 60% of the subjects can be traced back to the recent development of interest rates. Specifically, the propensity to compare the offers of competing lenders increases in an environment with rising interest rates (i.e., if the new loan offer by the incumbent lender has a higher interest rate than the previous one) and decreases when interest rates fall. Since the comparison of outside offers is a prerequisite for switching, this behavior has important implications regarding borrowers' switching behavior. The combination of our survey and experimental data allows us to reject potential alternative explanations for borrowers' loyalty such as credit availability, cross-subsidization,

or search costs considerations.

Overall, we contribute to the existing research by documenting the importance of recent interest rates for mortgage borrowers' search behavior, an observation that has not yet been documented in the context of relationship lending. Our survey motivates the analysis by showing that suboptimal mortgage refinancing behavior, a finding documented by earlier studies based on actual loan data, can also be observed in German survey data. In our laboratory experiment, we are able to replicate the switching behavior reported by the survey respondents when interest rates fall and additionally observe a substantially changed switching behavior when interest rates rise. Importantly, biases such as inertia or inattention which have been shown to matter in other mortgage markets can be excluded due to the institutional features of the German market.

Our findings are relevant to any lending relationship in which borrowers overestimate the effect of market competition on individual offers. On a more general level, we show that borrower loyalty in lending relationships can be driven by biased decision-making when the demand-side consists of individual borrowers instead of corporate clients. Our conclusions are therefore also relevant for the US and other mortgage markets where borrowers can refinance and switch to an outside lender at any time.

We proceed in Section 2 with a review of the related literature. In Section 3, we describe the relevant institutional aspects of the German retail mortgage market. Section 4 presents our empirical results on borrowers' switching behavior and discusses potential explanations of this behavior. Section 5 concludes.

2. Review of Related Literature

Our study is related to the research on relationship lending and the research examining the optimality of mortgage borrowers' decision-making.

As an important part of the literature on relationship banking where a financial intermediary invests in client-specific information and evaluates the client relationship through repeated interactions with the same client, relationship lending refers to longer-term borrowing relationships (Boot, 2000). As first argued by Sharpe (1990) and Rajan (1992), close ties between a borrowing firm and a lender specific to relationship lending can result in substantial costs for the borrower if the lender exploits her informational market power and extracts rents which are not justified by a borrower's true quality. As demonstrated in the analyses of Rajan (1992) and Von Thadden (2004), the mere fact of being new to a lender could thus lower a borrower's cost of credit. Yet, as shown by Ioannidou and Ongena (2010), switching costs resulting from lenders' market power and from administrative conditions can prevent borrowers from switching to a new lender. Petersen and Rajan (1995) show that limits to spatial competition in a credit market are a further potential source of lenders' market power and rent extraction in relationship lending. If the regional intensity of interbank competition is relatively low, the interest rates charged on loans decline more slowly with firm age than they do with a higher degree of competition among lenders even in the absence of an information monopoly. With increased spatial interbank competition, lenders' rents from relationship lending are reduced and the absolute volume of relationship lending decreases, a finding similar to that of Boot and Thakor (2000). Conducting a meta-analysis of more than 100 empirical studies examining the drivers and consequences of relationship lending,

Kysucky and Norden (2016) empirically investigate the potential benefits and disadvantages of relationship lending in a number of different market and country contexts. Their key findings show that strong relationships tend to be beneficial for borrowers; however, lending outcomes may differ across the different dimensions of lending relationships: in particular, long-term, exclusive, and synergy-focused lending relationships are correlated with higher credit volume and lower interest rates. These benefits are more likely to be achieved in countries with high bank competition. In sum, they conclude that relationship lending is not necessarily always beneficial for the borrower. Our paper adds to this field by providing a new perspective based on today's banking market structure. While the spatial distribution of lenders was a major determinant of credit market competitiveness in the 1990s, information and loan availability has increased dramatically due to new web-based offerings by independent websites providing interest rate comparisons by zip codes. This transparency and easy access to competitive offers – it takes less than an hour to receive competing offers – has changed the environment in the German mortgage loan market. In the context of German retail mortgages, borrower-related information can be accessed by outside lenders at the German General Credit Protection Agency. As a consequence, informational and geographical market power can be ruled out especially in the refinancing of mortgages as long as competition exists. In contrast to the existing studies, we focus on retail clients instead of corporate borrowers and provide evidence for the rent extraction of lenders *without* requiring lenders to have market power.³

Instead, as documented in earlier research, retail mortgage borrowers seem to make suboptimal financial decisions caused by systematic biases in the decision-making process. Shiller (2014) argues that more attention should be paid to the behavioral aspects of mortgage financing. In fact, retail mortgage borrowers are found to make suboptimal decisions in various domains of mortgage financing. Recent evidence by Woodward and Hall (2010, 2012) suggests that US retail mortgage borrowers do not necessarily use the increasing degree of competition on the mortgage market; by consulting too few mortgage brokers, they give away considerable savings potential.⁴ These results are stronger for borrowers with lower financial sophistication. Campbell (2012) points out that taking out a mortgage is a rare event for the individual household. As a result, especially households with low financial sophistication may end up with suboptimal decisions. Campbell and Cocco (2003, 2015) provide evidence on the complexity of mortgage related decisions such as the choice of an appropriate mortgage type or prepayment. With respect to refinancing, Campbell (2006) finds that given available mortgage rates in the US, too few borrowers refinance their fixed-rate mortgages. Agarwal, Rosen, and Yao (2016) reveal that over 50% of US borrowers who refinance their mortgages choose a suboptimal timing; a lack of financial sophistication and refinancing experience drives these results. Agarwal, Driscoll, and Laibson (2013) develop a closed-form solution to the problem of mortgage refinancing and find that even financial advisors mostly violate this rule. Andersen, Campbell, Meisner-Nielsen, and Ramadorai (2018) show that Danish mortgage borrowers exhibit inattention and inertia when deciding whether to refinance at all;

³Potential differences between relationship lending in the retail mortgage market and in the market for corporate credit are discussed in Section 4.3.

⁴A recent study by the Consumer Financial Protection Bureau reveals that almost 50% of US borrowers contact one lender only when taking out a mortgage.

the extent of both biases depends on household characteristics such as education or income. Keys, Pope, and Pope (2016) conclude that the failure to refinance costs the median US household more than \$11,000.⁵ Johnson, Meier, and Toubia (2019) report that 50% of mortgage borrowers lose thousands of dollars by not refinancing and that the suspicion of banks' motives is an important driver of refinancing. Our study provides a significant extension to this work by revealing a systematic bias in the refinancing decision based on the recent development of interest rates.

3. The German Mortgage Market

In most cases, German retail mortgages are full recourse debt with a fixed interest rate. Annuity loans with fixed monthly annuity payments consisting of fixed interest payments and partial repayments account for approximately 70% of all retail mortgage loans.⁶ The typical loan-to-value ratio (LTV) of an initial mortgage loan in Germany is around 70% to 75% (i.e., about 10 percentage points lower than the US average), and the median initial loan size is about €165,000. Due to scheduled repayments, Germany has a lower mortgage debt to GDP ratio than many other countries, see Green and Wachter (2005) and Campbell (2012). German mortgage loans are usually provided by banks (one third by savings banks; one fourth by credit banks and cooperative banks, respectively; 10% by mortgage banks), and less than 10% are taken out with *Bausparkassen* or insurance companies. In the last years, independent mortgage brokers have gained market shares and currently account for more than 30% of the market.

In contrast to the standard fixed-rate self-amortizing US mortgage, the scheduled amount of repayments is not determined by the loan contract time but can be chosen by the borrower. These repayments are usually much lower than US repayment rates, starting as low as 1% or 2% annually. As a consequence, the loan contract time (in most cases either 5, 10, or 15 years during which the interest rate is fixed) is usually shorter than necessary to repay the full loan, and refinancing is necessary at least once. Importantly, when refinancing, borrowers can choose between remaining with their incumbent lender or switching to an outside lender. Partial or full fee-free prepayment before the end of the loan contract time is usually ruled out or limited to a small fraction of the original loan value for German mortgages (e.g., 5% of the original loan per year).

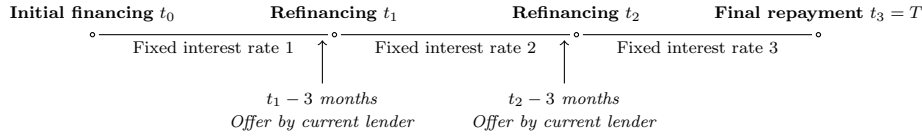
Figure 1 summarizes the timeline of a stylized German mortgage contract. At different points in time before the loan is fully amortized at T , refinancing is necessary when the fixed interest rate period ends and the loan has not been fully repaid, i.e., a borrower needs to find an agreement for the next fixed interest rate period. As an example, the interest rate might be fixed for 10 years from t_0 until t_1 ; since the loan is not fully repaid during this period, refinancing is necessary at t_1 . Depending on the repayment rate chosen at that

⁵As the German median initial loan size is about €165,000 and the fixed interest rate period usually equals 10 years, the savings potential in Germany is of comparable magnitude.

⁶These and the following numbers are taken from statistics published by Deutsche Bundesbank and by the European Mortgage Federation (EMF) as well as the overviews in Green and Wachter (2005), Campbell (2012), and Calza, Monacelli, and Stracca (2013). Interest payments are only tax-deductible in Germany as long as the property is rented out.

Figure 1: Stylized Timeline of a German Retail Mortgage

Stylized timeline of a German retail mortgage, assuming one mortgage loan outstanding. With the initial financing at t_0 , the interest rate and further credit conditions are fixed for a certain period of time (e.g., ten years). At t_1 , the loan must be paid back or refinanced; a further refinancing is due at t_2 (e.g., after another ten years). After the second refinancing, the interest rate is fixed until the final repayment is made at $t_3 = T$ (e.g., after another five years). The current lender is obliged to make a refinancing offer at least three months before the fixed interest rate period of the current loan expires.



point, another refinancing might be due at t_2 . At t_1 and t_2 , the borrower can either accept the incumbent lender's refinancing offer or switch to an outside lender.⁷

When refinancing, borrowers are in an almost ideal decision situation as their refinancing decisions are simplified by the following institutional and regulatory aspects: First, since German mortgage loans are not self-amortizing and full prepayment is generally ruled out prior to maturity, the refinancing decision is not about the timing of the refinancing.⁸ Instead, borrowers can focus on *how* to refinance their mortgage. Time pressure can thus be ruled out with respect to the refinancing decision. Second, German regulation requires the current mortgage lender to make a refinancing offer to the borrower at least three months prior to the expiration of the fixed interest rate period. As a default, the offer is accepted if the borrower does not react. The offered interest rate need not be competitive and the borrower can switch to any other mortgage lender subject to some administrative switching costs. These costs are equivalent to a one-time fee of less than €400 per €100,000 of the new loan amount. Changing the bank entry in the land register constitutes the main part of this fee. In addition, the German General Credit Protection Agency collects all relevant borrower information and provides this information to all banks (for a fee). As the LTV is lower than at the original property acquisition date and assuming that no payment delays have been registered, all banks have the same information to offer a refinancing loan.⁹ Third, the disclosure of the cost of credit is regulated. The *Preisangabenverordnung* (PAngV) regulation defines the basic determinants of the effective interest rate such as the repayment rate, debt discounts, or various fees. Excluding these items from the calculation of the effective interest rate is prohibited. As intended, comparisons between different credit offers can be based on the effective interest rate and German mortgages are thus a mostly homogeneous product with a highly competitive bank market. Moreover, the effective interest rate should depend on factors such as the LTV, the loan amount, the loan type, and the length of the fixed interest rate period.¹⁰ Interest rates can be compared across lenders using websites which help to find best indicative offers, keeping constant certain parameters

⁷Alternatively, a borrower might try to convince the incumbent lender to match the outside lender's offer.

⁸The borrower has the right to refinance a mortgage with no penalty after ten years at the latest. For most mortgage contracts a prepayment option of 5% per year is available prior to signing the contract and for an interest rate mark-up. Selling a house or apartment also triggers prepayment without penalties.

⁹In some cases, the refinancing bank contributes up to 100% of the switching costs and organizes the whole process, i.e., switching costs are already included in the offer.

¹⁰The LTV should be lower with a constant value of the real estate when refinancing. As shown in Appendix K, compared to countries such as the US, German real estate prices were stable in recent years.

such as the loan amount, LTV, repayment schedule, and maturity.

Focusing on refinancing instead of the initial loan has several advantages. All aspects related to the purchase of the real estate which require additional efforts by borrowers besides focusing on the financing aspects are irrelevant in the refinancing situation. Moreover, the default risk of borrowers is reduced since they have already adjusted their spending behavior to the necessary constant monthly payments over the course of the initial financing. Finally, from the lender’s perspective, the borrower quality is usually known after the first years of a lending relationship.¹¹

Summing up, retail mortgage loans are standardized and homogeneous due to the regulated quotation of the effective interest rate; the market is transparent, and interbank competition is intense. In addition, a number of financial consumer magazines publishes comprehensive comparisons of mortgage offers at least once per year. Borrowers should thus be able to compare standard competing offers.

4. Empirical Analysis

This section presents the setup and the results of our empirical analysis. We first describe our survey and then present the results (4.1). Our findings are then complemented and extended with the results of a specifically designed laboratory experiment to identify potential biases in borrowers’ decision-making (4.2). To strengthen our conclusions, we investigate potential alternative explanations for the observed refinancing behavior, using both the survey and the experimental results (4.3).

4.1. Survey Evidence on Borrowers’ Switching Behavior

Using a survey approach, we investigate to what extent German mortgage borrowers remain loyal to their incumbent lenders when refinancing their mortgages. A main feature of our survey is its specific design to examine borrower loyalty in mortgage lending relationships as the fraction of prolongations versus lender switches in the context of mortgage refinancing is not registered centrally for the German retail segment.¹²

4.1.1. Survey Setup and Summary Statistics

We conducted the survey in 2016 as an internet-based questionnaire among current and former German mortgage borrowers who have completed at least one refinancing. To this end, we cooperated with a commercial provider of consumer panels.¹³ All respondents were asked to provide several demographic and personal details as well as the central characteristics of their current or latest refinancing.

¹¹As discussed above, borrower defaults are recorded in the credit register of the German General Credit Protection Agency. Borrower quality can hence be assessed by outside lenders as well.

¹²The minimum reporting threshold of the regulation governing large loan exposures (*Großkredit- und Millionenkreditverordnung, GroMiKV*) has been lowered from €1,000,000 to €500,000 as of December 2013. Yet the amount exceeds virtually any loan exposure in the German retail mortgage market. In the future, smaller loans need to be reported based on the ECB’s AnaCredit project.

¹³Alternative attempts to create a large sample of refinancing borrowers in the German mortgage market besides accessing a private consumer panel – e.g., cooperations with newspapers – have proven unsuccessful. Respondents are members of the household panel of the cooperating commercial provider and receive a fixed payment for their participation in the survey. To avoid guessing or to give the chance to refuse an answer, the option ‘No answer’ was always available. The survey questions are provided in Appendix A.

Table 1: Survey: Borrower and Loan Characteristics

	Full sample		Switchers		Non-switchers	
	Mean	Median	Mean	Median	Mean	Median
<i>Demographics</i>						
Age	48.76	50.00	47.15	49.00	49.63	50.00
Male	0.60	1.00	0.62	1.00	0.60	1.00
Yearly net income		50–75		50–75		50–75
Financial literacy	3.32	3.00	3.45	4.00	3.26	3.00
Mortgage literacy	3.36	3.00	3.47	4.00	3.30	3.00
<i>Loan details</i>						
Effective interest rate p.a.	3.11	2.75	2.85	2.60	3.25	2.90
Nominal interest rate p.a.	2.90	2.50	2.74	2.50	2.98	2.55
Volume		75–100		75–100		75–100
Fixed interest rate period	116.43	120.00	117.06	120.00	116.09	120.00
LTV		60–70		60–70		60–70
Initial repayment p.a.	3.45	3.00	3.44	3.00	3.45	3.00
Intermediary	0.16	0.00	0.31	0.00	0.08	0.00
<i>Lender</i>						
Building association	0.10	0.00	0.13	0.00	0.09	0.00
Cooperative bank	0.18	0.00	0.18	0.00	0.17	0.00
Mortgage bank	0.05	0.00	0.07	0.00	0.03	0.00
Credit bank	0.21	0.00	0.24	0.00	0.20	0.00
Savings bank	0.32	0.00	0.22	0.00	0.37	0.00
Insurance company	0.03	0.00	0.04	0.00	0.02	0.00
Other	0.11	0.00	0.13	0.00	0.11	0.00
N	742		262		480	

Switchers are refinancing borrowers who switch to an outside lender when refinancing; *Non-switchers* are loyal to the incumbent lender; *Age* denotes respondents' age, measured in years; *Male* is the share of male respondents; *Yearly net income* is the yearly disposable net income of the respondents' households, measured in thousand € (response options specified as ranges); *Financial literacy* and *Mortgage literacy* are respondents' self-assessments of their knowledge in general financial matters and in the mortgage domain, measured on a scale from 0 to 5 where 0 denotes very little and 5 represents very high knowledge; *Effective interest rate p.a.* is the annual effective interest rate paid on the latest mortgage loan, measured in %; *Nominal interest rate p.a.* is the annual nominal interest rate paid on the latest mortgage loan, measured in %; *Volume* is the amount of the current or latest mortgage loan, expressed in thousand € (response options specified as ranges); *Fixed interest rate period* is the maturity, expressed in months; *LTV* is the loan-to-value ratio, expressed in % (response options specified as ranges); *Initial repayment* is the repayment at the onset of the latest financing, expressed in % of the loan sum; *Intermediary* is the share of respondents whose latest loan was taken out with support by a mortgage broker; *Lender* denotes the type of lender.

742 respondents completed the survey. As for the full sample, Table 1 shows that respondents are almost 50 years old; 60% are male. The share of male respondents is consistent with numbers usually reported for the German working population.¹⁴ The survey respondents are by about 10 years older than the working population on average; since refinancing borrowers usually refinance after the initial fixed interest rate period of an average of ten years, this number seems plausible as well. While the median yearly net household income is higher than the German average, it is broadly in line with the relatively higher income of households acquiring real estate. The average self-assessed financial literacy in the general domain is 3.32 out of 5 and 3.36 out of 5 in the mortgage specific domain. The median loan size is between € 75,000 and € 100,000 and the median LTV equals 60% to 70%; since we focus on refinancing borrowers, who by definition have already paid back a potentially substantial amount of their mortgage when refinancing, the loan volumes and LTVs in our data are on average smaller than market averages containing initial loans (see Section 3). The median length of the fixed interest rate period (120 months) is consistent with numbers that are usually reported for the overall market. The average annual effective interest rate equals 3.11%, and the initial annual repayment is 3.45%.

¹⁴Since regular income is a prerequisite for obtaining a mortgage, numbers from the working population seem to be an appropriate benchmark.

16% found their mortgage via a mortgage broker.¹⁵ It is important to note that even if the initial loan contract has been arranged via a mortgage broker, a refinancing offer is usually not provided by the broker. I.e., once the initial loan contract is signed, the mortgage broker is no longer involved in the further financing process as all correspondence is transferred to the bank. As a consequence, a refinancing offer to the borrower is typically provided by the bank with which the initial loan is taken out, but not by the broker.

73% of the survey respondents chose an annuity loan in their latest financing, followed by a forward loan (9%). Many borrowers took out their loans with savings banks (32%), credit banks (21%), and cooperative banks (18%). The loan payout dates range from 1996 to 2018 (including forward loans) with 2014 being the median. Overall, these numbers are in line with the situation in the German market described in Section 3.

Although the key characteristics of the survey respondents and their mortgages are comparable to market averages, there might be a selection bias in the data if panel members who participate in the survey have a special interest in mortgage-related issues and potentially higher-than-average financial knowledge in general or mortgage-related aspects compared to panel members who do not participate. In sum, about 800 borrowers who have already refinanced a mortgage were offered to participate in the survey; out of these, 742 respondents completed the survey. Thus, virtually all panel members who were invited to participate decided to complete the survey.

However, there might still be a selection bias if panel members are financially more sophisticated than non-members. If this is the case, we might obtain conservative estimates, as higher financial sophistication should induce better decisions. In other words, our findings with respect to switching and their implications regarding the cost of credit might be more pronounced in the total population of German mortgage borrowers and the chance to observe an effect in our data should be relatively lower.

Table 1 indicates that most respondents (65%) have not switched to an outside lender in their latest refinancing. Comparing borrowers who have switched to a new lender when refinancing to borrowers who have remained loyal to their incumbent lender in Table 1, we find that the former have higher self-assessed levels of financial literacy in general and in the mortgage domain (3.45 and 3.47 compared to 3.26 and 3.30, respectively; the differences between switchers and non-switchers are significant at the 1% and the 5% level). The annual effective interest rate paid by switchers (2.85%) is lower than the rate paid by non-switchers (3.25%; the difference is significant at the 1% level), while all other loan characteristics (volume, fixed interest rate period, LTV) do not substantially differ.¹⁶

Note that almost one third of the loans of switchers have been found with the help of mortgage brokers; the share is lower than 10% for non-switchers, which seems plausible.¹⁷ To further strengthen the assumption of a high degree of competition in the German mortgage market, respondents' familiarity with mortgage

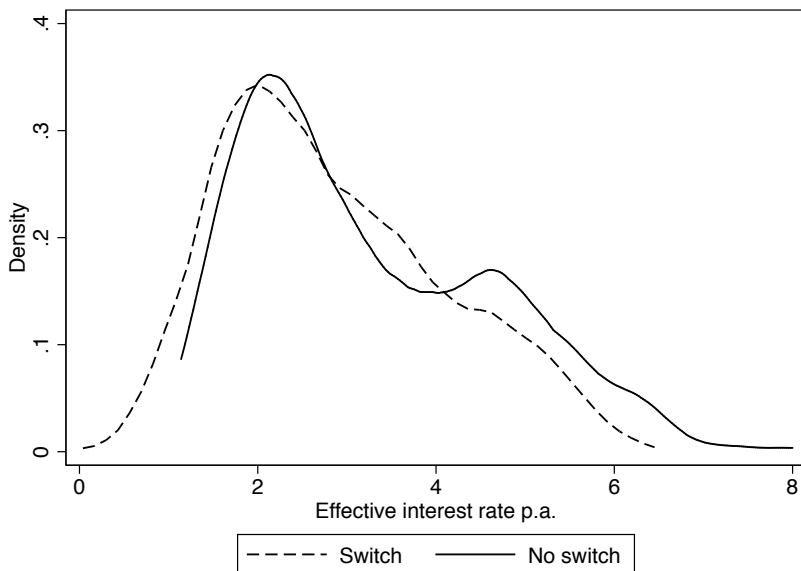
¹⁵Even if only 16% of borrowers actually took out their loan using a mortgage broker, the actual number of borrowers browsing the websites of mortgage brokers in order to access current market rates with the search engines available on these websites might be much higher.

¹⁶Note that non-switchers may also pay the lowest interest rates available in the market since they may renegotiate with their incumbent lender if they have a credible threat (e.g., an outside offer).

¹⁷The market share of more than 30% for mortgage brokers reported in Section 3 refers to both initial financings and refinancings. The lower market share regarding refinancings seems plausible since many borrowers simply refinance with the current lender without screening the market, thereby not consulting a broker.

Figure 2: Survey: Annual Interest Rates of Switchers and Non-Switchers

This figure plots the kernel densities of the annual effective interest rates, measured in %, paid by borrowers who have switched to an outside lender for their latest refinancing (*Switch*) and borrowers who have remained loyal to their incumbent lender (*No switch*).



brokers was additionally assessed. About 70% state they were aware of the existence of mortgage brokers before participating in the survey. After a short explanation of the services offered by brokers, almost 85% of all respondents explain they would generally be willing to use their services.

Figure 2 plots the densities of the annual effective interest rates paid by switchers and non-switchers. While the figure confirms that switchers pay a lower interest rate on average than non-switchers, it should be noted that such conclusions should be treated with great caution in a univariate context. Importantly, the interest rate is usually driven by the loan volume, the LTV, the fixed interest rate period, and the loan type. In addition, due to time-varying interest rates, such comparisons need to take into account the month and the year in which a loan is taken out.

4.1.2. Results

We next assess the impact of borrowers' switching decisions on their cost of credit in a multivariate setting. As argued in Section 3, the effective interest rate is the only valid figure for comparing the cost of credit offered by competing lenders. Table 2 contains the results of an OLS regression in which the dependent variable is the effective interest rate. In addition to the key building blocks of the effective interest rate – the loan volume, the LTV, the length of the fixed interest rate period, the loan type, and the date of the loan contract conclusion – we include a dummy variable which is equal to one if the borrower has switched to a new lender when refinancing the current or latest loan and zero otherwise. Moreover, we control for financial literacy, borrowers' experience with refinancing, and the type of lender chosen for the respective loan. Standard errors

are calculated based on the standard OLS variance estimator.¹⁸

In Table 2, we first observe that the addition of further control variables in Columns 1 to 7 gradually increases the R^2 from 0.02 to 0.66. Second, in all columns of Table 2, the coefficient of the switching dummy variable is significantly negative. In the full model without borrower characteristics (Column 5), it is as high as -0.397 , indicating that the interest rate paid by switching borrowers is by almost 40bps lower than the rate paid by non-switching borrowers. The results are virtually the same when we include the measures of financial literacy, the number of refinancings a borrower completed in the past, the lender type, and a dummy variable indicating whether a loan has been taken out with support by a mortgage broker in Column 8. Since the inclusion of the broker dummy does not substantially alter the results, we conclude that our results are not mainly driven by the fact that some borrowers make use of mortgage brokers while others refrain from making use of them.

These estimates are comparable in relative terms to the ones obtained by Ioannidou and Ongena (2010) for firms, where switching reduces interest rates by about 10% of the average cost of credit.¹⁹ The implication of these results is economically significant. An interest rate differential of 40bps will cost a non-switching borrower about €4,000 more than a switching borrower, assuming a loan amount of €100,000 and a fixed interest rate period of 10 years. Savings of this magnitude easily overcompensate all costs related to switching.

To assess the robustness of these results and exclude the possibility that we compare loans which are very different, we conduct a propensity score matching (Rosenbaum and Rubin, 1983) and match one or several loans of non-switching borrowers to each loan of a switching borrower. We then compute the full regression model (i.e., the same model as in Column 8 of Table 2). The matching is conducted with respect to the loan volume, the LTV, the length of the fixed interest rate period, and the loan type.²⁰ In our main specification, we match nearest neighbors (varying n to be 1, 3, and 5) with replacement.

Table 3 shows that the matching procedure reduces the number of observations in the regressions to 389, 557, and 642, respectively. Since we match with replacement, some observations of non-switching borrowers are used multiple times.²¹ We account for this fact by using weights for observations which are used more than once. With respect to the coefficients of the dummy variable indicating a lender switch, we observe values similar to our previous results in all columns; switchers pay by about 40bps lower interest rates on their mortgage loans.

We note two potential caveats: First, our survey was conducted in a period in which borrowers had experienced decreasing interest rates over a relatively long period. It is not obvious whether borrower behavior will be similar in a situation with rising interest rates. With falling interest rates, monthly interest payments will be lower after refinancing. Additional interest rate reductions by switching to an outside lender might

¹⁸Using robust standard errors leaves the significance of our results virtually unchanged.

¹⁹In Appendix B, we repeat the analysis of Table 2 but use the nominal interest rate instead of the effective interest rate as the dependent variable. The results are very similar to those reported in Table 2. Appendix C contains the coefficients of all control variables used in Table 2.

²⁰Matching on the date of the loan contract conclusion eliminates a significant number of observations since the switching decision is perfectly predicted; thus, we do not match on the date but control for it in our regressions. More details on the matching procedure are provided in Appendix D.

²¹In unreported regressions, we find that matching without replacement yields virtually identical results.

Table 2: Survey: The Cost Impact of Lender Switches

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Switch	-0.393*** (-3.82)	-0.367*** (-3.55)	-0.390*** (-4.11)	-0.457*** (-4.73)	-0.397*** (-3.59)	-0.377*** (-3.41)	-0.398*** (-3.55)	-0.419*** (-3.63)
Financial literacy						-0.122 (-1.47)	-0.118 (-1.41)	-0.132 (-1.56)
Mortgage literacy						0.041 (0.50)	0.033 (0.40)	0.054 (0.65)
Number of refinancings completed						-0.088 (-1.40)	-0.073 (-1.16)	-0.066 (-1.04)
Intermediary								0.136 (0.92)
Constant	3.246*** (53.04)	2.635*** (14.60)	4.897*** (4.47)	5.819*** (4.77)	5.560*** (3.87)	5.933*** (4.12)	5.144*** (3.44)	5.126*** (3.42)
Fixed interest rate period	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Volume	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LTV	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Date of loan contract conclusion	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Loan type	No	No	No	Yes	Yes	Yes	Yes	Yes
Zip code	No	No	No	No	Yes	Yes	Yes	Yes
Bank type	No	No	No	No	No	No	Yes	Yes
N	742	742	742	742	742	742	742	736
R ²	0.02	0.08	0.56	0.58	0.65	0.65	0.66	0.66
AIC	2,543	2,527	2,320	2,314	2,376	2,372	2,366	2,350
Degrees of freedom	740	726	551	542	443	440	433	427

This table contains the coefficients of an OLS regression (t-statistics in parentheses) in which the dependent variable is the annual effective interest rate, measured in %. Standard errors are calculated based on the standard OLS variance estimator. *Switch* is a dummy variable equal to one if a borrower has switched to a new lender when refinancing the current or last mortgage loan; *Financial literacy* and *Mortgage literacy* are respondents' self-assessments of their knowledge in general financial matters and in the mortgage domain, measured on a scale from 0 to 5 where 0 denotes very little and 5 represents very high knowledge; *Number of refinancings completed* is the number of mortgage refinancings that a borrower has conducted; *Intermediary* is the share of respondents whose latest loan was taken out with support by a mortgage broker; *Fixed interest rate period* is the maturity, expressed in months; *Volume* is the amount of the latest mortgage loan, expressed in thousand € (response options specified as ranges); *LTV* is the loan-to-value ratio, expressed in % (response options specified as ranges); *Date of loan contract conclusion* represents the date of the loan contract conclusion on a monthly basis; *Loan type* denotes the type of credit; *Zip code* represents the first two digits of the 5-digit zip code of the area in which the estate financed with the reported mortgage loan is located; *Bank type* denotes the type of lender; *AIC* is the Akaike information criterion. *, **, and *** denote significance at the 10%, the 5%, and the 1% level, respectively.

thus seem comparatively small both in absolute size and due to the decreasing marginal utility of wealth. This could explain the low number of switchers in our survey. For the same reasons, if interest payments increase, potential savings achieved by switching could loom relatively larger. Efforts to screen the market and to switch might thus be higher with rising interest rates.²²

Second, in order to attribute the observed switching behavior to biased decision-making, we need a benchmark against which we can test these and potential alternative explanations. In contrast to our survey, the laboratory experiment outlined in the following sections allows us to include the case of falling *and* rising interest rates to analyze individual behavior in different refinancing scenarios within subjects which might only occur in rare instances in real-world data. The simultaneous analysis of interest rate decreases and increases is not feasible with our survey data. In addition, the lab setting makes it possible to define interest rates, search costs, and switching costs such that the savings potential is standardized and can be assessed ex-ante by all subjects. Together with the high degree of control, this enables us to verify the prevalence of biased decision-making and the validity of potential alternative explanations.

²²Since we have information on the latest loans of the survey respondents only, we cannot compare the initial loan of a borrower to the same borrower's loan after refinancing.

Table 3: Survey: The Cost Impact of Lender Switches (Matched Loans)

	(1) $n = 1$	(2) $n = 3$	(3) $n = 5$
Switch	-0.414*** (-3.29)	-0.426*** (-4.02)	-0.402*** (-4.08)
Financial literacy	0.030 (0.31)	0.013 (0.15)	-0.083 (-1.10)
Mortgage literacy	-0.129 (-1.37)	-0.150* (-1.81)	-0.031 (-0.42)
Number of refinancings completed	-0.052 (-0.63)	-0.109 (-1.56)	-0.125** (-2.01)
Intermediary	0.164 (1.00)	0.016 (0.11)	0.148 (1.17)
Constant	3.936*** (3.46)	4.131*** (4.90)	4.083*** (5.12)
Fixed interest rate period	Yes	Yes	Yes
Volume	Yes	Yes	Yes
LTV	Yes	Yes	Yes
Date of loan contract conclusion	Yes	Yes	Yes
Loan type	Yes	Yes	Yes
Zip code	Yes	Yes	Yes
Bank type	Yes	Yes	Yes
N	385	552	637
R^2	0.74	0.62	0.58

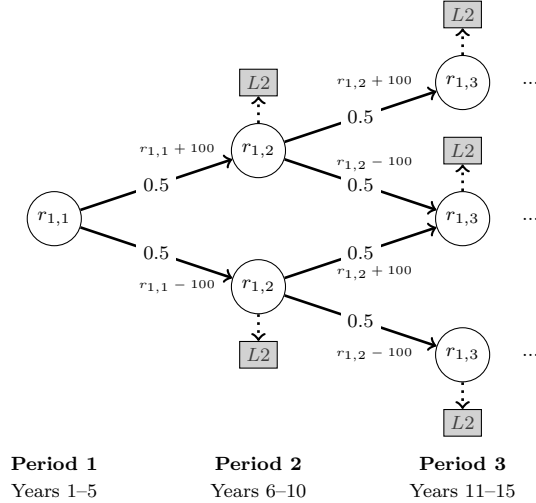
This table contains the coefficients of an OLS regression (t-statistics in parentheses) in which the dependent variable is the annual effective interest rate, measured in %. Each loan of a switching borrower is matched with one or more loans of non-switching borrowers (n nearest neighbors, with replacement). Standard errors are calculated based on the standard OLS variance estimator. *Switch* is a dummy variable equal to one if a borrower has switched to a new lender when refinancing the current or last mortgage loan; *Financial literacy* and *Mortgage literacy* are respondents' self-assessments of their knowledge in general financial matters and in the mortgage domain, measured on a scale from 0 to 5 where 0 denotes very little and 5 represents very high knowledge; *Number of refinancings completed* is the number of mortgage refinancings that a borrower has conducted; *Intermediary* is the share of respondents whose latest loan was taken out with support by a mortgage broker; *Fixed interest rate period* is the maturity, expressed in months; *Volume* is the amount of the latest mortgage loan, expressed in thousand € (response options specified as ranges); *LTV* is the loan-to-value ratio, expressed in % (response options specified as ranges); *Date of loan contract conclusion* represents the date of the loan contract conclusion on a monthly basis; *Loan type* denotes the type of credit; *Zip code* represents the first two digits of the 5-digit zip code of the area in which the estate financed with the reported mortgage loan is located; *Bank type* denotes the type of lender. *, **, and *** denote significance at the 10%, the 5%, and the 1% level, respectively.

4.2. Experimental Evidence on Mortgage Refinancing

We start with an intuitive behavioral explanation for the observed behavior: Borrowers tend to believe that their incumbent lender offers a good bargain if the new offer is cheaper than the previous loan and ignore the fact that competing lenders might be even cheaper. When borrowers refinance their mortgages, they compare the monthly payments of new loan offers to those of the expiring loans. If the new loan offered by the incumbent lender has a lower interest rate or leads to lower monthly payments, search efforts for additional outside offers are reduced. As an obvious consequence, it is less likely or simply not possible to find a better offer. Put differently, borrowers overestimate the effect of competition and thus stop searching. The higher the interest rate of the new loan offer by the incumbent lender compared to the previous one, the more borrowers start screening the market for alternatives. This is also relevant since with renegotiation, lower refinancing costs can be achieved without actually switching; borrowers however need a credible threat, i.e., an outside offer.

Figure 3: Experimental Setup

This figure displays the first three of five experimental periods. A dotted line denotes a decision to be made by the subject; a continuous line denotes the pre-simulated development of the (market) interest rate for L1. In each period, the interest rate offered by L1 can increase or decrease by 100bps compared to L1's offer in the previous period, each with a probability of 50%. In addition to the offers of L1 ($r_{1,1}$, $r_{1,2}$ etc.), L2 can be contacted in each period at the cost of ECU 3,000. The offer of L2 is 100bps higher or lower than the offer of L1 in every period, each with a probability of 50%.



4.2.1. Experimental Setup

All subjects in the experiment assume the role of borrowers.²³ Each subject must refinance a loan $L_{i,t}$ of 300,000 Experimental Currency Units (ECU) in four subsequent periods. Each period is five years long. An interest rate of $r_{i,t}$ is charged on the loan of Subject i in every Period t ; she receives a regular income $I_{i,t}$ in each period out of which she has to pay interest of $L_{i,t} \cdot r_{i,t} \cdot 5$ and finally repay the loan. A repayment $R_{i,t}$ is only made at the end of the last period in which the loan is fully repaid.²⁴ Equation (1) summarizes the payoff $P_{i,t}$ of Subject i in Period t .

$$P_{i,t} = I_{i,t} - L_{i,t} \cdot r_{i,t} \cdot 5 - R_{i,t} \quad (1)$$

Before the start of the experiment, subjects are instructed that they are allowed to keep any accumulated experimental wealth which remains at the end of the experiment, $\sum P_{i,t}$, converted from ECU into € at a rate of 1:10,000.²⁵

Figure 3 displays the experimental procedure from the perspective of an individual subject. There are two lenders in the experimental mortgage market. Importantly, lender behavior is simulated and there is no market impact or strategic behavior. Subjects start with Lender 1 (L1). In each period, subjects can decide to accept the refinancing offer by L1 set at the average mortgage market interest rate or to additionally

²³The detailed experiment instructions are provided in Appendix E.

²⁴This setting ensures that the decision situation is the same in absolute € terms in each period.

²⁵10% of all subjects are randomly selected to receive their payments. This procedure is consistent with Charness, Gneezy, and Halladay (2016), Kahneman, Knetsch, and Thaler (1990), Andersen, Harrison, Lau, and Rutström (2008), and Meier and Sprenger (2010).

consult Lender 2 (L2).²⁶ The development of L1’s offer from Period $t - 1$ to Period t can be described as $r_{1,t} = r_{1,t-1} + 100\text{bps}$ or $r_{1,t} = r_{1,t-1} - 100\text{bps}$, each with a probability of 0.5 (known by the subjects).²⁷ In total, four different interest rate paths on three interest rate levels are used, leading to twelve versions. Similar to Baucells, Weber, and Welfens (2011), the development of interest rates is simulated along pre-defined paths.²⁸ Soliciting an offer from L2 costs ECU 3,000 in addition to the final interest rate contracted (independent of the decision to accept the offer of L2). L1 cannot react to the offers of L2 or negotiate terms with the borrower.²⁹ Subjects know that if they pay for receiving the offer of L2, there is a probability for a cheaper offer (-100bps compared to the offer of L1) of 0.5; however, with the same probability, L2’s offer is more expensive ($+100\text{bps}$). Thus, the likelihood of L2’s current offer, $r_{2,t}$, compared to the offer of L1, $r_{1,t}$, is 0.5 for $r_{2,t} = r_{1,t} + 100\text{bps}$ and for $r_{2,t} = r_{1,t} - 100\text{bps}$, respectively. Price dispersion in our experimental setting is not driven by the absolute level of interest rates and is common knowledge. Should the offer of L2 be more expensive, the existing offer of L1 can still be accepted. The market screening costs of ECU 3,000 can be thought of as search costs.³⁰ Importantly, no further switching costs arise if subjects decide to accept the offer of L2.

An example of a potential decision in two subsequent periods is displayed in Figure 4: the interest rate offered by L1 in Period 1 is 7%; L1 offers the average mortgage market interest rate of 8% for Period 2. If the subject decides to solicit an offer from L2, she pays ECU 3,000 or 20bps per year (ECU 3,000 on a loan of ECU 300,000 for a period of 5 years) in order to have a 50% chance for a rate of 7%. An offer by L2 of 9% can be ignored and L1’s offer of 8% still be accepted after paying the screening costs.

Our choice of parameters ensures that the expected value of contacting L2 is positive and constant across periods. Put differently, the incentives to contact L2 are the same with rising interest rates as with falling interest rates. As price dispersion and costs are the same in all periods, time-varying decisions cannot be attributed to these parameters and the choice of contacting L2 should only depend on the risk preferences of subjects. The risky decision is to contact L2: On the one hand, a subject has to pay and thus may lose the ECU 3,000 if the new offer is not cheaper than the offer of L1. On the other hand, she can realize substantial interest rate savings if the new offer is cheaper. If she decides not to contact L2, she will only know the new L1 interest rate, has no search costs, and receives the new L1 contract.³¹

The main variables of interest are the four borrowing decisions in Periods 2 to 5 and subjects’ search behavior. At the end of the experiment, subjects have to answer a short questionnaire in order to shed light on their decision-making process and to gather data on demographic aspects, financial literacy, risk preferences, and cognitive abilities as measured with the cognitive reflection test (CRT) described in Frederick (2005).³²

Table 4 displays the experimental parameters. Each subject goes through one of the twelve versions only.

²⁶Obviously, there are many more parameters in the real-world environment (e.g., selecting the original time to maturity, fixing the initial repayment rate) but we want to focus here on changing interest rates since they are most salient.

²⁷This setting is similar to Gneezy (2005) where the price of a stock follows a random walk with potential movements of +\$1 and -\$1.

²⁸With the runs test as described in Swed and Eisenhart (1943), the randomness of each interest rate development was verified.

²⁹L1 always moves first in our experiment and just offers the average market rate.

³⁰Greenbaum, Kanatas, and Venezia (1989) argue that such costs exist because the borrower must provide the potential lender with references and further information in order to be made an offer.

³¹Subjects face no time limit and can read all screens including the instructions as long as they need to. The experiment can

Figure 4: Experiment: Decision-Making Example

This figure contains a decision-making example over two subsequent periods. After Period 1 with a fixed interest rate of 7%, L1 will offer a new contract for the next period (= 5 years) at an equally likely interest rate of ± 100 bps. The subject can immediately accept the new offer of 8% or solicit an additional offer by L2. This offer can be higher or lower by 100bps than the existing offer of L1. A higher offer of L2 does not need to be accepted, but the screening costs of 20bps per year or ECU 3,000 are still incurred if L2 has been contacted.

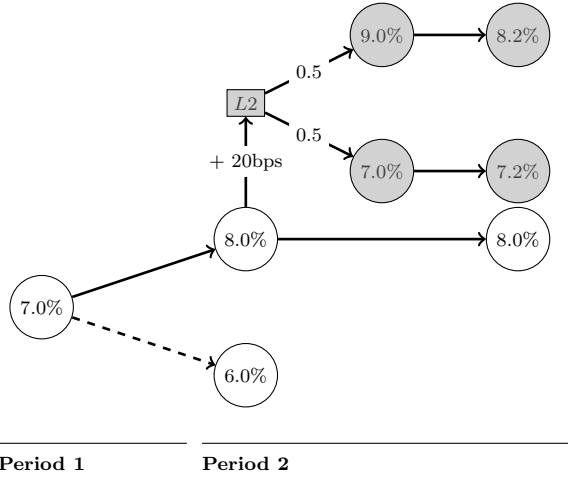


Table 4: Experiment: Parameters

Path	Vers.	Loan ECU	Income ECU	Per. No.	Dec. No.	Probability		L1 Interest Rate/Per.					Cost ECU
						Up	Down	1 %	2 %	3 %	4 %	5 %	
↗↘↗↗	1	300,000	240,000	5	4	0.5	0.5	9	10	9	10	11	3,000
	2	300,000	195,000	5	4	0.5	0.5	6	7	6	7	8	3,000
	3	300,000	315,000	5	4	0.5	0.5	14	15	14	15	16	3,000
↘↗↘↘	4	300,000	240,000	5	4	0.5	0.5	11	10	11	10	9	3,000
	5	300,000	195,000	5	4	0.5	0.5	8	7	8	7	6	3,000
	6	300,000	315,000	5	4	0.5	0.5	16	15	16	15	14	3,000
↘↗↗↗	7	300,000	240,000	5	4	0.5	0.5	9	8	9	10	11	3,000
	8	300,000	195,000	5	4	0.5	0.5	6	5	6	7	8	3,000
	9	300,000	315,000	5	4	0.5	0.5	14	13	14	15	16	3,000
↗↘↘↘	10	300,000	240,000	5	4	0.5	0.5	11	12	11	10	9	3,000
	11	300,000	195,000	5	4	0.5	0.5	8	9	8	7	6	3,000
	12	300,000	315,000	5	4	0.5	0.5	16	17	16	15	14	3,000

This table contains the parameters of the experimental setup. There are four different interest rate paths. In addition, each path is shifted by several percentage points to control for potential level effects, leading to twelve versions of an interest rate path which are allocated to subjects in the order of their login. The choice of parameters ensures that the expected value of the final wealth is the same for all subjects within each interest rate path. *Path* shows period-by-period increases (↗) and decreases (↘) of the interest rate offer of L1 from Period 1 to 5 by one percentage point; *Vers.* is the version number; *Loan* denotes the amount of the loan in ECU on which the interest payments have to be made and which has to be repaid in the final period; *Income* is the constant income in ECU subjects receive in each period; *Per.* denotes the number of periods each subject encounters; *Dec.* is the number of decisions each subject has to make; *Probability* denotes the probability of an *Up* or a *Down* movement of the interest rate offer of L1 in the next period; *L1 Interest Rate/Per.* shows the pre-simulated interest rate sequences of L1 in % by period; *Cost* is the cost in ECU of soliciting an offer from L2.

The development within each of the four interest rate paths is the same in terms of the absolute differences in the interest rate offered by L1 from one period to the next in order to test our hypothesis for different levels

only be started after providing the correct answers to various comprehension questions.

³²As discussed in Frederick (2005), CRT scores have been found to have predictive power regarding decision-making. The CRT questions and the questionnaire are provided in Appendix F and Appendix G.

of interest rates. Note that the expected value of final wealth is the same for all subjects within each path.

In each period, subjects are provided with information on the old interest rate, the new interest rate offered by L1, the difference between the two rates, the current income, the interest payments to be made in absolute terms in the current period with the rate offered by L1, the total wealth to be expected after the current period, and a graphical display of the interest rate path since Period 1 (refer to Appendix H for a screenshot of the experimental setup). If a subject decides to solicit an offer from L2, the interest rate and the resulting payment are added to the information displayed.

4.2.2. *Decision Theories and Hypotheses*

As a benchmark, we consider an expected utility maximizing borrower adhering to the axioms of rational choice as described by Von Neumann and Morgenstern (1944).³³ Following Arrow (1971), it is a natural assumption to assume non-increasing absolute risk aversion (NIARA), see also the discussion by Gneezy (2005): with increasing expected terminal wealth, absolute risk aversion remains constant or decreases.

Empirically, many individuals deviate from the axioms of rationality in decisions under risk. In (cumulative) prospect theory (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992) gains and losses compared to some reference point drive individual decision-making.³⁴ While individuals typically exhibit risk-averse behavior in the gain domain (i.e., for positive deviations from the reference point), risk-seeking behavior dominates the loss domain (i.e., when outcomes fall short of the reference point). Previous research has tried to identify potential candidates for intertemporal reference points. In previous research related to asset market settings, the initial, the last, the highest, the lowest, and the average price are identified as potential reference points in the decision to sell (Weber and Camerer, 1998; Gneezy, 2005; Baucells, Weber, and Welfens, 2011). As found in a recent study by Dougal, Engelberg, Parsons, and Van Wesep (2015), previously contracted interest rates can serve as reference points in a credit market setting. Similar to Weber and Camerer (1998), Baucells, Weber, and Welfens (2011), and Shefrin and Statman (1985), we analyze the initial and the most recent (loan) price.

We define a subject as being consistent with constant absolute risk aversion (CARA) if the decision to solicit an offer from L2 is the same in each period as the same absolute amounts are at stake. We define a subject as being consistent with constant relative risk aversion (CRRA) and decreasing absolute risk aversion (DARA) if, with increasing levels of expected final wealth, the willingness to take a risky decision (i.e., to contact L2) does not decrease. We hypothesize that a decrease in the interest rate offered by L1 in Period t compared to Period $t - 1$ is perceived as a gain while an increase is regarded as a loss.³⁵ The curvature of the value function implies that decreasing interest rates (i.e., gains) should lower the willingness to take risks

³³Our specification of expected utility does not specify the risk preferences of the subjects. In any case, a risk-neutral or a risk-loving subject would always choose to contact L2 as the expected value of doing so is positive; for risk-averse subjects, the case is less clear-cut and depends on the individual risk aversion parameters. For sufficiently risk-averse subjects, it can be optimal not to solicit an offer from L2.

³⁴We assume that probabilities are perceived in a non-distorted way. In the absence of highly skewed distributions, this is a reasonable assumption, see e.g. Barberis and Xiong (2009).

³⁵Rising interest rates imply higher interest payments and thus a lower disposable income for borrowers. This further supports the assumption that borrowers perceive increasing interest rates as a loss. The choice of the experimental parameters (e.g., loan volume and income) ensures that all subjects exhibit the same liquidity constraints.

Table 5: Experiment: Summary Statistics of Subjects

	Mean	Median
Financial literacy	4.62	5
General risk preferences	5.14	5
Financial risk preferences	3.91	4
Cognitive reflection test score	1.94	2
Age	25	25
Male	0.54	1
Economics as field of study	0.56	1
N	250	250

This table shows the summary statistics of the 250 subjects. *Financial literacy* is the self-assessed financial literacy, measured on a scale where 0 is lowest and 10 is highest; *General risk preferences* and *Financial risk preferences* are the self-assessed risk preferences in general and in financial matters, measured on a scale where 0 is no risk tolerance and 10 is high risk tolerance; *Cognitive reflection test score* is the total score of the three cognitive reflection tasks, ranging from 0 to 3; *Age* is the age of subjects, measured in years; *Male* is a dummy variable equal to 1 if subjects are male; *Economics as field of study* is a dummy variable equal to 1 if the field of study is related to economics or business administration.

while increasing interest rates (i.e., losses) should increase the willingness to take risks. As the risky decision is to solicit an offer from L2, we should observe relatively more contacts to L2 after an increase in interest rates than after a decrease if previous interest rates serve as reference points.³⁶

4.2.3. Results

The 250 subjects who participate in the experiment are university students in the subject pool of the experimental laboratory where the experiment was conducted. No restrictions with respect to the background of potential subjects were implemented such that subjects from all fields of study and all age groups were invited to participate. Subjects could participate on a first-come, first-served basis until the maximum number of 250 subjects had been reached.

Table 5 reveals that subjects assess their financial literacy with an average value (median) of 4.62 (5) on a scale ranging from 0 to 10 (where 0 is lowest and 10 is highest). On the same scale (0 being the lowest and 10 the highest risk tolerance), the average (median) self-assessed risk preference in general matters equals 5.14 (5); the corresponding value in financial matters equals 3.91 (4). The average (median) subject is 25 (25) years old. 54% are male.³⁷

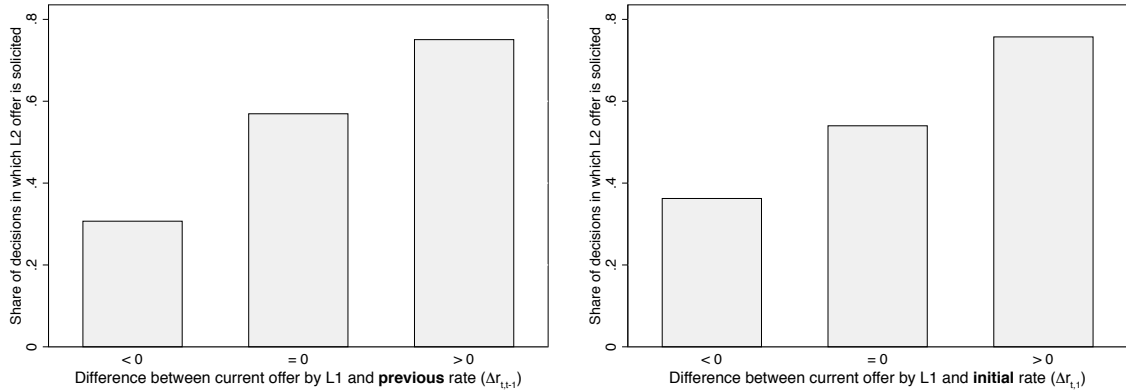
Using students as experimental subjects is common practice. However, our experimental subjects might differ from the survey respondents in several ways. As should be expected, the experimental subjects are younger on average; however, the direction of a potential bias resulting from younger subjects is not obvious ex-ante. The share of male subjects (54%) is similar to the share of male survey respondents in the survey (60%). Besides age and gender, education and experience could influence subjects' decisions: On the one hand, since more than half of the experimental subjects study an economics-related subject, they might be financially more sophisticated. In this respect, they might make more informed decisions than the survey respondents. On the other hand, the experimental subjects lack the mortgage financing experience of the survey respondents. This is why they might make less informed decisions than the survey respondents. The

³⁶For loss aversion values of up to about 3.3, the value of contacting L2 is still positive with the piecewise power value function of Tversky and Kahneman (1992).

³⁷Further details are provided in Appendix I.

Figure 5: Experiment: Decisions to Contact Lender L2, Grouped by Interest Rate Delta

This figure shows the individual decisions to solicit an offer from L2, grouped by the difference $\Delta r_{t,t-1}$ between the rate offered by L1 in the respective Period t and the finally contracted interest rate from the previous Period $t-1$ (left-hand panel) as well as $\Delta r_{t,1}$, which denotes the difference between the rate offered by L1 in the respective period and the final interest rate from the initial Period 1 (right-hand panel); > 0 denotes a positive difference; $= 0$ denotes a difference of exactly 0 (a difference between the current offer by L1 in Period t and the rate contracted in the previous Period $t-1$ of exactly 0 can only arise if the offer of L2 has been accepted in the previous period); < 0 denotes a negative difference. The figure is based on 1,000 decisions (four decisions by each subject).



net effect of these two potential biases is not clear ex-ante. Moreover, in spite of these concerns, choosing students as subjects should not bias the results as we are primarily interested in *within-subject* variation.

Our first finding is that about 30% of the subjects decide consistent with CARA as their decisions are identical at all wealth levels. The behavior of about 5% of the subjects is consistent with DARA (not including CARA); they make riskier decisions (i.e., contact L2) with increasing final wealth levels. In sum, less than 40% of the subjects display a behavior which can be reconciled with the common assumptions of expected utility theory.

The decisions to contact L2 are summarized in Figure 5. In 558 of 1,000 cases (250 subjects with four decisions each), subjects decide to solicit an offer from L2, indicating that on average, contacting L2 is regarded more beneficial than immediately accepting the offer of L1. $\Delta r_{t,t-1} = r_{1,t} - r_{t-1}$ (left-hand panel) denotes the difference between the current offer of L1 in Period t and the interest rate contracted in the previous period (which could be either with L1 or L2). About 75% contact L2 after an increase in the interest rate $r_{1,t}$ offered by L1 compared to the previous period's finally contracted rate. After a decrease in the rate offered by L1, only slightly more than 30% decide to contact L2. With a difference of exactly 0, less than 60% contact L2.³⁸ This monotonic pattern is consistent with the role of recent interest rates as reference points. Regarding the difference $\Delta r_{t,1} = r_{1,t} - r_1$ between $r_{1,t}$ and the rate from Period 1 (right-hand panel), more than 75% solicit an offer from L2 after an increase while only about 35% and less than 55% do so after a decrease and if the difference is equal to 0, respectively. Again, the monotonicity of the results supports the assumption of reference-dependent search efforts.

³⁸A difference between the current offer by L1 in Period t and the rate contracted in Period $t-1$ of exactly 0 can only arise if the offer of L2 was accepted in the previous period.

In sum, a higher difference between L1’s current offer and either the previous interest rate or the initial interest rate increases the share of subjects contacting L2.³⁹ Considering that most survey respondents took out their refinancing loans in a decreasing interest rate environment, the 35% of switchers among the survey respondents are in line with the about 30% to 35% of experimental subjects soliciting an offer from L2 after a decrease in interest rates.

As our experiment captures real-world borrower behavior when interest rates are falling, we assume that its conclusions are also valid for rising interest rates. Interestingly, after an increase in the cost of credit, the share of subjects soliciting an offer from L2 rises significantly to more than 70% in both reference point specifications. Thus, while we can replicate the results of our survey, the experiment adds the relevant case of rising interest rates in which the chance to realize interest rate savings is recognized and realized more often by the subjects. The interest earnings of L1 thus significantly decrease when interest rates rise compared to the situation in which interest rates decline.

The dependent variable in our multivariate analyses is the decision to solicit an offer from L2 in any period of the experiment. As we analyze several observations for the same subjects over time, we control for autocorrelation and heteroskedasticity. The results are summarized in Table 6. Controlling for various subject and experiment related background variables (such as age, gender, main field of study as well as the experimental period and the interest rate path version), we find that a positive difference between the current offer by L1 and the interest rate from the previous period, $\Delta r_{t,t-1} > 0$, is a highly significant (1% level) predictor of the decision to solicit an outside offer with a marginal effect of 0.243 (Column 1). An increase in the interest rate compared to the preceding period significantly increases the likelihood of contacting L2 compared to a situation with decreasing or constant rates. Similarly, the influence of a positive difference between the current offer by L1 and the interest rate in Period 1, $\Delta r_{t,1} > 0$, is significant at the 1% level with a positive marginal effect of 0.371 (Column 3). This implies that the propensity to contact L2 increases the more the current offer is above the initially contracted rate.

The self-assessed degrees of financial literacy and general risk preferences do not or only weakly influence the decision; a positive coefficient for the latter is plausible as a higher willingness to take risks should increase the propensity to contact L2.⁴⁰ The outcome of the CRT is significant (1% level) with a positive effect. The higher the score achieved in the CRT, calculated as the sum of correct answers (with 0 as the minimum and 3 as the maximum), the more likely a subject is to contact L2. We attribute the positive influence of the CRT to the correct calculation of the positive expected value of soliciting an offer from L2. Positive previous experience with contacting L2, defined as at least one solicited offer that turned out to be less expensive than the offer of L1, has a strong positive influence (1% level). Controlling for previous experience slightly increases the marginal effects of $\Delta r_{t,t-1} > 0$ and $\Delta r_{t,1} > 0$.⁴¹

³⁹In our dataset, subjects accept the offer made by L2 whenever this offer is lower than the offer provided by L1.

⁴⁰The insignificance of financial literacy is due to the fact that the self-assessed measure is positively correlated with the general risk preferences measure. We exclude the self-assessed financial risk preferences due to the high correlation ($\rho = 0.69$) with the general risk preferences measure.

⁴¹In Appendix J, we repeat the analysis of Table 6 but include the first decision of each subject only. The results are virtually unchanged.

Table 6: Experiment: Probit Regression Results

	(1)	(2)	(3)	(4)
$\Delta r_{t,t-1} > 0$	0.243*** (4.78)	0.267*** (4.99)		
$\Delta r_{t,1} > 0$			0.371*** (4.65)	0.400*** (4.96)
Current interest rate	0.112*** (4.39)	0.098*** (3.72)	0.072** (2.28)	0.056* (1.71)
Financial literacy	0.002 (0.15)	0.002 (0.17)	0.003 (0.24)	0.003 (0.28)
General risk preferences	0.022** (2.04)	0.021* (1.92)	0.019* (1.79)	0.018* (1.66)
Cognitive reflection test score	0.057*** (2.64)	0.061*** (2.92)	0.059*** (2.75)	0.063*** (3.05)
Positive previous experience		0.208*** (4.63)		0.200*** (4.52)
All further controls	Yes	Yes	Yes	Yes
N	1,000	1,000	1,000	1,000
Pseudo R^2	0.18	0.20	0.17	0.19

This table shows the marginal effects of a probit regression of the decision to solicit an offer from L2 (z -statistics in parentheses). Standard errors are clustered at the subject level. The dependent dummy variable is equal to 1 if L2 is contacted in Period t . $\Delta r_{t,t-1} > 0$ is a dummy variable which is equal to 1 if the interest rate difference between the current offer made by L1 and the preceding period's final rate is positive; $\Delta r_{t,1} > 0$ is a dummy variable which is equal to 1 if the interest rate difference between the current offer made by L1 and the initial period's final rate is positive; *Current interest rate* is the interest rate of L1, offered in the current period t ; *Financial literacy* is the self-assessed financial literacy of the subjects, measured on a scale from 0 to 10 (with 10 being highest); *General risk preferences* represents the self-assessed risk tolerance of the subjects, measured on a scale from 0 to 10 (with 10 denoting the highest level of risk tolerance); *Cognitive reflection test score* is the score achieved in the CRT section, measured on a scale from 0 to 3; *Positive previous experience* is a dummy variable equal to 1 if at least 1 previous offer of L2 was cheaper than the offer of L1; *All further controls* include subjects' age, gender, field of study, the experimental period, and the version of the experiment (1–12). *, **, and *** denote significance at the 10%, the 5%, and the 1% level, respectively.

In sum, the propensity to solicit additional offers increases when interest rates rise and decreases when interest rates fall. Search efforts are thus reference-dependent even when the costs and benefits of switching are clearly defined, constant, and known. These results are significant, both statistically and economically.

4.3. Alternative Explanations

To strengthen the conclusion that recent interest rates as reference points drive borrowers' search efforts and switching behavior, this section discusses potential alternative explanations for their observed decisions. Using the results of the survey and the laboratory experiment, we show that none of these approaches is capable of explaining borrowers' switching decisions.

4.3.1. Further Relationship Lending Outcomes

Following Kysucky and Norden (2016), the cost of credit is only one of several potential outcomes of relationship lending, and focusing on interest rate savings in the context of a borrower's mortgage loan may be misleading. Credit availability (1), collateral requirements (2), and maturity aspects (3) are additional important variables related to close ties between a borrower and her lender. In contrast to the research on relationship lending with a focus on corporate borrowers, the latter two aspects are irrelevant in the context of retail mortgage refinancing as collateralization is standardized and the maturity can be chosen at the borrower's discretion. In our context, credit availability might constitute a reason for borrowers to remain loyal to their incumbent lender even if the cost of credit is lower with outside lenders. Moreover, the cost

Table 7: Survey: Determinants of Income Risk, Cross-Subsidization, and Search Costs

	Switchers	Non-Switchers	Significance	Obs.
Mortgage-to-income ratio	1.67	1.67	0.623	742
House bank as current lender (yes = 1)	0.38	0.44	0.715	742
Search costs for refinancing	None	None	0.821	742

This table shows the variables related to credit availability, cross-subsidization, and search costs for switchers and non-switchers. *Switchers* are refinancing borrowers who switch to an outside lender when refinancing; *Non-switchers* are loyal to the incumbent lender; *Significance* denotes the p-value of a ranksum or χ^2 -test; *Obs.* shows the number of survey respondents included. *Mortgage-to-income ratio* represents the median of the relation between a borrower’s loan amount and the yearly net income; *House bank as current lender* is the share of borrowers whose current loan was taken out with their house bank; *Search costs for refinancing* denote the median of the expected search costs for finding a suitable refinancing, expressed in € (response options specified as ranges).

of other products within a bank-customer relationship (4) might be included in the assessment whether to switch or not.

First, as pointed out by Petersen and Rajan (1994), higher credit availability is a major advantage of relationship lending from the borrower’s perspective. In particular, credit might be available to relationship borrowers to a greater extent than to non-relationship borrowers in times of financial difficulties. In the context of mortgage financing, borrowers’ primary concern is that they could lose their homes to which they are emotionally attached. In situations in which borrowers are temporarily unable to meet their monthly payment obligations towards their lender, they could benefit from their previous reputation in the credit relationship and thus delay further action by the lender to the extent that regulatory requirements provide lenders with some discretion.

The possibility of building a reputation is excluded in our laboratory experiment by design since borrowers cannot default, i.e., credit availability is not an issue. If credit availability considerations were driving the results, switching considerations should not depend on interest rate changes. The share of decisions to view offers other than the incumbent lender’s is as low as about 30% to 35% in decreasing interest rate environments (which is roughly consistent with our survey) and increases significantly when interest rates rise. Our experimental results thus suggest that loyalty to the current lender rises when interest rates fall even when credit availability considerations can be ruled out and the expected benefits of switching are always the same.

As further evidence, the survey data allows us to determine whether switching borrowers differ from non-switching borrowers with respect to the ability of making their monthly payments to the lender. Intuitively, borrowers with a higher mortgage-to-income ratio should be most interested in high credit availability since they are more likely to not meet the required payments in a given month than borrowers with a lower ratio. If credit availability played a role in borrowers’ decision-making, we should observe significant differences between switchers and non-switchers in this regard. As shown in Table 1 and Table 7, among the 742 survey respondents, we find that switchers and non-switchers do not exhibit significant differences in terms of the median mortgage size (€ 75,000 to € 100,000), income range (€ 50,000 to € 75,000), and mortgage-to-income ratio (1.67).

Second, a mark-up on the interest rate of a mortgage loan might constitute a cross-selling premium, i.e.,

the higher cost of credit could be compensated with a discount on other products such as further loans or higher interest on the same borrower’s deposits with the same bank. By design, cross-selling is excluded in our experimental setting where the setup allows for one product (the mortgage loan to be refinanced) only; the switching propensity, especially with falling interest rates, is still remarkably low. A cross-selling premium should be most relevant for the survey respondents who have taken out their mortgage with their house bank where they are most likely to have other financial products such as deposits, investments, or further loans; such borrowers should exhibit a lower propensity to switch to an outside lender when refinancing if a cross-selling premium drives the results. As shown in Table 7, although the share of borrowers who have taken out the mortgage with their house bank is higher for non-switching borrowers (44%) than for switching borrowers (38%), a χ^2 -test reveals that these differences are not significant. Besides, it is unlikely that borrowers will accept higher costs for a large mortgage loan in exchange for higher interest rates on their deposits which might be comparatively small.

4.3.2. Search Costs

A further challenge to our conclusions is that endogenous search costs could prevent borrowers from screening the market. Assuming a sequential search process as described e.g. in Weitzman (1979) and Morgan and Manning (1985), borrowers might anticipate that the search process for an appropriate refinancing is long and costly, in particular if renegotiations are anticipated. Such behavior could be optimal and would not be classified as a bias. This explanation would imply that borrowers who anticipate high search efforts would refrain from searching and thus from switching due to simple cost considerations. If high search costs determined borrowers’ decisions, we should observe that borrowers with higher assessments of search costs deem a lender switch less profitable on average.

The experimental setup defines the same constant exogenous search costs for all individuals. Subjects can view one additional offer, thereby ruling out the possibility that search costs are endogenous and the search process is sequential. Even in the absence of endogenous search costs, we observe the reported pattern of reference-dependent search efforts and the low switching propensity in falling interest rate environments, indicating that factors other than endogenous search costs drive the results.

As further evidence, all 742 survey respondents are asked to assess the costs of screening the market for alternative offers. Table 7 shows that the median response is 0 for both groups; importantly, the responses of switchers and non-switchers do not significantly differ. Since the loan amounts between the two groups do not differ significantly, these results also hold for relative search costs (i.e., search costs in relation to the loan amount). A potential caveat is the fact that the survey respondents are asked to assess potential *monetary* search costs. However, in addition to such monetary costs, borrowers might expect *non-monetary* search costs when screening the market for further offers (such as the time needed to compare alternative offers and to understand differences in interest rates). Based on our survey setup, we cannot rule out that non-switchers have different expectations of non-monetary search costs than switchers and that these differences are not reflected in our results.

4.3.3. Further Potential Explanations

A number of further alternative explanations could drive the observed refinancing decisions.

Following Andersen, Campbell, Meisner-Nielsen, and Ramadorai (2018), inattention implies that only few mortgage borrowers refinance optimally while inertia refers to the observation that borrowers who are inattentive to refinancing incentives are unlikely to refinance. Both biases are, however, much less important in the context of German mortgages since borrowers need to refinance at a specified date even in the absence of refinancing incentives. Moreover, the asymmetry in borrowers' switching behavior observed in the experiment cannot be explained by inattention and inertia since the incentives to contact the outside lender are the same with rising interest rates as with falling interest rates and inattentive borrowers' probability of contacting the outside lender should be constant across periods. For the same reasons, the status quo bias (Samuelson and Zeckhauser, 1988) is unlikely to drive the observed decision-making.

Procrastination of refinancing (O'Donoghue and Rabin, 1999) can be ruled out for the same reasons. German borrowers need to refinance at a specific date which cannot be postponed, and the experiment uses this very setting.

Borrowers' awareness of the potential benefits of a lender switch might constitute a further driver of their search effort. Following this potential interpretation, some borrowers might be unable to accurately estimate the costs of not switching to an outside lender. This possible explanation is further supported by the observation that subjects' scores achieved in the CRT are significantly related to their search efforts in the experiment. However, this interpretation is unable to explain the asymmetric search efforts observed in the experiment; if subjects underestimated the benefits of switching, they should do so both after interest rate increases and interest rate decreases.

5. Conclusion

We focus on the demand-side of lending relationships and investigate the impact of past interest rates on the refinancing of their mortgages. Previous research argues that increasing interbank competition lowers lenders' rents, but this research cannot explain why borrowers remain loyal to their incumbent lender without any cross-selling compensation or better credit availability when competition is intense and the cost of credit is relatively high.

To this end, we analyze to what extent borrowers remain loyal to their incumbent lender when refinancing their mortgages and estimate the effects of this decision on the cost of credit. We base our analysis on unique data obtained by a survey among mortgage borrowers and experimental data. This enables us to analyze several competing explanations for borrowers' refinancing decisions.

The survey results are the starting point of our analysis. We observe that less than 40% of borrowers switch to a new lender when refinancing. Borrowers who are loyal to their incumbent lenders face higher costs of credit by almost 40bps on average. In this respect, we confirm the findings of earlier studies that document similar behavior using actual US and Danish loan data. Our major result is based on a laboratory experiment and shows that changing interest rates affect borrowers' search behavior. Even if market screening costs are

negligible and fixed, switching costs are nonexistent and shopping around has a well-defined and obvious positive expected value, the decision to screen outside offers significantly depends on the past development of contracted interest rates. If interest rates have increased compared to the previous loan, efforts to screen the market for alternative outside offers are intensified compared to an environment of decreasing or constant interest rates. Traditional decision theories such as expected utility theory cannot explain this variation in search efforts. We also show that alternative explanations cannot explain borrowers' switching decisions. Credit availability, cross-product subsidization, search costs, and biases usually found in other mortgage market settings do not seem to drive our results. In sum, although supply-side competition is intense, many borrowers are not able to realize the substantial savings potential when refinancing due to demand-side biases.

These results have important implications on the aggregate level. With the total German market size of more than €1.2trn of mortgage loans and with the survey loans' median length of the fixed interest rate period of 10 years, the prolongation ratio of 65% results in a yearly prolongation volume of more than €70bn. Assuming potential average interest rate savings of 40bps, the total savings potential in the German mortgage market thus amounts to about €3bn each year.⁴²

In theory, the existing regulation should put borrowers in the position to compare alternative loan offers between competing lenders. In addition, with the rise of the internet-based loan search, borrowers should be able to obtain a satisfactory overview of the market. These factors underline that further regulation of lenders with respect to mortgage refinancing is not necessary. Due to intense regulatory efforts in the past, all mechanisms which enable borrowers to make sensible refinancing decisions are already in place. As long as borrowers act in the way described above, however, lenders can generate relatively high income with these customers.

Our conclusions are not confined to the German mortgage loan market but applicable to any lending relationship in which the borrower has the option to opt out at a given time. Whenever borrowers are subject to the misconceptions outlined in this paper, lenders can extract rents in a competitive market. Thus, in line with Shiller (2014), further research in housing finance with a behavioral perspective is important.

⁴²A loan is thus refinanced after 10 years on average, leading to a yearly refinancing volume of about €120bn. Prolongations account for 65% of this volume (as indicated by our survey, see Section 4.1), i.e. about €78bn. Interest rate savings of 40bps occur each year over a loan's lifetime (10 years).

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Appendices for online publication

A. Survey: Questions

(translated from German)

Self-Assessment of General Financial Knowledge and Mortgage Specific Financial Knowledge

Below we would like to ask you to rate your knowledge regarding general financial issues as well as your knowledge concerning retail mortgages. For this purpose please use a scale from "0" to "5" where "0" indicates no or very little knowledge and "5" represents extensive knowledge.

1. How do you rate your general financial knowledge?
 0 1 2 3 4 5
2. How do you rate your knowledge with respect to mortgage financing?
 0 1 2 3 4 5

Current Mortgage Financing Situation and Financing Details

In the following, please refer to your current loan if you are currently conducting a real estate financing, respectively to your last repaid loan if you conducted a financing in the past.

If your current respectively last financing consists/consisted of several loans, please refer exclusively to the highest one at payout.

If you have already financed several private real estates, please refer to your last financed real estate.

1. How many refinancings have you already conducted?
 1 2 3 More than 3
1. Have you switched to an outside lender for your current/last refinancing?
 Yes, I have switched to an outside lender for my current/last refinancing
 No, I have not switched to an outside lender for my current/last refinancing
 No answer
2. Which type of loan have you chosen for your current/last financing?
 Annuity loan
 Loan by savings and loan association
 Forward loan
 Fixed loan
 Loan with variable interest rate
 Full repayment loan
 Loan in foreign currency
 Other
 No answer
3. How high was your current/last loan at the beginning of your current/last financing?
 More than €1,000,000
 €750,001 to €1,000,000
 €500,001 to €750,000
 €250,001 to €500,000
 €200,001 to €250,000
 €150,001 to €200,000
 €100,001 to €150,000
 €75,001 to €100,000
 €50,001 to €75,000
 Up to €50,000
 No answer
4. When was your current/last loan paid out to you?
 Month:

 Year:

5. How long is/was the length of the fixed interest rate period of your current/last loan?
- Years:
- Months:
6. How high is/was the annual nominal interest rate of your current/last loan?
- Nominal interest rate:
7. How high is/was the annual effective interest rate of your current/last loan?
- Effective interest rate:
8. How high is/was the initial annual repayment of your current/last loan?
- Initial annual repayment:
9. With which lender did you take out your current/last loan?
- Credit bank
 Savings bank
 Cooperative bank
 Savings and loan association
 Mortgage bank
 Insurance company
 Other
 No answer
10. Before participating in this survey, were you aware that mortgage loans can be taken out (or refinanced) with independent mortgage brokers?
- Yes, I was aware of the existence of such services
 No, I was not aware of the existence of such services
 No answer
11. An independent mortgage broker acts as an intermediary between lenders and borrowers and facilitates the comparison of alternative loan offers for borrowers. If a loan contract is signed, the broker usually receives a compensation (which is usually paid by the lender).
 Would you be willing to take out (or refinance) a mortgage loan with an independent mortgage broker?
- Yes, I would be willing to take out (or refinance) a mortgage loan with an independent mortgage broker
 No, I would not be willing to take out (or refinance) a mortgage loan with an independent mortgage broker
 No answer
12. Has your loan been arranged by a mortgage broker?
- Yes, the loan has been arranged by a mortgage broker
 No, the loan has not been arranged by a mortgage broker
 No answer
13. Have you taken out the loan with your house bank?
- Yes, I have taken out the loan with my house bank
 No, I have not taken out the loan with my house bank
 No answer

Real Estate

Below we would like to ask you to answer some questions about the financed real estate.

1. How do you use the financed real estate?
- Own use
 Partial renting
 Full renting
 Other
 No answer
2. How high was the total value of the financed real estate at the beginning of the current/last financing?
3. Which loan-to-value ratio underlies/underlay your current/last financing?
- More than 90%
 Up to 90%
 Up to 80%
 Up to 70%
 Up to 60%

- Up to 50%
- No answer

4. What is the zip code of the location of your real estate (if different from your residence)?

- Zip code:

Costs for Refinancing

Below we would like to ask you to provide us with some estimations regarding the costs of switching to a new lender when refinancing your mortgage.

1. How high do you assess the monetary search costs incurred when looking for outside offers when refinancing your mortgage loan?

Assumption: You are looking for a refinancing of a mortgage loan of €100,000 for the next 10 years. The residential property charge amounts to €200,000.

- No search costs
- €1 to €299
- €300 to €599
- €600 to €899
- €900 to €1,199
- €1,200 to €1,499
- At least €1,500
- No answer

2. How high do you assess the monetary costs incurred when switching to an outside lender when refinancing your mortgage loan?

Assumption: You are looking for a refinancing of a mortgage loan of €100,000 for the next 10 years. The residential property charge amounts to €200,000.

- No switching costs
- €1 to €299
- €300 to €599
- €600 to €899
- €900 to €1,199
- €1,200 to €1,499
- At least €1,500
- No answer

Personal Data

Below we would like to ask you to provide some general information regarding your person.

1. In which year were you born?

- Year:

2. What is your gender?

- Male
- Female

3. What is your highest educational achievement?

- No graduation from school
- Certificate of secondary education
- General certificate of secondary education
- Higher education entrance qualification
- Apprenticeship
- Graduation from university of applied sciences
- Graduation from university
- PhD
- No answer

4. What is the zip code of your current residence?

- Zip code:

5. How high is your aggregate annual disposable net household income?

- Less than €25,000
- €25,000 to €49,999
- €50,000 to €74,999
- €75,000 to €99,999
- €100,000 to €149,999
- €150,000 to €199,999

- € 200,000 to € 249,999
- At least € 250,000
- No answer

B. Survey: The Cost Impact of Lender Switches (Nominal Interest Rates)

This table replicates the analysis presented in Table 2 but uses the nominal interest rate as the dependent variable.

Our results are very similar to the findings obtained when using the effective interest rate as the dependent variable.

Table B.1: Survey: The Cost Impact of Lender Switches (Nominal Interest Rates)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Switch	-0.246**	-0.226**	-0.256***	-0.302***	-0.256**	-0.242**	-0.259**	-0.281***
	(-2.55)	(-2.33)	(-2.89)	(-3.34)	(-2.49)	(-2.34)	(-2.47)	(-2.62)
Financial literacy						-0.130*	-0.127	-0.142*
						(-1.68)	(-1.63)	(-1.81)
Mortgage literacy						0.074	0.069	0.092
						(0.97)	(0.90)	(1.19)
Number of refinancings completed						-0.079	-0.065	-0.059
						(-1.34)	(-1.10)	(-0.99)
Intermediary								0.141
								(1.03)
Constant	2.984***	2.428***	3.851***	4.755***	4.365***	4.688***	3.973***	3.958***
	(52.19)	(14.37)	(3.77)	(4.17)	(3.26)	(3.48)	(2.84)	(2.83)
Fixed interest rate period	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Volume	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LTV	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Date of loan contract conclusion	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Loan type	No	No	No	Yes	Yes	Yes	Yes	Yes
Zip code	No	No	No	No	Yes	Yes	Yes	Yes
Bank type	No	No	No	No	No	No	Yes	Yes
N	742	742	742	742	742	742	742	736
R ²	0.01	0.06	0.56	0.57	0.65	0.65	0.66	0.66

This table contains the coefficients of an OLS regression (t-statistics in parentheses) in which the dependent variable is the annual nominal interest rate, measured in %. Standard errors are calculated based on the standard OLS variance estimator. *Switch* is a dummy variable equal to one if a borrower has switched to a new lender when refinancing the current or last mortgage loan; *Financial literacy* and *Mortgage literacy* are respondents' self-assessments of their knowledge in general financial matters and in the mortgage domain, measured on a scale from 0 to 5 where 0 denotes very little and 5 represents very high knowledge; *Number of refinancings completed* is the number of mortgage refinancings that a borrower has conducted; *Intermediary* is the share of respondents whose latest loan was taken out with support by a mortgage broker; *Fixed interest rate period* is the maturity, expressed in months; *Volume* is the amount of the latest mortgage loan, expressed in thousand € (response options specified as ranges); *LTV* is the loan-to-value ratio, expressed in % (response options specified as ranges); *Date of loan contract conclusion* represents the date of the loan contract conclusion on a monthly basis; *Loan type* denotes the type of credit; *Zip code* represents the first two digits of the 5-digit zip code of the area in which the estate financed with the reported mortgage loan is located; *Bank type* denotes the type of lender. *, **, and *** denote significance at the 10%, the 5%, and the 1% level, respectively. *, **, and *** denote significance at the 10%, the 5%, and the 1% level, respectively.

C. Survey: The Cost Impact of Lender Switches (With Control Variables Reported)

This table replicates the analysis presented in Table 2 but contains the coefficients of the key control variables used.

Table C.1: Survey: The Cost Impact of Lender Switches (With Control Variables Reported)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Switch	-0.393*** (-3.82)	-0.367*** (-3.55)	-0.390*** (-4.11)	-0.457*** (-4.73)	-0.397*** (-3.59)	-0.377*** (-3.41)	-0.398*** (-3.55)	-0.419*** (-3.63)
Loan volume: up to €50,000		0.085 (0.53)	0.036 (0.24)	0.037 (0.24)	0.056 (0.34)	0.022 (0.13)	0.034 (0.20)	0.019 (0.11)
Loan volume: €50,001 to €75,000		-0.175 (-1.15)	-0.159 (-1.13)	-0.135 (-0.95)	-0.164 (-1.05)	-0.165 (-1.06)	-0.121 (-0.78)	-0.124 (-0.79)
Loan volume: €75,001 to €100,000		0.057 (0.37)	0.011 (0.08)	0.017 (0.12)	-0.058 (-0.38)	-0.065 (-0.43)	-0.086 (-0.57)	-0.093 (-0.61)
Loan volume: €150,001 to €200,000		0.020 (0.11)	-0.127 (-0.80)	-0.113 (-0.71)	-0.148 (-0.83)	-0.144 (-0.81)	-0.137 (-0.77)	-0.146 (-0.82)
Loan volume: €200,001 to €500,000		-0.515*** (-2.70)	-0.231 (-1.33)	-0.189 (-1.09)	-0.201 (-1.02)	-0.201 (-1.02)	-0.201 (-1.02)	-0.241 (-1.21)
Loan volume: €500,001 to €750,000		0.084 (0.19)	-0.348 (-0.72)	-0.502 (-1.04)	-0.762 (-1.41)	-0.675 (-1.25)	-0.599 (-1.09)	-0.621 (-1.13)
Loan volume: €750,001 to €1,000,000		-0.909 (-0.97)	-0.268 (-0.25)	-0.210 (-0.19)	0.236 (0.17)	-0.183 (-0.13)	-0.152 (-0.11)	-0.202 (-0.14)
Loan volume: more than €1,000,000		0.467 (0.61)	0.851 (1.27)	0.685 (0.99)	0.582 (0.75)	0.671 (0.87)	0.655 (0.85)	0.663 (0.85)
LTV: up to 60%		0.209 (1.49)	0.191 (1.46)	0.144 (1.10)	0.128 (0.88)	0.097 (0.67)	0.074 (0.51)	0.054 (0.36)
LTV: up to 70%		0.398*** (2.73)	0.182 (1.37)	0.165 (1.24)	0.210 (1.42)	0.195 (1.32)	0.192 (1.30)	0.184 (1.23)
LTV: up to 80%		0.595*** (3.84)	0.520*** (3.64)	0.497*** (3.47)	0.526*** (3.25)	0.482*** (2.97)	0.475*** (2.93)	0.455*** (2.79)
LTV: up to 90%		0.393 (1.64)	0.354 (1.63)	0.327 (1.52)	0.329 (1.37)	0.258 (1.07)	0.277 (1.15)	0.236 (0.97)
LTV: more than 90%		0.590*** (3.24)	0.296* (1.78)	0.233 (1.40)	0.114 (0.61)	0.075 (0.40)	0.084 (0.45)	0.072 (0.38)
Fixed interest rate period		0.003*** (3.48)	0.003*** (3.07)	0.002*** (2.66)	0.002*** (2.47)	0.002*** (2.09)	0.002*** (2.02)	0.002*** (2.24)
Loan type: loan by savings and loan association				0.173 (1.40)	0.148 (1.07)	0.129 (0.93)	0.235 (1.51)	0.219 (1.40)
Loan type: fixed loan				0.082 (0.51)	0.069 (0.39)	0.024 (0.13)	0.024 (0.13)	0.035 (0.19)
Loan type: forward loan				0.264* (1.76)	0.336*** (2.04)	0.327*** (1.98)	0.313* (1.90)	0.338*** (2.02)
Loan type: loan in foreign currency				0.143 (0.13)	-0.157 (-0.14)	0.040 (0.04)	0.261 (0.23)	0.167 (0.15)
Loan type: full repayment loan				-0.428** (-2.44)	-0.356* (-1.80)	-0.345* (-1.75)	-0.386* (-1.94)	-0.390* (-1.96)
Loan type: loan with variable interest rate				-0.013 (-0.05)	0.099 (0.35)	0.080 (0.29)	0.098 (0.35)	0.105 (0.37)
Loan type: other				-0.761 (-1.47)	-0.965* (-1.67)	-0.982* (-1.70)	-1.077* (-1.84)	-1.056* (-1.80)
Loan type: no answer				-1.188 (-0.90)	-0.767 (-0.51)	-0.901 (-0.61)	-0.940 (-0.61)	0.000 (.)
Financial literacy						-0.122 (-1.47)	-0.118 (-1.41)	-0.132 (-1.56)
Mortgage literacy						0.041 (0.50)	0.033 (0.40)	0.054 (0.65)
Number of refinancings completed						-0.088 (-1.40)	-0.073 (-1.16)	-0.066 (-1.04)
Intermediary								0.136 (0.92)
Constant	3.246*** (53.04)	2.635*** (14.60)	4.897*** (4.47)	5.819*** (4.77)	5.560*** (3.87)	5.933*** (4.12)	5.144*** (3.44)	5.126*** (3.42)
Date of loan contract conclusion	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Zip code	No	No	No	No	Yes	Yes	Yes	Yes
Bank type	No	No	No	No	No	No	Yes	Yes
N	742	742	742	742	742	742	742	736
R ²	0.02	0.08	0.56	0.58	0.65	0.65	0.66	0.66

This table contains the coefficients of an OLS regression (t-statistics in parentheses) in which the dependent variable is the annual effective interest rate, measured in %. Standard errors are calculated based on the standard OLS variance estimator. *Switch* is a dummy variable equal to one if a borrower has switched to a new lender when refinancing the current or last mortgage loan; *Loan volume* is the amount of the latest mortgage loan, expressed in thousand € (response options specified as ranges); *LTV* is the loan-to-value ratio, expressed in % (response options specified as ranges); *Fixed interest rate period* is the maturity, expressed in months; *Loan type* denotes the type of credit; *Financial literacy* and *Mortgage literacy* are respondents' self-assessments of their knowledge in general financial matters and in the mortgage domain, measured on a scale from 0 to 5 where 0 denotes very little and 5 represents very high knowledge; *Number of refinancings completed* is the number of mortgage refinancings that a borrower has conducted; *Intermediary* is the share of respondents whose latest loan was taken out with support by a mortgage broker; *Date of loan contract conclusion* represents the date of the loan contract conclusion on a monthly basis; *Zip code* represents the first two digits of the 5-digit zip code of the area in which the estate financed with the reported mortgage loan is located; *Bank type* denotes the type of lender. *, **, and *** denote significance at the 10%, the 5%, and the 1% level, respectively. *, **, and *** denote significance at the 10%, the 5%, and the 1% level, respectively.

D. Survey: Propensity Score Matching

This section outlines the details of the propensity score matching (Rosenbaum and Rubin, 1983) of loans of switching and non-switching borrowers in our survey dataset. We first describe the calculation of the propensity score and then show how the matching is performed. The calculations are based on similar procedures used in Drucker and Puri (2005) or Saunders and Steffen (2011).

Calculation of the Propensity Score

In order to calculate the propensity score, we first estimate a probit model and then calculate the propensity score for each observation; i.e., for each loan of a switching and a non-switching borrower, a propensity score is calculated. Equation (D.1) is the basis for the calculation of the propensity score.

$$P(x_i) = P(T_i = 1|x_i) \tag{D.1}$$

In the first step, we estimate the following probit model:

$$S = \beta_0 + \beta_1 \text{volume} + \beta_2 \text{ltv} + \beta_3 \text{maturity} + \beta_4 \text{type} \tag{D.2}$$

where S is a dummy variable which is equal to 1 (equivalent to $T_i = 1$ in the equation above) if a lender switch has been conducted and 0 ($T_i = 0$) otherwise and *volume*, *ltv*, *maturity*, and *type*, represent the (vectors of) covariates described in Section 4.1. The treatment group is the group of switching borrowers; the untreated or control group contains borrowers remaining loyal to their incumbent lenders.

In the second step, we estimate the propensity score based on the outcome of the probit regression. The propensity score can be interpreted as the probability that a borrower switches to a new lender when refinancing, taking into account all matching variables.

Matching

We employ the nearest neighbor matching method with n loans as nearest neighbors. I.e., each loan of a switching borrower is matched with n loans of non-switching borrowers which exhibit the lowest difference in propensity scores. Since we use the specification with replacement in our main specification, a loan of a non-switching borrower can be included in the matched group of more than one loan of a switcher, which is accounted for by using weights in our regressions. We vary n between 1, 3, and 5. The outcomes are reported in Table 3.

We refrain from applying alternative matching specifications such as kernel matching or local linear matching. While both specifications have the potential to lower the variance of the estimates, the fact that all control observations are included in the estimation amplifies the danger of obtaining poor matches; this concern is of prime importance in our context. As our number of control observations is sufficiently large, we thus rely on the nearest neighbor algorithm, thereby presumably reducing the estimation bias.

E. Experiment: Instructions

(translated from German)

Experiment on Credit Decisions

Introduction

You are going to participate in an experiment on credit decisions which consists of 5 periods. One period is equal to 5 experimental years. The experiment therefore lasts for 25 experimental years.

The experiment will take 10 to 15 minutes. Please do not use the *Back* or *Refresh* buttons of your browser. Should you leave the experiment early, you will not be able to receive any payments. Repeated participation is not possible.

Compensation

The currency in this experiment is *Experimental Currency Units (ECU)* with an exchange rate of $\text{ECU } 10,000 = \text{€}1$. After the experiment, about 10% of all participants will be randomly selected to receive a payment. The amount paid depends on your final wealth at the end of the experiment. You will receive your final wealth, converted into €. The expected value of the payment – should you be chosen for a payment – is about €20. Your actual payment can be higher or lower – depending on your decisions in the experiment. Final wealth can never fall below ECU 0.

Experimental Procedure

Imagine you took out a loan some time ago (Period 1) as high as ECU 300,000. In each of the following periods you can refinance your loan. This means that the yearly interest rate that you pay on your loan is determined in each period (i.e., for 5 years). You will decide, period by period, how to refinance your loan. At the end of Period 5, the loan will be fully repaid out of your account. Before that, no repayment will be made.

In each period, you have to pay the interest rate and you receive an income which is the same in each period. The interest payment is a result of the currently valid yearly interest rate and the loan amount and is calculated over 5 years (i.e., 1 period). Your income minus your interest payment equals your wealth.

In each period, you first receive the offer of one lender (*Lender 1*). Compared to the offer of the previous period, this can be higher or lower by 1 percentage point with equal probability. For example, if Lender 1 offers an interest rate of 10% in Period 1, Lender 1 will offer either 11% or 9% in Period 2, each with equal probability.

In addition to the offer of Lender 1, you can contact a further lender (*Lender 2*) in each period. The offer of Lender 2 is either 1 percentage point higher or lower than the current offer of Lender 1, each with equal probability; you can still accept the offer of Lender 1. You incur costs of ECU 3,000 if you decide to contact Lender 2. If you contact Lender 2, these costs have to be paid in any case, even if you accept the offer of Lender 1 in the end.

Example 1: Lender 1 offers an interest rate of 10% for the current period. You decide to contact Lender 2. The offer of Lender 2 is 11%. You accept the offer of Lender 1. For this period, you pay 10% interest and ECU 3,000 for contacting Lender 2.

Example 2: Lender 1 offers an interest rate of 10% for the current period. You decide to contact Lender 2. The offer of Lender 2 is 9%. You accept the offer of Lender 2. For this period, you pay 9% interest and ECU 3,000 for contacting Lender 2.

Example 3: Lender 1 offers an interest rate of 10% for the current period. You decide to accept this offer immediately. For this period, you pay 10% interest and incur no further costs.

F. Experiment: Cognitive Reflection Test

The questions used for the cognitive reflection test follow Frederick (2005). For the purpose of our experiment, the questions were translated into German. The distribution of the total score and the share of correct answers for each question are shown in Appendix I.

1. A bat and a ball cost €1.10 in total. The bat costs €1.00 more than the ball. How much does the ball cost?
2. If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?
3. In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?

G. Experiment: Questionnaire

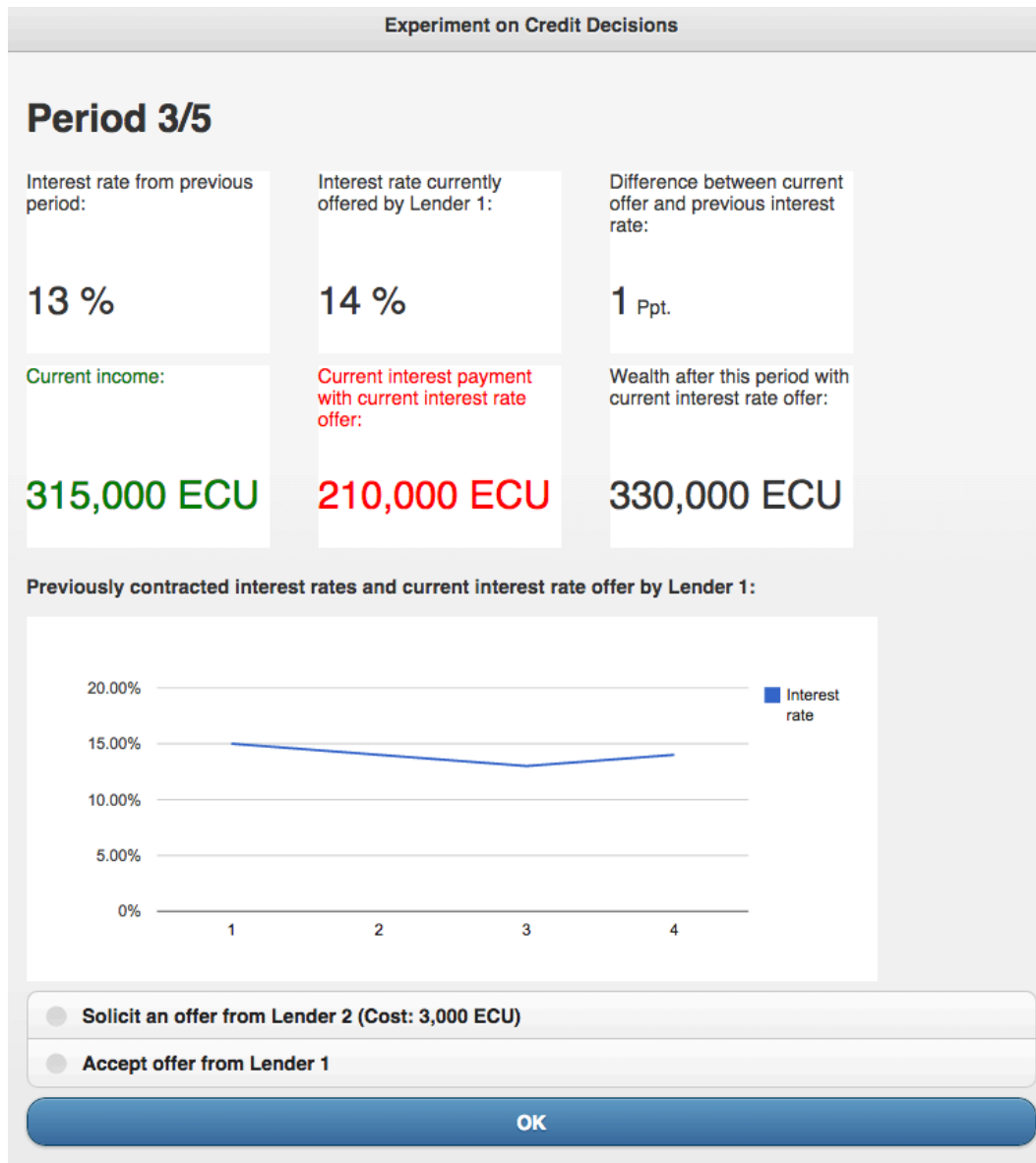
(translated from German)

1. Which decision criterion have you used when choosing whether to contact Lender 2 or not?
2. Please rate your general financial literacy on a scale from 0 to 10 where 0 indicates very low general financial literacy and 10 represents very high financial literacy.
3. Please rate your risk tolerance in general matters on a scale from 0 to 10 where 0 indicates no risk tolerance and 10 represents high risk tolerance.
4. Please rate your risk tolerance in financial matters on a scale from 0 to 10 where 0 indicates no risk tolerance and 10 represents high risk tolerance.

H. Experiment: Screenshot

(translated from German)

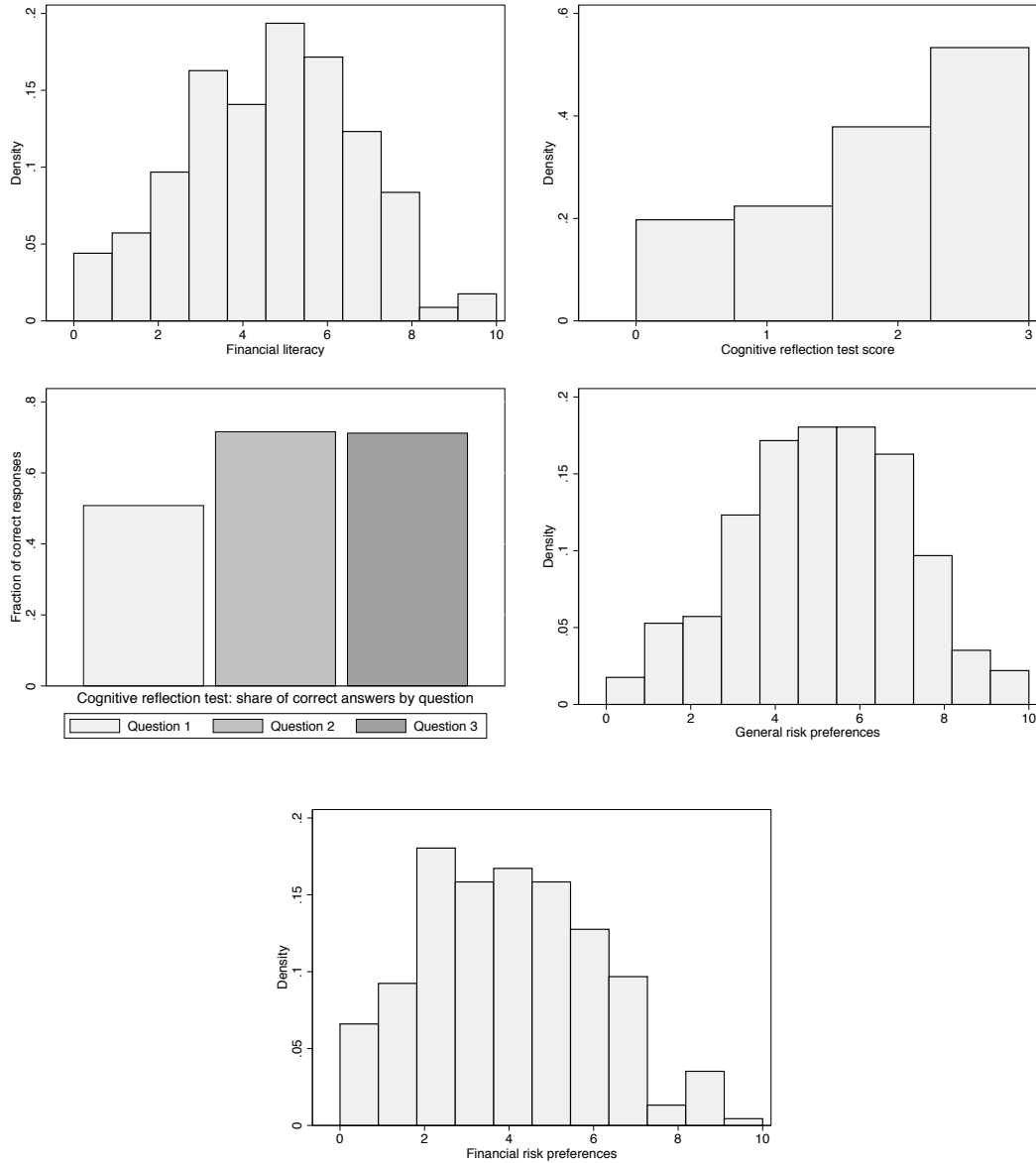
Figure H.1: Experiment: Screenshot



I. Experiment: Additional Statistics

Figure I.1: Experiment: Further Statistics

Further descriptive statistics regarding the laboratory experiment (250 subjects). *Financial literacy* denotes the self-assessed financial literacy, measured on a scale where 0 is lowest and 10 is highest; *Cognitive reflection test score* is the total score of the three cognitive reflection tasks, ranging from 0 to 3; *Cognitive reflection test: share of correct answers by question* shows the share of correct answers for each of the three questions of the test; *General risk preferences* and *Financial risk preferences* are the self-assessed risk preferences in general and in financial matters, measured on a scale where 0 is no risk tolerance and 10 is high risk tolerance.



J. Experiment: Robustness (First Period Only)

Table J.1 is based on the analysis presented in Table 6 but focuses on the first decision of each subject only. This corresponds to a between-subjects experimental design in which the within-subjects component is eliminated. The number of observations equals 250 (i.e., one decision for each of the 250 subjects).

By definition, compared to Table 6, previous experience is excluded since the first decision of each subject is included and previous experience does not exist at this stage of the experiment (i.e., no positive previous experience has been made). For the same reason, the separation between $\Delta r_{t,t-1} > 0$ and $\Delta r_{t,1} > 0$ is not necessary.

Our results are qualitatively similar to those in Table 6. We conclude that our findings are not driven by our choice of a within-subjects design.

Table J.1: Experiment: Probit Regression Results (First Period Only)

	(1)
$\Delta r_{t,t-1} > 0$	0.252*** (3.83)
Current interest rate	0.017* (1.69)
Financial literacy	0.004 (0.24)
General risk preferences	0.004 (0.26)
Cognitive reflection test score	0.019 (0.59)
All further controls	Yes
N	250
Pseudo R^2	0.15

This table shows the marginal effects of a probit regression of the decision to solicit an offer from L2 (z -statistics in parentheses) in Period 2 of the experiment (i.e., the first period in which subjects make a decision). Standard errors are clustered at the subject level. The dependent dummy variable is equal to 1 if L2 is contacted in Period 2. $\Delta r_{t,t-1} > 0$ is a dummy variable which is equal to 1 if the interest rate difference between the current offer made by L1 and the preceding period's final rate is positive; *Current interest rate* is the interest rate of L1, offered in the current period t ; *Financial literacy* is the self-assessed financial literacy of the subjects, measured on a scale from 0 to 10 (with 10 being highest); *General risk preferences* represents the self-assessed risk tolerance of the subjects, measured on a scale from 0 to 10 (with 10 denoting the highest level of risk tolerance); *Cognitive reflection test score* is the score achieved in the CRT section, measured on a scale from 0 to 3; *All further controls* include subjects' age, gender, field of study, and the version of the experiment (1–12). *, **, and *** denote significance at the 10%, the 5%, and the 1% level, respectively.

K. Nominal House Prices

Figure K.1: Development of Nominal House Prices

Development of nominal house prices between 2001 and 2016 as reported by the Federal Reserve Bank of Dallas (<https://www.dallasfed.org/institute/houseprice>). *Aggregate* denotes a weighted average of 23 countries, including the US, several countries from Europe, Asia, and Africa, as well as Australia.

