Household debt demand and negative reference rates

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This study investigates the impact of unconventional monetary policy actions and the negative interest rate policy (NIRP) on the determinants of household debt demand. We used the combined household-level microdata and macro-level variables, which enabled us to disentangle the household factors from the macroeconomic variables in loan demand. We lent support that the determinants of loan demand depend on the sign of interest rate and varied depending on positive and negative reference rates. Our robust evidence stresses the important role of financial literacy in loan demand especially. The unprecedented and controversial period of monetary policy featuring negative reference rates inadvertently led to an increased debt demand, especially among the less-educated households.

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1. Introduction

The expansion of household credit has proven to be important for business cycles worldwide, and often a strong growth in mortgage credit has proceeded to a financial crisis (e.g., Schularick and Taylor, 2012; Mian et al., 2017). Yet, a more detailed analysis of household debt demand has remained an under-researched area (Zinman, 2015; Christelis et al., 2021) although it has become a policy agenda of high importance[4]. In addition, several central banks (like the European Central Bank (ECB) and the central banks of Denmark, Switzerland, Sweden, and Japan) set policy rates below zero during the last decade, as the economies were facing the effective lower bound for nominal interest rates but were still in need for further stimulation in the post-crisis state. The impacts of this kind of unconventional monetary policy on loan demand are largely unknown. This study examines the impacts of unconventional monetary policy actions and negative interest rate policy (NIRP) on the household debt demand.

The recent, unpreceded, and controversial Negative Interest Rate Policies (NIRPs) introduced by the central banks after the Great Financial Crisis (GFC) impose a need to analyze the connections between extremely low interest rates and household debt. There are only very few studies concentrating on the supply side of household loan markets, and a scant amount of research focuses on the demand side. Recent studies have suggested that during this controversial period in monetary policy, the retail banks were reluctant to pass on the negative rates to depositors, preventing funding costs from fully adjusting to the changes in market interest rates (see, e.g., Eggertson et al., 2019; Heider et al., 2019). Some empirical evidence contradicts the notion that policy rate reductions lead to an increase in credit supply through reduced funding costs (Lauritzen, 2022). Additionally, Molyneux et al. (2020) showed that bank lending was weaker in the NIRP-adopting countries than in the countries not adopting the negative policy rates. Our study views this discussion, especially from the demand side, and analyzes whether the unpreceded policy also affected household debt demand.

The main factors of household debt demand in previous studies have been first of all related to macroeconomic factors such as real interest rate, inflation, GDP growth, unemployment rate, and housing prices (e.g., Kiyotaki and Moore, 1997; de Bandt et al., 2009; Meng et al., 2013). Second, some of the papers focused (separately from macro factors) on the micro level too, i.e., the household demographic factors such as the household head's age, level of education, income, wealth, region of residence, and household size (e.g., Crook, 2001; Campbell, 2006; Breuer et al., 2015; Strzelecka and

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[4]For example, a recent European Central Bank's Financial stability report, November 2023, states: "…higher interest rates have begun to feed through to higher debt service costs, notably in countries where the share of variable-rate lending has historically been very high. Going forward, households may see their debt servicing capacity erode if energy prices soar again, interest rates remain higher for longer and/or labour market conditions deteriorate significantly."

Zawadzka, 2020). Third, the consumer confidence or sentiment measured at the macro-level (e.g., Acemoglu and Scott, 1994; Carroll et al., 1994; Gric et al., 2022) or micro-level (e.g., Souleles, 2004; Hyytinen and Putkuri, 2018; Białowolski, 2019) has also been considered. Finally, the role of the level of households' financial literacy (see e.g., Hastings et al., 2013; Lusardi and Tufano, 2015) has been scrutinized, too. We not only explore the factors found to be of importance for loan demand, but we also examine the impacts of factors that have had conflicting evidence in earlier studies. Moreover, there is no previous evidence of the impacts of these factors in the era of negative interest rates. Hence, the factors of special interest in our analysis are housing prices, level of education, and financial confidence, especially during the NIRP.

We contribute to the previous literature by examining the household debt demand incorporating both micro- and macro-level factors in the same model. Specifically, we concentrate on analyzing the factors of loan demand with varying effects during different financial circumstances. This can be accomplished by using a detailed and comprehensive household-level panel dataset of Finnish households covering the years from 2009 to 2019, comprising annually 25,000 individuals (approximately 10,000 households) augmented by a set of most relevant macroeconomic variables, many of which are measured at the regional level. Thus, our Finnish dataset is unique in containing representative data of the Finnish population at household-level and especially in combining the register- and survey-based components.

Our starting point is the mixed evidence in the earlier literature. In our empirical modeling of the household debt demand, we employ a linear probability model with a special interest in the selected factors and the different impacts they have during periods of positive and negative reference rates.

Our study provides insights into household borrowing behavior and the impact of both micro- and macroeconomic factors on their debt demand especially during the era of negative reference rates. We find that the more educated households were less likely to acquire other consumer loans during the negative reference rate era, which we interpret to indicate the impact of better cognitive skills related to financial literacy, and hence, a better understanding of the real interest rate dynamics. In addition, the impact of financial confidence had varying roles in households' debt demand, depending on the positive or negative reference rate periods. We interpret that this reflects the importance of precautionary savings since financial confidence had a negative impact on the debt demand throughout the 2009-2015 period. Finally, the impact of housing prices on mortgages was regime-dependent. In the era of negative reference rates, the regional house price changes had no impact on the demand for housing loans whereas during the era of positive interest rates house prices had a positive relationship with housing loans, which can be seen following the claim that debt demand drives housing prices during looser financial conditions (e.g. Justiniano et al., 2019).

In sum, our results suggest that the era of unconventional monetary policy had non-orthodox consequences with respect to the traditional theory of loan demand. Accordingly, households were largely immune to the loan costs and negative interest rates did not affect unanimously on the household groups. The less-educated households tended to be more likely to raise loans for consumption. We consider these findings to have important implications for policymakers and lenders and call for targeted support and education or stricter macroprudential regulation to ensure households manage their borrowing behavior effectively.

The remainder of this paper is structured as follows. Section two gives the background for forming the hypotheses of this study. In section three, we describe the data and variables used in the empirical analysis, and in section four, we construct the empirical model. Section five reports the empirical results, and section six gives conclusions.

2. Background and hypotheses

In the post-GFC era, Policymakers and academic research have directed interests to focus on the impacts of household debt on the aggregate economy. This paper focuses on the factors known to give mixed results in the previous literature. The aim is to further understand the demand-side dynamics of the debt market during the negative interest rates and unconventional monetary policy. In this section, we discuss the role of previously detected three main factors driving the household debt demand, i.e., the house price changes, the level of education, and financial confidence. These factors constitute the three starting hypotheses to be tested in the Finnish data.

First, the feedback loop of property prices and secured (collateralized) credit has led to the question of causality. We are lacking evidence of which of the two was the initial shock and which was the response to credit booms. The rising house prices might have impacted income expectations, as suggested by Attanasio et al. (2009), not to mention the findings, which posit that increasing house prices are the source of initial shock resulting in credit booms (e.g., Laibson and Mollerstrom, 2010; Foote et al., 2012). In addition, Mian and Sufi (2011) have argued that households borrow aggressively against the rising value of their homes. However, in a later study Mian and Sufi (2018) concluded that the weight of the empirical evidence leans on the interpretation that, rather than a cause, the rising house prices are a response to the credit expansion. There is also some empirical evidence that exogenous credit expansion directly affects house prices (e.g., Di Maggio and Kermani, 2017). However, housing prices might still occasionally drive the debt demand, conditional on some other factors, such as credit availability.

Justiniano et al. (2019) argue that housing prices tend to rise in times of looser credit constraints and an increased credit supply, leading to a credit expansion and shifts in the debt demand, as observed in the early 2000s in the US. Former findings make it interesting to analyze whether the change in reference rates alters the effect of housing prices on debt demand. We argue that rising housing prices or collateral values drove debt demand during the positive reference rate era, following for example the rationing of Mian and Sufi (2011) but as the reference rates went below zero, the collateral was not the driving force for demand, as it was overruled by the loan rates, as households experienced negative reference rates, following the arguments of Justiniano et al. (2019). Based on these we formulate our first testable hypothesis as follows:

Hypothesis 1. *During strict or neutral financial circumstances, housing prices drive the debt demand, whereas during looser financial conditions, such as those associated with the negative interest rate policy (NIRP), the driving effect wears off and the direction of causality might turn the other way around.*

Second, the level of education has been reported to have a positive relationship with debt demand, as more educated households tend to demand more debt (e.g., Crook, 2001; Strzelecka and Zawadzka, 2020). This might relate to the higher income expectations and a better understanding of financial possibilities among the higher-educated households. However, when financial sophistication is extended to cover a deeper concept of financial literacy, the lack of financial literacy relates to more adverse debt behavior (Moore, 2003; for Finnish households see Kalmi and Ruuskanen, 2018) as well as the inability to judge debt positions and excessive debt loads (Lusardi and Tufano, 2015).

One could argue that households with different levels of education react differently to the unpreceded change in rates during the NIRP. We propose that households with higher levels of education are more able to comprehend the concept of real interest rates and the rationale of the Central Bank interest rate decisions, which makes low rates, in a sense, transitory in the fight against low inflation. Consequently, we see that less financially literate households, displaying more adverse debt behavior, are prone to demanding more debt, particularly for consumption, under the period of negative rates compared to their more educated counterparts. This leads us to derive the second testable hypothesis to be given:

Hypothesis 2. *Households react differently to the negative (nominal) reference rates according to their educational level. The households with a better level of education ask for less debt (on average) than their less educated counterparts during the negative reference rate era, as they better understand the effective real interest rates, and/or the transitory properties of negative rates.*

Finally, households' financial confidence has also been revealed to be of importance for debt demand. For example, Barnes and Olivei (2017) have shown that surveys on consumer sentiment include important information for loan demand beyond the standard economic determinants. Indeed, the individual-level consumer confidence (Białowolski, 2019) and optimistic forecast errors of individuals' financial situations (Souleles, 2004; Hyytinen and Putkuri, 2018) seem to signal higher levels of debt in households. Nonetheless, results are not unanimous among different types of debts. Micro-level studies posit that the consumers tend to raise less consumption-linked credit when expecting better financial times yet still are willing to borrow for durable consumption (Białowolski, 2019). Consumer confidence has been reported to have a positive impact on household debt at the macro level as well (e.g., Acemoglu and Scott, 1994; Carroll et al., 1994; Souleles, 2004; Gric et al., 2022).

The mixed results of the previous literature might imply that the micro-level households' confidence relates differently to debt demand depending on the financial circumstances. When loans are more costly (i.e. positive reference rates) we expect household confidence to drive household debt demand as discussed. However, under negative rates, we anticipate that the (low) cost of debt becomes more influential than the household's perception of borrowing. Based on these, we present the third testable empirical hypothesis:

Hypothesis 3. *Household's financial confidence drives debt demand during periods of positive reference rates with a positive sign to mortgages and a negative sign to credit for consumption. However, the effect disappears in the period of negative reference rates as the impact of confidence is overtaken by the negative rates.*

We will conduct the empirical testing of our hypotheses using the Finnish data and applying various panel econometric techniques. Next, we describe both the data and methodology to test whether the previously specifically focused three factors have a different explanatory role w.r.t. the household debt demand during the periods of positive and negative reference rates.

3. Data and variables

Household-level observations are extracted from the *Statistics Finland's Income Distribution Statistics* (IDS). This highly detailed micro-level annual dataset consists of two parts. The first part is a register-based component, where the data are collected from administrative registers, such as the annual census data, tax registers, and social and pension registers. This register-based component of the data contains among other things detailed demographic information about the households, as well as data on the sources of their income and borrowing behavior. The second part, the *Income and Living Conditions Survey*, is a survey-based dataset, which is gathered based on questions about the households' expectations on the subsequent development of their financial situation. These two datasets cover the years from 1990 to 2019. The data consist of time series on households' incomes and changes in their several different attributes having almost 750 different constituents. The data have a yearly sample size of approximately 25,000 individuals, which is approximately 10,000 households. The sampling is based on a rotation of the households. During the period from 1990 to 2008, each household is in the data for two consecutive years, and from 2009 onwards for four years. The Statistics Finland uses a sampling scheme that overweighs entrepreneurs and high-income households to ensure the representativeness of the population. The same sampling weights are used in our study.[5]

The sample with a four-year rotation covers the years from 2009 to 2019. This period is optimal for our research question since it consists of both the post-GFC and pre-COVID-19 period which thus enables our focus on the prominent consequences of negative interest rates observed in the data. The initial sample consisted of 277,427 individuals and when selecting only the household-level data, we had a sample of 113,555 observations. This was approximately 10,000 households per year. We dropped the households where the age of the head of the household was under 18, if the region was Ahvenanmaa (a small region with little or no data on regional macroeconomic variables available), and trimmed the sample for outliers.[6] The final sample consisted of 108,623 observations.

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[5] The participating households and individuals receive a weighting factor, which is based on a two-phase sampling design by the Statistics Finland. First, the weights are corrected by stratum with the inverse figures of sample persons. Second, the response-corrected weights are scaled to the number of households and calibrated to correspond with the population's known key demographic distributions and income sums in the total data. The yearly calibrated weighting factors increase household's and individual's observed values to ensure the population representativeness.

[6] The reasons for leaving for example the observations on household specific sentiment, and level of education are discussed later in the paper. We dropped a total of 77 observations aged under 18, 4 observations for high income or debt levels, 3457 observations for being outside of range 1-5 in the sentiment surveys, whereas no observations were dropped out due to unknown level of education.

The set of micro-level variables of interest included the debt holdings of households, level of education, disposable income, age of the household head, and region of residence. In addition, we employed some survey-based variables, based on questions on subjective financial well-being and households' views on both backward- and forward-looking development of their financial situation. Our data did not include measures for wealth or liquidity (e.g., savings) of the households, but for controlling these effects we used the regional averages of these factors. These data were also collected from the Statistics Finland databases.

To incorporate the macro-level variables into our analysis, the annual IDS data were matched with a number of macroeconomic variables collected from the databases of both the *Statistics Finland* and the *Bank of Finland*. This set of variables was collected at a regional level, when available, and included inflation, regional unemployment rate, regional real GDP growth, and regional real house price changes. To capture a proxy for the monetary conditions effectively also during the era of negative interest rates we applied the data shadow rate calculated by Kortela (2016), updated to cover our sample period until the end of 2019. Hence, we included the values of the shadow rate of interest as one of the core aggregate level indicators in our analysis, too.

Some characteristics of the main variables of interest are discussed in more detail in the following section. Details about the controls are provided in the Appendix, accompanied by their descriptive statistics (see Table A1). Data on the supply-side variables of the banking sector were collected from the International Monetary Fund (IMF) data sources, and their descriptive statistics are reported in Appendix Table A2.

Our primary data coincide with the one used by Hyytinen and Putkuri (2018) to a degree, but we updated it with observations covering the period of 2014 to 2019 and we used a four-year rotation instead of two. Furthermore, as a completely novel extension, we used the macro-level variables at the regional level when available.

3.1. Financial environment in the sample period

The period spanning from 2009 to 2019 witnessed several intriguing changes in the economic circumstances, characterized by Europe's struggle with low growth and moderate inflation in the post-GFC era. This era includes also the European Sovereign Debt crisis, large ECB central bank open market operations in the bond market, and revisions in the macroprudential regulatory framework. Hence, the sample period includes both the expansion of central bank open market operations and macroprudential regulation decisions. Furthermore, the sample includes the Draghi's ''whatever it takes'' speech in July 2012 as well as the NIRP, which was introduced by the ECB in June 2014,

when it lowered the deposit facility (DF) rate from 0 to −0.10%.[7] Subsequently, the main money market (Euribor) rates fell below zero in 2015.[8] For our estimations, the main emphasis is on the Euribor rate movements, as the Euribor rates have been the most used reference rates for consumer loans in Finland[9].

In addition, during our sample period, the ECB introduced the Targeted Long-Term Refinancing Operations (TLTROs) as one of the unconventional monetary policy tools. A series of bank long-term funding projects started from the first TLTRO in June 2014, followed by the TLTRO II in March 2016, and finally TLTRO III in March 2019. TLTRO has been seen to provide banks with certainty for attractive funding, enhancing the bank performance (e.g., Bats et al., 2023), and the nonstandard policy actions such as NIRP or TLTROs have been shown to stimulate the debt supply (Altavilla et al., 2021). Moreover, banks with funding stress reported lower levels of non-mortgage liabilities in Canadian banks during the GFC (Damar et al., 2020). The evidence suggests that these refinancing operations might stimulate debt supply or at least prevent it from decreasing due to funding problems. Notable, it is important to note that these actions in enhancing liquidity were active in both the positive and negative reference rate periods.

For mortgages, the national macroprudential regulations played a significant role. After the GFC, in 2010, the Finnish Financial Supervisory Authority recommended that mortgages should not be financed with a loan-to-value (LTV) ratio exceeding 90%. Subsequently, in 2016, the maximum LTV was officially set at 90% (with the exception of 95% for the first-time home loans). While the LTV ratio limit for the first-time home buyers remained unchanged, it was adjusted for the other buyers, fluctuating between 85% and 90% in 2018, 2020, and 2021.

One has to also notice two specific constraints in the Finnish mortgage market demand during the sample period. First, during the period of negative policy rates, the pass-through of these rates to mortgage rates was significantly limited, as banks set a floor to zero for the reference rates used in mortgages from 2016 onwards (Kwan et al., 2023). Second, the imposition of a LTV ratio limit affected the mortgage demand during this period, restricting the access to mortgages. These structural changes need to be acknowledged when comparing especially the development of mortgage demand to the other forms of household debt demand.

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[7] The NIRP period continued through our sample period and ended when the DF increased from -0.50% to 0 in July 2022.

[8] The 1-month Euribor rate went negative on 19th of January, 3-month Euribor rate on 21st of April, 6-month Euribor rate on 6th of November 2015, and the 12-month Euribor rate on 6th of February 2016.

[9] For example, Bank of Finland (BoF; 2022) Analysis states: "The interest rates on new housing loans in Finland are almost exclusively variable, and, in recent years, interest rates on loans have been mainly tied to Euribor rates".

3.2. Forms of household debt demand

The IDS dataset contains a comprehensive list of indicators to measure different types of household borrowing activities, such as mortgages, and other personal loans. In our study, the focus is on households' total borrowing, i.e., the total amount of loans, mortgages, and the amount of other debts[10]. The measures of various forms of debt are available for four consecutive years for each household. From these, we obtain an individual household's one-year change in the debt item by taking the difference between the amount of that debt at time t, and the amount of it at time t-1.

TABLE 1
Descriptive statistics on the alternative forms of the dependent variable for the empirical analysis

	Mean	Median	St.Dev.
Total amount of debt	59 564	9032	114 033
Change in the total amount of debt	194	0	46 921
Household with a loan dummy	.607	1	.488
Debt demand dummy	.184	0	.388
Entering debt markets dummy	.039	0	.194
Mortgage	38 466	0	74 072
Change in mortgage	294	0	34 818
HH with a mortgage dummy	.399	0	.490
Mortgage demand dummy	.068	0	.252
Entering mortgage markets dummy	.028	0	.164
Other debt	15 283	0	58 908
Change in other debt	-254	0	36 109
HH with other debts dummy	.441	0	.496
Other debt demand dummy	.181	0	.385
Entering other debt markets dummy	.058	0	.234

Note: Table 1 reports descriptive statistics on the alternative forms of the dependent variable used in the estimations. In the estimations, we focus primarily on the total amount of debt, mortgages, and other consumer debts. In this table, we present the average amounts, average changes, and proportion of households with a loan, that have had positive change in or have taken new debt for all the three specifications of debt. Table 1 reports only the mean, medium, and standard deviation values for the sake of confidentiality of the household-level data. The data are obtained from the Statistical Finland's Income Distribution Statistics (2009-2019).

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[10] Other debts include, for example, loans taken out for the purchase of a holiday home or a car, as well as student loans and other consumer loans. Hence, we include in our analysis the consumer and other debts granted by credit and financial institutions, as well as the loans worth at least 1,700 euros granted by other creditors.

For estimation purposes, we use a dummy variable that takes the value of one when the change in debt is positive and zero otherwise as one possibility for the dependent variable[11]. In an additional analysis, we also incorporate a similar dummy variable, but now with a value of one when the household enters loan markets for the first time and zero otherwise. See Table 1 for the descriptive statistics of the different debt specifications.

3.3. House price changes

To investigate the feedback loop of property prices and debt demand and compare the periods of positive and negative reference rates to each other, we include a measure of housing price changes in the model. The house price changes (calculated from prices of old dwellings in housing companies) are measured regionally and in real terms. The data for regional house price changes were gathered from the Statistics Finland database. Summary statistics are presented in Table 2 Panel A.

3.4. Level of education

IDS data provide seven different levels of educational information: none or comprehensive, upper secondary education, short-cycle tertiary education, bachelor's or equivalent level, master's or equivalent level, doctoral or equivalent level, and the level of education unknown. For our estimations, we follow the categorization of Hyytinen and Putkuri (2018). The values of unknown level of education are dropped and the rest of the levels are compressed into four categories: i) none or comprehensive, ii) secondary level, iii) lower-degree tertiary, and iv) higher-degree tertiary or doctorate. We assume that this categorization is adequate for revealing the differences in households' educational level, yet capturing the differences rather than a dummy set, for example, for the households having at least a college degree, as in Crooks (2001). Table 2, Panel A reports the summary statistics, and Panel B the proportion of households at each level of education.

3.5. Household's financial confidence

The survey part of the IDS was conducted in the first part of the year, typically in spring. Households are asked about their financial situation from two perspectives: backward-looking realizations and forward-looking expectations. Realizations of the previous year and expectations for the upcoming

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[11] As we do not have actual information about households' decision to apply for debt and whether they are granted it, nor the household-level information about negative debt demand (assets), and many households in the data have zero debt holdings throughout the sample period, our data for the debt information is concentrated on the value of zero which then prevents us to use the actual change in the debt amount as the measure for the debt demand. To overcome this, we change the definition of the dependent variable to a binary representation having a value of one when the household's change in debt is positive, and zero otherwise.

year were rated on a scale of 1 to 5, representing a clear or slight worsening, no change, or slight or clear improvement, respectively. Both backward-looking realizations and forward-looking expectations are used to create a measure of normalized consumer confidence ranging between -1 and +1. Appendix 3 discusses the construction of this measure in detail.

Note that this measure was created based on the methodology described in a European Commission (2006) report, which was also utilized by Białowolski (2019). However, the survey-based component of the data does not include measures of any other expectations (for example, on inflation, job market development, or other macro-level expectations); therefore, we use only the measures available to us. For this reason, there are some differences between the methodologies used in previous literature and by us. Our confidence measure ranges between -1 and +1, analogously to the other above-mentioned constituent measures of household-level overall confidence. Table 2, Panel B reports the distribution of households in the different categories of financial confidence.

TABLE 2
Descriptive statistics on the explanatory variables

Panel A. Summary statistics of main explanatory variables

	Mean	St.Dev.	Min.	Max.
Regional real house price change (percentages)	-.363	2.660	-9.770	9.580
Confidence	-.022	.290	-1	1

Panel B. Proportion of households in the categories of categorical explanatory variables

Confidence (index), C_{it}			
-1.00	.005		
-.75	.017	Level of education	
-.50	.090	None or comprehensive	.191
-.25	.166	Secondary level	.401
0	.501	Lower-degree tertiary	.254
.25	.141	Higher-degree tertiary or doctorate	.155
.50	.062		
.75	.012		
1	.006		

Note: Panel A reports descriptive statistics on the explanatory variables of our interest. Panel B reports the distribution of answers measuring the realized or expected change in the household's financial situation and the calculated confidence index. The variables of actual realizations and expectations are trimmed for the estimation so that all the observations not having values from 1 to 5 are dropped from the data. The data are from Statistical Finland's Income Distribution Statistics (2009-2019), Statistics Finland, and Kortela (2016).

3.6.   Controls

Identifying the changes in the debt demand due solely to the three factors of interest requires controlling for a vast set of information on household characteristics and the economic environment. Hence, in the estimations, we apply controls for both the micro- and macro-level effects that have been previously shown to affect the household debt demand.

The previously reported microeconomic factors (besides the financial confidence and level of education) affecting the household debt demand are mostly related to the household demographics such as the household head's age, region of residence, income, wealth, and household size (e.g., Campbell, 2006; Breuer et al., 2015).

In our study, we use the natural logarithm of the household head's age as the age control. The role of households' region is measured based on a categorical dummy variable covering all 19 regions in Finland, where the first region (Uusimaa) is an omitted category. The measure for household size is categorized into three different household size groups[12]. In addition, we employ the natural logarithm values of the aggregate regional measures for wealth and savings, as the household-specific measures for these variables are not included in the IDS data. However, the regional average for savings was dropped from the estimations due to a high level of correlation between the measure and wealth, inflation, and interest rates (see Table A2 in the Appendix).

Macroeconomic control factors affecting the household debt demand (besides the interest rate) include inflation (the year-on-year change in harmonized[13], fixed taxes consumer price index (CPI) calculated by Statistics Finland), unemployment rate, GDP growth, and interest rate (see e.g., Kiyotaki and Moore, 1997; de Bandt et al., 2009).

We measure the unemployment rate and real GDP growth on a regional level, while the measure for (harmonized) inflation is a national-level measure. In estimations, we lag the macroeconomic variables by one year to ensure that these variables are observed at time t by the households before they make their borrowing decisions.

For empirical regression models, we need a variable that reflects the relevant debt demand price series, that is, the loan (reference) interest rate. As our period focuses on the time of unconventional monetary policy, when the money market interest rates (such as the Euribor rates) hovered around and below zero, the shadow interest rate, first introduced by Black (1995), is reported to perform

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[12] In the spirit of Hyytinen and Putkuri (2018), the first group of households is no-children households, the second group is one or two-children households, and the third group is more than two children households. The first category, no-children households, is omitted in the estimations.

[13] European Union-level harmonized consumer price index is used, as it does not include housing prices, and interest on consumer and other loans, and prevents overlapping with other control variables. In addition, excluded from this consumer price index are gambling, fire insurance, vehicle tax, and fishing and hunting fees.

better when estimating models with interest rates as an explanatory variable (Kortela, 2016; Wu and Xia, 2016; Wu and Xia, 2020). The shadow interest rate is designed to acknowledge monetary policy actions and the option for depositors to hold currency, so the short-term nominal rate is bound to zero. Hence, the shadow rate is a relevant indicator of also the monetary policy stance when the short-term nominal rate is allowed to go below zero (Black, 1995).

By including the diverse household-specific and (regional) macroeconomic variables, we aim to establish a more clarified approach for assessing the shifts in the debt demand at the individual household level. The remaining fluctuations can be attributed to behavioral changes among households with different income levels due to the negative reference rates. The descriptive statistics on all the control variables are reported in Table A1 in the Appendix and the correlations among variables in Table A2 in the Appendix.

4. Empirical approach

In our estimations, we are focusing on the role of the level of education, financial confidence, and house price changes, especially during the negative (nominal) reference rate era. The rest of the factors behind household debt demand serve as the control variables in our analyses. Our analysis is based on the following general form regression equation:

$$Y_{i,t} = \beta_1 C_{i,t} + \beta_2 H_{j,t-1} + \beta_3 S_{i,t} + \beta_4 C_{i,t} * Post_t + \beta_5 H_{j,t-1} * Post_t + \beta_6 S_{i,t} * Post_t$$
$$+ \gamma_{i,t} X_{i,t} + \delta_t Z_{j,t-1} + \varepsilon_{i,t} \tag{1}$$

In equation (1), $Y_{i,t}$ is the measure for debt demand (binary variable) of household i in time t, $C_{i,t}$ is household-specific financial confidence, $H_{j,t-1}$ is regional, j, housing price change, and $S_{i,t}$ is an indicator for the categorical level of education[14]. $Post_t$ is a dummy variable indicating the period from 2016 to 2019, $X_{i,t}$ is a vector of household-specific control variables, $Z_{j,t-1}$ is a vector of macroeconomic control variables of region j in time $t-1$, and $\varepsilon_{i,t}$ is the error term. By lagging the right-hand side variables for macroeconomic circumstances by one year, we ensure that these variables are observed at time t by the households making their forecasts before taking on the debt. Equation (1) is estimated separately for total debt, mortgages, and other debts. The prominently different effects of the negative reference rate era are emphasized through interactions with the Post-dummy-variable.

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[14] The level of education is measured in four categories: i) none or comprehensive, ii) secondary level, iii) lower-degree tertiary, and iv) higher-degree tertiary or doctorate.

Furthermore, it is problematic to identify specifically the demand equation from the market level data, as both the demand and supply factors operate jointly towards the market equilibrium, and both influence the changes in the amount of household debt. To ensure that we have estimated a demand equation, we use the method suggested by de Bandt et al. (2009), which tests whether the residuals of the regression model are correlated with one or more supply factors. The previous literature has revealed that for the private debt market, the relevant supply-side factors are related to the banking sector's profitability and risk attributes (see e.g., de Bandt et al., 2009; Gric et al., 2022).[15]

5. Results

We estimate the probability of a positive change in the debt volume of a household using a linear probability model as presented in Equation (1). The main emphasis of our research is on the effects of NIRP on the total amount of loans, but we also separately analyze the demand for mortgages and other consumer loans to see whether there are differences among the most used loan types of consumer borrowing. Our study focuses on whether the negative reference rates changed the relationships between the factors of special interest (household's financial confidence, level of education, and regional house prices) and household debt demand. The other factors presented earlier are used as the control factors in the estimations.

Note that the omitted category in columns one to nine refers to the households with none or a comprehensive level of education. In addition, we see that the group of regional macroeconomic variables describing the development of underlying economic conditions also captures the time effects in our estimations which is in line, for example, with Gourinchas and Parker (2002), and Hyytinen and Putkuri (2018). In addition, we take care of the prominent idiosyncratic heterogeneity, and we used the robust standard errors on region-year-level clusters, as in Hyytinen and Putkuri (2018).

Table 3 reports the results of the linear probability model for different loan types and with altering the controls used (presented in columns). The period of negative reference rate (2016-2019) is captured by the Post-dummy-variable. Table 3 provides some support for all three hypotheses, but especially for Hypotheses 1, and 2. One can also observe the importance of using controls. The use of both the micro and macro controls enhanced the predictive power of the model resulting in more

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[15] See the Appendix (Tables A3) for a broader discussion of our chosen supply-side indicators, their descriptive statistics, and correlations with the demand equation residuals.

reliable and robust results. Especially, our results emphasize the significant role of the regional macroeconomic variables in explaining the household-level debt demand.

We are also able to confirm many of the previous literature reported relationships between the different factors and debt demand. However, we do not go through these results here in more detail, as we focus only on the selected factors. Hence, the results reporting the effects of the control variables are given in an Online Appendix.

To test the robustness of our findings, we re-estimated the models by using the logit model and found results similar to those reported in Table 3 (see Online Appendix for more details). Furthermore, our further identification analyses suggest that we have been able to identify a demand function from our regression analysis (see Appendix 2) because the residuals of the model covering the whole sample period do not correlate with the supply-side factors captured by the measures for bank profitability and risk-taking.

Next, we examine the results of each of our research hypotheses, given in Section 2, one by one.

5.1. Hypothesis 1

During strict or neutral financial circumstances, housing prices drive the debt demand, whereas during looser financial conditions, such as those associated with the negative interest rate policy (NIRP), the driving effect wears off and the direction of causality might turn the other way around.

Our empirical results supported Hypothesis #1. Table 3 confirms that the effect of regional real house price changes is, as expected. During the positive reference rate era house price changes also drove the household debt demand, see also Laibson and Mollerstrom (2010) or Mian and Sufi (2011). However, the regional house price changes lost their statistical significance in the period of negative reference rates. This is in line with the interpretation for example by Mian and Sufi (2018) that the development of housing market prices follows the changes in debt demand rather than the opposite. We see that the collateral value of the houses was important for households during positive reference rates, but once reference rates went negative, the loan prices were overdriving the collateral value w.r.t. debt demand. These findings support our hypothesis that house prices do not drive household debt demand under loose financial conditions such as negative reference rates era.

TABLE 3

Results from analyzing the effects of demand factors on the positive change in debt

Dependent variable	All debt			Mortgages			Other debts		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Confidence	-.091***	-.049***	-.039***	-.030***	-.010*	-.011**	-.090***	-.051***	-.042***
	(.008)	(.007)	(.007)	(.004)	(.004)	(.004)	(.007)	(.006)	(.006)
Reg. real house price change	.817***	.816***	.652***	.264***	.250***	.167**	1.226***	1.284***	1.019***
	(.105)	(.055)	(.078)	(.044)	(.040)	(.059)	(.114)	(.060)	(.102)
Level of education Secondary level	.214***	.020***	.004	.069***	-.008*	-.005	.219***	.033***	.017**
	(.003)	(.005)	(.005)	(.002)	(.003)	(.003)	(.004)	(.005)	(.006)
Level of education Lower-degree tertiary	.214***	.015**	.013*	.090***	.010**	.010**	.207***	.017**	.015*
	(.004)	(.006)	(.006)	(.003)	(.004)	(.004)	(.005)	(.007)	(.007)
Level of education Higher-deg. tert. or dr.	.202***	-.028***	-.020**	.096***	.002	.000	.190***	-.029**	-.021*
	(.006)	(.007)	(.007)	(.004)	(.005)	(.005)	(.008)	(.009)	(.009)
Confidence x POST	-.043***	-.022*	-.022*	-.001	.008	.008	-.047***	-.026*	-.026*
	(.012)	(.011)	(.010)	(.007)	(.007)	(.007)	(.012)	(.011)	(.011)
Reg. real house price change x POST	-.174	-.206	-.127	.031	.060	.171	-.801***	-.735***	-.507**
	(.170)	(.144)	(.162)	(.096)	(.099)	(.111)	(.171)	(.164)	(.152)
Level of education Secondary level x POST	-.147***	-.009	.002	-.049***	.003	.001	-.154***	-.021*	-.010
	(.008)	(.008)	(.008)	(.004)	(.005)	(.005)	(.008)	(.008)	(.009)
Level of education Lower-degree tertiary x POST	-.180***	-.041***	-.030***	-.063***	-.011	-.013*	-.178***	-.045***	-.035***
	(.008)	(.008)	(.008)	(.005)	(.006)	(.006)	(.009)	(.010)	(.010)
Level of education Higher-deg. tert. or dr. x POST	-.173***	-.031**	-.021*	-.053***	.000	-.002	-.179***	-.044***	-.035**
	(.011)	(.011)	(.011)	(.006)	(.006)	(.006)	(.011)	(.012)	(.012)
HH spec. controls	-	Yes	Yes	-	Yes	Yes	-	Yes	Yes
Macroecon. controls	-	-	Yes	-	-	Yes	-	-	Yes
Number of observations	66 297	66 297	66 297	66 303	66 297	66 297	66 303	66 297	66 297
R-squared	.193	.231	.235	.072	.093	.094	.193	.228	.233

Note: Table 3 reports the OLS estimates of the effect of household confidence, house price changes, and level of education on households having a positive change in debt volumes, with the rest of the micro- and macroeconomic (including regional average wealth) variables used as the control variables. i) Columns 1-3 the total amount of loans (All debt), ii) columns 4-6 mortgages, and iii) columns 7-9 other debts. POST is a dummy variable that equals one in the years 2016 to 2019 and zero in the years 2009 to 2015. Standard errors are clustered at the year-region level and reported in parentheses; ***$p<0.001$, **$p<0.01$, *$p<0.05$. The data are from Statistics Finland's Income Distribution Statistics (2009-2019), Statistics Finland, Bank of Finland, and Kortela (2016).

5.2. Hypothesis 2

Households react differently to the negative (nominal) reference rates depending on their educational level. The households with a better level of education ask for less debt (on average) than their less educated counterparts during the negative reference rate era, as they better understand the effective real interest rates, and/or the transitory properties of negative rates.

Table 3 displays that the probability of a household raising more debt is lower for highest educated households compared to less-educated counterparts in all loan types and both positive and negative reference rates periods. However, when observing households with secondary-level education we can see that these households were more likely to raise other consumer debts during the positive reference rate era but less likely to do so in the negative reference rate era. This behavior is even more prominent with households having lower degree tertiary levels of education, as these households were more likely to raise loans in all three specifications of household debt during the positive reference rates era but significantly less (both in statistical and economic terms) likely to do so in the period of negative reference rates. Hence, one could claim that Hypothesis #2 holds with the data, at least in the case of other consumer debt.

Accordingly, educated households might have reacted differently to the negative reference rates and have perhaps concentrated on paying back other consumer loans rather than taking more of them. This contradicts the main previous findings of the effects of the level of education being only positively related to the household debt demand (e.g., Crook, 2001), but is in line with the findings of Bos et al. (2022), who found poorer credit portfolio choices of less-educated and low-income Swedish households when facing exogenous changes in their budget constraint (of which a negative reference rate could be seen as).

5.3. Hypothesis 3

Household's financial confidence drives debt demand during periods of positive reference rates with a positive sign to mortgages and a negative sign to credit for consumption. However, the effect disappears in the period of negative reference rates as the impact of confidence is overtaken by the negative rates.

Table 3 indicates that the effect of financial confidence impacts similarly in both periods, but it is not statistically significant during the era of negative reference rates. Even so, the economic significance of the impacts of financial confidence on mortgages is not large in either of the subsample

periods. However, for all loans, and loans other than mortgage debt, the results between the two periods are different, suggesting that an increasing level of financial confidence has a different effect on the debt demand in different financial environments.

The impacts on the households' financial confidence are unexpected during the positive reference rate period since the relationship w.r.t the mortgage demand is negative. This contradicts the results from some of the most recent macro-level studies (e.g., Gric et al., 2022), but it is partially in line with recent micro-level findings (e.g., Białowolski, 2019). This negative relationship can also reflect precautionary saving behavior. After all, the NIRP was introduced in 2014 to stimulate the economy in the post-crisis situation with low real economic growth and inflation. Since the GFC in 2008 was followed in Europe by the European Sovereign Debt crisis (our sample years from 2009 to 2015), the uncertainty of economic circumstances could have increased household savings. This argument is in line with, for example, early evidence of Lunt and Livingstone (1991), who suggested that the theoretical predictions indicate household savings to be positively related to optimism about economic circumstances and individual finances.

5.4. Entering the loan markets

As an additional analysis, we tested whether these findings hold for households entering the loan market too. To analyze this, we created a dummy variable for the households entering the loan market[16] for all loans, mortgages, and other household loans. The findings reported in Table 4 largely coincide with the results reported in Table 3, with few exceptions.

Table 4 lends prominent support for Hypothesis #1. Regional house price changes seem to have a significant role in driving household debt demand during the period from 2009 to 2015 but the significance mostly fades in the latter period from 2016 to 2019. However, there are differences compared to the results in Table 3. For households entering into the mortgage markets, it is the house prices that seem to drive the debt demand during the period of negative reference rates. This finding seems intuitive, as first-time home buyers are expected to be more interested in housing prices than households already having mortgages.

Interestingly, the level of education does not seem to play a role in the decision of households to enter the loan markets. One can find some statistical significance from the results, but economically, these estimates do not hold much value. The estimates provide no support for our Hypothesis #2, and according to the results, one could claim that it holds better with the households already in the loan markets. There is more support for the other hypotheses in our results, similar to those in Table 3.

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[16] As we observe households for only four consecutive years, we are not able to tell whether it is the household's first time entering the loan market or whether the household re-enters the market.

TABLE 4

Results from analyzing the effects of demand factors on entering the debt market

Dependent variable	All debt			Mortgages			Other debts		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Confidence	-.007*	-.004	-.000	-.016***	-.009**	-.008**	-.010*	-.002	-.000
	(.004)	(.003)	(.003)	(.003)	(.003)	(.003)	(.004)	(.004)	(.004)
Reg. real house price change	.186***	.180***	.153**	.112***	.115***	.086**	.296***	.299***	.270***
	(.025)	(.025)	(.051)	(.024)	(.020)	(.032)	(.045)	(.049)	(.071)
Level of education Secondary level	.038***	.003	-.004	.028***	-.004	-.004	.056***	.006*	.002
	(.001)	(.002)	(.002)	(.001)	(.002)	(.003)	(.002)	(.003)	(.003)
Level of education Lower-degree tertiary	.034***	-.002	-.003	.033***	.000	.000	.054***	.002	.002
	(.002)	(.003)	(.003)	(.002)	(.002)	(.002)	(.003)	(.003)	(.003)
Level of education Higher-deg. tert. or dr.	.035***	-.004	-.001	.035***	-.002	-.002	.060***	.001	.003
	(.003)	(.004)	(.004)	(.002)	(.003)	(.003)	(.003)	(.004)	(.004)
Confidence x POST	.003	.006	.006	.000	.004	.004	-.003	.002	.002
	(.005)	(.005)	(.005)	(.005)	(.005)	(.005)	(.007)	(.006)	(.006)
Reg. real house price change x POST	-.035	-.001	-.015	.031	.095	.121*	-.099	-.030	-.013
	(.062)	(.062)	(.070)	(.054)	(.053)	(.061)	(.096)	(.105)	(.109)
Level of education Secondary level x POST	-.034***	-.006	-.001	-.020***	.002	.003	-.042***	-.004	-.001
	(.004)	(.004)	(.004)	(.003)	(.003)	(.003)	(.004)	(.004)	(.004)
Level of education Lower-degree tertiary x POST	-.039***	-.010*	-.006	-.025***	-.003	-.002	-.047***	-.008	-.005
	(.004)	(.005)	(.004)	(.003)	(.003)	(.003)	(.005)	(.005)	(.005)
Level of education Higher-deg. tert. or dr. x POST	-.040***	-.011	-.007	-.020***	.003	.003	-.048***	-.009	-.006
	(.006)	(.006)	(.006)	(.004)	(.004)	(.004)	(.005)	(.006)	(.006)
HH spec. controls	-	Yes	Yes	-	Yes	Yes	-	Yes	Yes
Macroecon. controls	-	-	Yes	-	-	Yes	-	-	Yes
Number of observations	66 297	66 297	66 297	66 303	66 297	66 297	66 303	66 297	66 297
R-squared	.032	.039	.043	.028	.037	.037	.051	.059	.060

Note: Table 4 reports the OLS estimates of the effect of household confidence, house price changes, and level of education on households on household entering the loan market, with the rest of the micro- and macroeconomic variables controlled. Columns represent three separate specifications for the debt forms: i) Columns 1-3 the total amount of loans (All debt), ii) columns 4-6 mortgages, and iii) columns 7-9 other debts. POST is a dummy that equals one in the years 2016 to 2019 and equals zero in the years 2009 to 2015. Standard errors are clustered at the year-region level and reported in parentheses; ***p<0.001, **p<0.01, *p<0.05. The data are from Statistics Finland's Income Distribution Statistics (2009-2019), Statistics Finland, Bank of Finland, and Kortela (2016).

In the period of positive reference rates, the households' financial confidence indicator still has a negative relationship with respect to entering the loan markets, but statistically, it is significant only in the case of mortgages. Thus, the already discussed interpretation of precautionary savings effects during the European Sovereign Debt crisis remains valid in the case of entering the mortgage market. Table 4 also reports that financial confidence lost its significance during the period from 2016 to 2019, as in Table 3. However, it seems that financial confidence does not have any major role when it comes to entering the debt market, under any financial circumstances.

To test the robustness of our findings, we re-estimated the models by using the logit model and found results similar to those reported in Table 4 (see Online Appendix).

5.5. Policy implications

We find that the more educated households are less likely to acquire other consumer loans during the negative reference rate era, which we interpret to indicate the impact of cognitive skill on financial literacy and hence a better understanding of the real interest rate dynamics. These findings are in line with, for example, Bos et al. (2022) who argued that the less-educated households make seemingly poorer borrowing decisions that reinforce conditions of poverty, and the findings of Lusardi and Tuffano (2015) on the relationship between financial literacy and indebtedness.

The results suggest that the era of unconventional monetary policy had non-orthodox consequences with respect to the traditional theory of loan demand. Accordingly, households were largely immune to the loan costs and the negative reference rate did not affect unanimously on the household groups. The less-educated households tended to be more likely to raise loans for consumption. This calls for targeted support and education to help less-educated households manage their finances effectively, and lower the risk of poverty through overborrowing.

In addition, the impact of financial confidence has varying roles for households' debt demand, depending on the positive or negative reference rate periods. We interpret that precautionary saving behavior played a role in the agent's behavior while financial confidence had a negative impact on debt demand throughout the 2009-2015 period, as higher financial confidence negatively impacted the debt demand. This mechanism is important for policymakers as it impacts the effectiveness of the policies.

Finally, the impact of housing prices on mortgages was regime-dependent. At the zero lower bound, in the era of negative interest rates, changes in regional house prices had no impact on the demand for housing loans whereas during the era of positive reference rates house prices had a positive relationship with housing loans. However, the negative reference rates coincide with the LTV ratio limit regulation set in Finland and the true effects of both of these events are hard to identify

with our yearly data. Former studies at both macro and micro levels, cross-country or country-specific (e.g., Lim et al., 2011; Vandenbussche et al., 2015; Akinci and Olmstead-Rumsey, 2018; de Ajauro et al., 2020; Mokas and Giuliodori, 2023) have shown that macroprudential regulation (including LTV ratio) helps curb mortgage loan creation and is effective in mitigating the pro-cyclicality of credit, leverage, and housing prices. Thus, although our results imply that the effectiveness of such macroprudential regulations is questionable during the negative reference rate period, this claim needs further research.

6. Conclusions

As the GFC drew attention to the accumulation of household debt levels, both the policymakers and academia focused their interest on the impact of debt on individuals in the broader economy. However, the mechanisms behind the credit expansion and the factors driving the household debt demand in this process have largely remained outside the policy and research agenda. In addition, studies on the household loan supply have shown that the normal relationship between decreasing funding costs and household loan supply does not hold during the recent unconventional and unpreceded monetary policy measures of European central banks (Molyneux et al., 2020; Lauritzen, 2022). For the natural linkages of the demand and supply conditions, the period of unconventional monetary policy characterized by the NIRP and subsequent negative reference rates (e.g., the 12-month Euribor rate) perceived by households is also important to examine separately as the factors affecting the demand-side of the loan markets, too. This is also of special interest among the central banks, as it is important for the policymakers to understand the consequences and implications of the novel policy tool. The literature lacks evidence of the impact of negative interest rates on the demand for household loans and to what extent the impact of the NIRP is transmitted via the other determinants of loan demand. Our study provides an answer to this question.

We examine this question taking into account the level of education, financial confidence, and housing prices. Using a large panel of household-level microdata with 25,000 individuals (approximately 10,000 households) augmented with (regional) macro-level variables, we tested four hypotheses concerning the aforementioned factors and found support for our expectations.

First, in our Finnish data sample, the educated households were less likely (compared to their less-educated counterparts) to raise more other consumer loans in the era of negative reference rates, but not before it. This suggests a better understanding of the dynamics and consequences of the real interest rate among the well-educated households. Second, financial confidence had an opposite impact depending on the positive and negative reference rates. Furthermore, households seem to

increase their precautionary savers during the European Sovereign Debt crisis, as household financial confidence had a negative effect on the debt demand. Third, the regional house price changes drove household borrowing in the period of positive reference rates, but they did not affect the debt demand during the era of negative interest rates.

Based on our results, we argue that the period of negative money market interest rates had unintentional consequences as the negative reference rates caused the less-educated households to be more likely to raise loans for other purposes than housing. These results call for targeted support and education to help the households effectively manage their borrowing in order to prevent poverty through overborrowing. In addition, targeted macroprudential tools can be considered. Our results provide further discussion on the mechanisms of implementing monetary policy decisions.

Although our research provides important insights into the determinants of household debt demand, certain limitations need to be acknowledged. Specifically, we were unable to model the decision-making process behind households' loan applications or lenders' decision to grant them. This gap highlights the need for future studies to explore the full equilibrium in the credit market. Furthermore, we recommend that future studies should incorporate more precise measures of financial literacy to better understand the role of financial or debt literacy in the debt demand behavior of households.

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APPENDIX I

TABLE A1
Descriptive statistics of the control variables

Panel A. Continuous and binary microeconomic control variables

	Mean	Median	St.Dev.
Age	52	52	16
ln age	3.886	3.951	.347
Disposable Income (EUR)	55 438	48 671	49 976
Logarithm of disposable income	10.712	10.792	.669

Panel B. Categorical microeconomic control variables (proportion of households in each category)

Region of residence		Region of residence (cont.)	
Uusimaa	.268	Central Finland	.052
Southwest Finland	.092	South Ostrobothnia	.039
Satakunta	.049	Ostrobothnia	.032
Kanta-Häme	.031	Central Ostrobothnia	.013
Pirkanmaa	.095	North Ostrobothnia	.070
Päijät-Häme	.035	Kainuu	.015
Kymenlaakso	.034	Lapland	.033
South Karelia	.024	Household size groups (# of children)	
South Savo	.032	No children	.701
North Savo	.052	One or two children	.238
North Karelia	.034	More than two children	.060

Panel C. Macroeconomic control variables

	Mean	St.Dev.	Min.	Max.
Shadow interest rate (percentage)	-.807	1.051	-2.516	.587
Inflation (percentage)	1.523	1.032	-.150	3.300
Regional unemployment rate (percentage)	8.451	1.763	4.500	17.500
Regional real GDP growth (percentage)	1.731	3.986	-11.539	12.676
Regional average net wealth	201 100	36 962	148 872	277 461
ln average net wealth	12.195	.179	11.911	12.533
Regional average amount of savings	20 143	2 322	16 225	25 326
ln average amount of savings	9.904	.114	9.694	10.140

TABLE A1
Continued

Note: Panel A reports descriptive statistics on the explanatory continuous and binary microeconomic control variables used in the estimations. Panel A reports only mean, medium, and standard deviation for confidentiality of household-level data. Panel B reports the proportion of households in categorical microeconomic control variables. The region of Åland was dropped from the data when used in estimations. The data of panels A, and B are from Statistics Finland's Income Distribution Statistics (2009-2019). Panel C reports descriptive statistics of macroeconomic control variables used in the estimation collected from the Bank of Finland, and Statistics Finland.

Table A2

Correlations table for continuous variables

	Debt demand (binomial)	Enter. loan markets	Financ. conf. index	Lag reg. real h.price change	Shadow interest rate	Ln age	Ln disp. income	Lag inf	Lag reg, real GDP growth	Lag reg. unempl.	Ln reg. savings	Ln reg. net wealth
Debt demand (binomial)	1											
Enter. loan markets	.389	1										
Financ. conf. index	-.088	-.013	1									
Lag reg. real h.price change	.053	.024	-.007	1								
Shadow interest rate	.030	.006	.032	.354	1							
Ln age	-.204	-.065	.252	-.032	-.019	1						
Ln disp. income	.047	-.032	-.045	.007	-.062	.126	1					
Lag inf	.007	-.004	.040	.004	.765	-.016	-.044	1				
Lag reg, real GDP growth	-.018	-.007	-.022	.045	-.055	.011	.044	.078	1			
Lag reg. unempl.	-.016	-.007	.010	-.198	-.147	.020	-.092	-.174	.004	1		
Ln reg, savings	.010	.008	-.036	.261	-.120	-.034	.128	-.095	.099	-.616	1	
Ln reg. net wealth	-.015	-.002	-.054	-.031	-.439	-.003	.135	-.346	.259	-.417	.746	1

Note: Table A2 reports the correlations between disposable income, 3-month Euribor rate, 12-month Euribor rate, natural logarithm of household head's age, normalized financial expectations, lagged regional unemployment, lagged regional real GDP growth, lagged regional real house price change, lagged inflation, natural logarithm of regional liquidity of households, and natural logarithm of regional net wealth of households.

APPENDIX II - Supply side factors

Credit growth is not solely determined by the demand side, as the supply side plays also a major part in the availability of household funding. Banks face limitations from their internal factors but also from the regulation they face. To identify that our model is, in fact, a demand equation for household loans, we use the method suggested by de Bandt et al. (2009) and test whether the residuals of our regression model are not correlated with one – or several – proper supply factors. For the banking sector variables we used four ratios similar to Gric et al. (2022), i.e. the Common Equity Tier 1 Capital to risk-weighted assets (Capital to RW Assets), non-performing loans (NPL) to gross loans (NPL ratio), return on assets (ROA), and liquid assets to total assets (Liquid Asset ratio). These four ratios represent the banking sector's capitalization, credit risk, profitability, and liquidity. The only difference to the above-mentioned papers is that instead of taking only the Capital-to-Assets ratio, we used the Tier 1 Capital to risk-weighted assets ratio, which is assumed to give a more precise picture of the capital adequacy of the banking sector. These variables can be seen to capture the supply-side credit growth factors as they characterize broadly determinants of the availability of funding for the banks. The descriptive statistics of the chosen variables can be seen in Table A3 below. The correlations of residuals and the chosen banking sector factors can be seen in Panel B of Table A3 below. As we can see, the correlations are not statistically significant, and hence, we can conclude that our equation captures the role of demand-side factors in the bank loan markets.

TABLE A2
Identification of the bank loan demand function

Panel A. Descriptive statistics of the supply side variables

	Mean	St.Dev.	Min.	Max.
Capital to RW Assets	.175	.030	.136	.219
NPL ratio	.008	.003	.004	.015
ROA	.007	.004	.005	.018
Liquidity ratio	.136	.049	.059	.213

Panel B. Correlations of residuals and the chosen banking sector factors

	Capital to RW Assets	NPL ratio	ROA	Liquidity ratio
Residuals	-.006	-.006	-.008	-.007

Note: Panel A2 reports descriptive statistics of banking sector control variables collected from the International Monetary Fund. Panel B reports the correlation of residuals from Table 3, Column 3 to the selected supply side factors. Data for supply-side factors are from the International Monetary Fund (IMF).

APPENDIX III – Household-specific consumer confidence

The survey was conducted in the first part of the year, typically in spring. Households are asked about their financial situation from two perspectives: backward-looking realizations and forward-looking expectations. Realizations of the previous year and expectations for the upcoming year were rated on a scale of 1 to 5, representing a clear or slight worsening, no change, or a slight or clear improvement, respectively. Three additional values were used for those who did not want to answer, were unable to answer, or had missing information. Households that did not answer both questions on a scale of 1 to 5 were excluded from the analysis.

To measure household-specific, i, confidence at time t, both backward-looking realizations (A_{it}) and forward-looking expectations (E_{it}) are used to create a measure of normalized consumer confidence ranging between -1 and +1. The household-specific confidence (C_{it}) was calculated by summing the two survey question values, subtracting the average value (6), and dividing the difference by the maximum possible deviation from the average (4). The formula and cross-tabulated outcomes are below. Values may appear contradictory, such as when the actual financial situation is rated 1 but the expected change is rated 5, resulting in a confidence value of 0, similar to when a household answered both questions with a value of 3 (no changes). This possible bias is controlled for in the robustness checks of the results.

Our theoretical model suggests that consumers are forward-looking, but we can see from the data that past and contemporaneous information might have a role in determining their expectations as well. This is also a reason to incorporate not only expectations but also the actual realizations of our measure of consumer confidence. Measuring the household-specific consumer confidence is based on the definition $C_{it} = \frac{A_{it} + E_{it} - 6}{4}$, where, C_{it} is the measure of household-specific confidence, A_{it} refers to the survey-based view on the actual financial situation, E_{it} to the survey-based view on expectations of a change in the financial situation, all observed by an individual household *i* at time *t*.

This measure was created based on the methodology described in a European Commission (2006) report, which was also utilized by Białowolski (2019). However, the survey-based component of the data does not include measures for any other expectations (for example, on inflation, job market development, or other macro-level expectations) of a consumer; therefore, we use only the measures available to us. For this reason, there are some differences between the methodologies used by mentioned former literature and by us. Our confidence measure ranges between -1 and +1, analogous to the other above-mentioned constituent measures of household-level overall confidence. Already in Panel B of Table 2, we report the distribution of households in the different categories of financial

confidence. Panel A of Table A3 reports the distribution of households in the different categories of the survey answers in actual realization and expectations. Panel B in Table A3 reports the cross-tabulated results of the equation and the range of the answers.

TABLE A3
Actual realizations, expectations, and financial confidence

Panel A. Proportion of households in each category

Actual realization, Ait		Expectations, Eit	
1 clearly better	.035	1 clearly better	.029
2 slightly better	.187	2 slightly better	.182
3 about the same	.582	3 about the same	.650
4 slightly weaker	.153	4 slightly weaker	.117
5 clearly weaker	.044	5 clearly weaker	.022
1 clearly better	.035	1 clearly better	.029

Panel B. Crosstabulation of the values of expectations (E_{it}) and actual realizations (A_{it}) of the household's financial situation, used for the calculation of the household-specific financial confidence indicator

		Expectations, E_{it}				
		1	2	3	4	5
	1	-1.00	-0.75	-0.50	-0.25	0.00
Actual	2	-0.75	-0.50	-0.25	0.00	0.25
realizations, A_{it}	3	-0.50	-0.25	0.00	0.25	0.50
	4	-0.25	0.00	0.25	0.50	0.75
	5	0.00	0.25	0.50	0.75	1.00

Note: Panel A reports the distribution of answers to the variables measuring the realized or expected change in the household's financial situation. The variables of actual realizations and expectations are trimmed so that all the observations not having values 1 to 5 are dropped from the data when used in estimations. Panel B reports the values calculated to measure household-specific consumer confidence. The data of panels A, and B are from Statistical Finland's Income Distribution Statistics (2009-2019).

Online Appendix

This online appendix presents additional results which did not find their way into the paper.

Full results

Below are the full results of Table 3. Note that with categorical variables the omitted values are: None or comprehensive level of education, the region of Uusimaa, and households with no children.

TABLE A4

Results from analyzing the effects of demand factors on the positive change in debt

Dependent variable	All debt			Mortgages			Other debts		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Confidence	-.091***	-.049***	-.039***	-.030***	-.010*	-.011**	-.090***	-.051***	-.042***
	(.008)	(.007)	(.007)	(.004)	(.004)	(.004)	(.007)	(.006)	(.006)
Reg. real house price change	.817***	.816***	.652***	.264***	.250***	.167**	1.226***	1.284***	1.019***
	(.105)	(.055)	(.078)	(.044)	(.040)	(.059)	(.114)	(.060)	(.102)
Level of education Secondary level	.214***	.020***	.004	.069***	-.008*	-.005	.219***	.033***	.017**
	(.003)	(.005)	(.005)	(.002)	(.003)	(.003)	(.004)	(.005)	(.006)
Level of education Lower-degree tertiary	.214***	.015**	.013*	.090***	.010**	.010**	.207***	.017**	.015*
	(.004)	(.006)	(.006)	(.003)	(.004)	(.004)	(.005)	(.007)	(.007)
Level of education Higher-deg. tert. or dr.	.202***	-.028***	-.020**	.096***	.002	.000	.190***	-.029**	-.021*
	(.006)	(.007)	(.007)	(.004)	(.005)	(.005)	(.008)	(.009)	(.009)
Confidence x POST	-.043***	-.022*	-.022*	-.001	.008	.008	-.047***	-.026*	-.026*
	(.012)	(.011)	(.010)	(.007)	(.007)	(.007)	(.012)	(.011)	(.011)
Reg. real house price change x POST	-.174	-.206	-.127	.031	.060	.171	-.801***	-.735***	-.507**
	(.170)	(.144)	(.162)	(.096)	(.099)	(.111)	(.171)	(.164)	(.152)
Level of education Secondary level x POST	-.147***	-.009	.002	-.049***	.003	.001	-.154***	-.021*	-.010
	(.008)	(.008)	(.008)	(.004)	(.005)	(.005)	(.008)	(.008)	(.009)
Level of education Lower-degree tertiary x POST	-.180***	-.041***	-.030***	-.063***	-.011	-.013*	-.178***	-.045***	-.035***
	(.008)	(.008)	(.008)	(.005)	(.006)	(.006)	(.009)	(.010)	(.010)
Level of education Higher-deg. tert. or dr. x POST	-.173***	-.031**	-.021*	-.053***	.000	-.002	-.179***	-.044***	-.035**
	(.011)	(.011)	(.011)	(.006)	(.006)	(.006)	(.011)	(.012)	(.012)

TABLE A4 Continued

Region of Southwest Finland	.022*** (.006)	.026*** (.005)	-0.001 (.004)	-0.003 (.004)	.031*** (.009)	.042*** (.007)
Region of Satakunta	.026** (.009)	.031*** (.007)	.015** (.005)	.013* (.005)	.025* (.011)	.033*** (.008)
Region of Kanta-Häme	.017 (.010)	.023* (.010)	.010 (.005)	.008 (.005)	.035** (.013)	.042** (.013)
Region of Pirkanmaa	.010 (.007)	.017* (.007)	.003 (.005)	.001 (.006)	.023* (.011)	.041*** (.010)
Region of Päijät-Häme	.028*** (.008)	.033*** (.007)	.011 (.006)	.009 (.006)	.030** (.010)	.042*** (.008)
Region of Kymenlaakso	.021 (.012)	.029** (.011)	-.002 (.005)	-.006 (.006)	.044** (.014)	.064*** (.011)
Region of South Karelia	.031*** (.009)	.037*** (.008)	.007 (.006)	.005 (.007)	.052*** (.011)	.066*** (.010)
Region of South Savo	.008 (.010)	.023* (.010)	.002 (.007)	-.002 (.007)	.021 (.012)	.045*** (.012)
Region of North Savo	.016 (.009)	.031*** (.008)	.006 (.007)	.003 (.007)	.028** (.011)	.052*** (.008)
Region of North Karelia	.015 (.009)	.035** (.011)	.008 (.007)	.005 (.010)	.021 (.012)	.061*** (.011)
Region of Central Finland	.029*** (.006)	.034*** (.006)	.015** (.005)	.013* (.006)	.032** (.011)	.050*** (.009)
Region of South Ostrobothnia	.009 (.009)	.015* (.007)	.004 (.006)	.002 (.006)	.017 (.013)	.026** (.009)
Region of Ostrobothnia	.005 (.009)	-.004 (.009)	.000 (.006)	.002 (.006)	.006 (.012)	-.006 (.010)
Region of Central Ostrobothnia	.018 (.017)	.032 (.018)	.005 (.010)	.004 (.010)	.016 (.017)	.033* (.015)
Region of North Ostrobothnia	.025** (.008)	.038*** (.008)	.006 (.006)	.002 (.006)	.039*** (.009)	.060*** (.009)
Region of Kainuu	.013 (.010)	.030* (.012)	.012 (.007)	.008 (.009)	.043*** (.011)	.077*** (.011)

TABLE A4 Continued

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Region of Lapland		.026** (.009)	.045*** (.010)		.007 (.005)	.003 (.006)		.036** (.013)	.069*** (.013)
ln Age		-.204*** (.006)	-.242*** (.007)		-.085*** (.004)	-.079*** (.004)		-.185*** (.006)	-.221*** (.007)
HH size Group 1-2 children		-.025*** (.005)	-.020*** (.005)		.011** (.003)	.010** (.003)		-.004 (.005)	.000 (.005)
HH size Group more than two children		-.041*** (.008)	-.033*** (.008)		.007 (.006)	.005 (.006)		-.007 (.008)	.001 (.008)
ln Disposable income		.091*** (.002)	.056*** (.003)		.037*** (.001)	.044*** (.002)		.082*** (.002)	.049*** (.003)
Shadow interest rate			.604* (.297)			.444* (.211)			.873* (.407)
Inflation			-.799* (.338)			.444* (.275)			.873* (.486)
Regional real GDP growth			-.139*** (.038)			-.018 (.032)			-.183*** (.052)
Regional unemployment			-.175 (.154)			.020 (.119)			-.568** (.183)
Ln Regional average net wealth			.046*** (.003)			-.007*** (.002)			.047*** (.004)
Number of observations	66 297	66 297	66 297	66 303	66 297	66 297	66 303	66 297	66 297
R-squared	.193	.231	.235	.072	.093	.094	.193	.228	.233

Note: Table A4 reports the OLS estimates of the effect of household confidence, house price changes, and level of education on households having a positive change in debt volumes, with the rest of the micro- and macroeconomic (including regional average wealth) variables. i) Columns 1-3 the total amount of loans (All debt), ii) columns 4-6 mortgages, and iii) columns 7-9 other debts. POST is a dummy variable that equals one in the years 2016 to 2019 and zero in the years 2009 to 2015. Standard errors are clustered at the year-region level and reported in parentheses; ***p<0.001, **p<0.01, *p<0.05. The data are from Statistics Finland's Income Distribution Statistics (2009-2019), Statistics Finland, Bank of Finland, and Kortela (2016).

Estimating with Logit

For testing robustness, we re-estimate the models in Tables 3 and 4 using Logit regression and report the results respectively in Tables A5 and A6 below.

TABLE A5

Results from analyzing the effects of demand factors on the positive change in debt

Dependent variable	All debt			Mortgages			Other debts		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Confidence	-.765***	-.229***	-.229***	-.732***	-.002	-.120*	-.763***	-.244***	-.249***
	(.038)	(.048)	(.048)	(.054)	(.056)	(.060)	(.039)	(.043)	(.043)
Reg. real house price change	3.301*	4.837***	3.967***	.628	3.120***	2.065*	5.420***	7.667***	6.085***
	(1.473)	(.419)	(.536)	(3.091)	(.652)	(.930)	(1.487)	(.448)	(.723)
Level of education Secondary level	-1.321***	.085*	.086*	-2.623***	-.225***	.003	-1.294***	.172***	.177***
	(.021)	(.038)	(.038)	(.037)	(.065)	(.071)	(.026)	(.040)	(.043)
Level of education Lower-degree tertiary	-1.320***	.142***	.145***	-2.340***	.149*	.215**	-1.364***	.160***	.166***
	(.026)	(.042)	(.042)	(.039)	(.063)	(.069)	(.036)	(.048)	(.048)
Level of education Higher-deg. tert. or dr.	-1.394***	-.080	-.077	-2.269***	.072	.019	-1.473***	-.082	-.078
	(.035)	(.051)	(.051)	(.043)	(.077)	(.084)	(.059)	(.065)	(.065)
Confidence x POST	-.149*	-.194**	-.195**	.173	-.007	.014	-.200**	-.243***	-.242**
	(.068)	(.068)	(.068)	(.115)	(.107)	(.112)	(.074)	(.074)	(.074)
Reg. real house price change x POST	1.152	-1.195	.050	4.969	1.928	4.526*	-2.409	-4.475***	-2.185
	(1.758)	(1.054)	(1.154)	(3.497)	(1.836)	(2.018)	(1.754)	(1.164)	(1.136)
Level of education Secondary level x POST	1.807***	.033	.033	3.105***	.294*	.125	1.776***	-.050	-.053
	(.063)	(.067)	(.068)	(.098)	(.119)	(.121)	(.065)	(.069)	(.070)
Level of education Lower-degree tertiary x POST	1.588***	-.181**	-.184**	2.939***	.134	-.042	1.601***	-.222**	-.229**
	(.061)	(.066)	(.066)	(.096)	(.116)	(.116)	(.072)	(.076)	(.076)
Level of education Higher-deg. tert. or dr. x POST	1.635***	-.115	-.119	3.118***	.324**	.158	1.579***	-.232*	-.242*
	(.078)	(.084)	(.084)	(.100)	(.120)	(.122)	(.093)	(.093)	(.094)
HH spec. controls	-	Yes	Yes	-	Yes	Yes	-	Yes	Yes
Macroecon. controls	-	-	Yes	-	-	Yes	-	-	Yes
Number of observations	66 303	66 297	66 297	66 303	66 297	66 297	66 303	66 297	66 297

Note: Table A5 reports the Logit estimates of the effect of household confidence, house price changes, and level of education on households having a positive change in debt volumes, with the rest of the micro- and macroeconomic (including regional average wealth) variables used as the control variables. i) Columns 1-3 the total amount of loans (All debt), ii) columns 4-6 mortgages, and iii) columns 7-9 other debts. POST is a dummy variable that equals one in the years 2016 to 2019 and zero in the years 2009 to 2015. Standard errors are clustered at the year-region level and reported in parentheses; ***p<0.001, **p<0.01, *p<0.05. The data are from Statistics Finland's Income Distribution Statistics (2009-2019), Statistics Finland, BoF, and Kortela (2016).

TABLE A6

Results from analyzing the effects of demand factors on entering the debt market

Dependent variable	All debt			Mortgages			Other debts		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Confidence	-0.747***	-.015	-.001	-.918***	-.126	-.246*	-.652***	.049	.005
	(.066)	(.095)	(.093)	(.074)	(.093)	(.102)	(.061)	(.077)	(.078)
Reg. real house price change	-.121	4.406***	3.962*	-1.153	3.248***	2.660*	1.091	5.062***	4.734***
	(4.659)	(.828)	(1.541)	(4.894)	(.714)	(1.149)	(3.853)	(1.037)	(1.418)
Level of education Secondary level	-3.261***	-.062	-.094	-3.572***	-.315***	-.121	-2.844***	.005	.082
	(.043)	(.072)	(.073)	(.052)	(.095)	(.109)	(.039)	(.061)	(.065)
Level of education Lower-degree tertiary	-3.383***	-.065	-.069	-3.408***	.003	.047	-2.879***	.061	.082
	(.076)	(.080)	(.079)	(.066)	(.083)	(.092)	(.066)	(.073)	(.074)
Level of education Higher-deg. tert. or dr.	-3.358***	-.033	-.022	-3.345***	-.002	-.058	-2.785***	.111	.091
	(.075)	(.107)	(.106)	(.063)	(.109)	(.110)	(.070)	(.078)	(.079)
Confidence x POST	.614***	.165	.164	.263	.009	.027	.375**	.027	.037
	(.138)	(.145)	(.144)	(.156)	(.156)	(.164)	(.115)	(.118)	(.121)
Reg. real house price change x POST	4.930	.160	.928	7.357	4.166	6.233*	3.078	-.419	.980
	(5.006)	(1.956)	(2.204)	(5.350)	(2.269)	(2.524)	(4.253)	(2.191)	(2.322)
Level of education Secondary level x POST	3.380***	-.051	-.027	4.011***	.349*	.208	3.148***	.025	-.033
	(.124)	(.132)	(.132)	(.135)	(.158)	(.165)	(.101)	(.105)	(.108)
Level of education Lower-degree tertiary x POST	3.195***	-.212	-.191	3.820***	.180	.040	3.055***	-.058	-.115
	(.143)	(.1449	(.142)	(.154)	(.158)	(.167)	(.128)	(.124)	(.127)
Level of education Higher-deg. tert. or dr. x POST	3.183***	-.228	-.208	4.027***	.389*	.256	3.050***	-.073	-.124
	(.177)	(.190)	(.191)	(.138)	(.159)	(.166)	(.122)	(.121)	(.124)
HH spec. controls	-	Yes	Yes	-	Yes	Yes	-	Yes	Yes
Macroecon. controls	-	-	Yes	-	-	Yes	-	-	Yes
Number of observations	66 303	66 297	66 297	66 303	66 297	66 297	66 303	66 297	66 297

Note: Table A6 reports the Logit estimates of the effect of household confidence, house price changes, and level of education on households on household entering the loan market, with the rest of the micro- and macroeconomic variables controlled. Columns represent three separate specifications for the debt forms: i) Columns 1-3 the total amount of loans (All debt), ii) columns 4-6 mortgages, and iii) columns 7-9 other debts. POST is a dummy that equals one in the years 2016 to 2019 and equals zero in the years 2009 to 2015. Standard errors are clustered at the year-region level and reported in parentheses; ***p<0.001, **p<0.01, *p<0.05. The data are from Statistics Finland's Income Distribution Statistics (2009-2019), Statistics Finland, Bank of Finland, and Kortela (2016).