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Loan-to-Value Regulations on Mortgages and the Use and Refinancing of Unsecured Debt

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ABSTRACT

We study how loan-to-value (LTV) regulations on mortgages can change the use of unsecured debt and mortgage refinancing behaviors for households at or near the regulatory limits imposed. This study focuses on the differences in unsecured debt market participation between Norway and Sweden, where LTV regulations are in effect, and Denmark and earlier studies, where no LTV limits are imposed. We analyze the unsecured debt loan market using data from a repeated household survey from 2019 and 2021 with 4,010 and 3,023 respondents, respectively. We also explore mortgage lending and unsecured debt using a unique micro data set covering 7,385 Norwegian households. Our analysis shows that unsecured debt increases with LTV level but that households' refinancing behaviors explain the lower increase in unsecured household debt at or near the regulatory limit for LTV on mortgages. We further demonstrate that an increasing number of households cannot refinance unsecured debt with mortgage debt. This lack of ability can lead to a rapid increase in the number of financially vulnerable households. We are the first to demonstrate that changes in different debt sources and refinancing patterns can increase the number of financially vulnerable households when LTV regulations are imposed solely on mortgage debt.

1. Introduction

Macro-prudential regulations are an essential tool for preventing future financial crises, and mortgage regulations are an integral part of such regulations (Aikman et al., 2019). Loan-to-value (LTV) regulations have been introduced in several countries over the last two decades and are considered effective in reducing growth in mortgage loans (Morgan et al., 2019). We extend this research by improving the understanding of LTV regulation's effects on households' financial vulnerability and usage of different sources of debt. Our research is thus of interest to both policymakers and banks.

Regulations are only effective in countries where banks are willing to supply credit beyond the imposed thresholds. For this study, we assume that banks perceive a limited risk in granting loans to the imposed regulatory limits and that there are incentives to supply credit to the maximum of these regulations. We focus on LTV post-refinancing as a limiting factor in the ability to refinance and the effect of LTV regulations on cash-out refinancing. A bank's willingness to provide mortgages at or close to the value of a house depends on a country's economic outlook and the prospect of employment and growth in housing prices. This willingness may increase after prolonged growth periods, and LTV regulations focus on curbing issues such as procyclicality (Lim et al., 2011).

In this study, we examine how households use refinancing and unsecured debt[1] to finance consumption at or near regulatory LTV limits on mortgage lending. We contrast the findings from Norway and Sweden, where LTV limits are imposed, with findings from Denmark, where they are not. We then compare them with earlier research on the use of unsecured debt in the UK (Del Rio & Young, 2006) and mortgage refinancing in the US (Brown et al., 2015; Mian & Sufi, 2011). We are the first to explore the effect of LTV regulations on mortgage refinancing of unsecured debt and unsecured debt market participation. We expand on earlier research by contrasting findings in countries with

LTV regulations to those in countries without LTV regulations and combining micro-data from a bank to expand survey results to this end. The novelty of our approach is visible from the contrasting results obtained from countries with LTV regulations and the unsecured debt market participation in countries without such regulations and from exploring household lending behavior at or close to the LTV limits on mortgage lending. LTV regulations can, over time, lead to a gradual build-up of households with mortgages close to the LTV limits, as illustrated in Figure 4 in the Appendix. This increase in households with limited access to increase their mortgage debt underlines the importance of more knowledge about the long-term effects of households' use of different sources of debt close to the regulatory limits for mortgage lending. We hypothesize that an improved economic outlook increases access to and the use of unsecured debt, as well as the willingness to grant mortgages with an LTV at the regulatory limit. Mortgage lenders become more willing to lend as the estimated default risk decreases and consumers' willingness to use unsecured debt increases. This is because an improvement in the economic outlook reduces their fear of repayment difficulties. We further propose that imposing regulations on mortgage lending can increase the willingness to provide unsecured debt to homeowners by increasing the housing equity available to other creditors. We expect to find that using unsecured debt in countries with LTV regulations on mortgages is more dependent on home ownership and less dependent on income and other repayment risk indicators. We expect households with a high demand for debt to use more of all sources of debt, and a high LTV is ceteris paribus, a strong indicator of high demand for debt and willingness to borrow. Thus, we expect the use of unsecured debt to increase as LTV on the household mortgage increases. The increasing cost of a mortgage as LTV increases may also reduce the relative cost of unsecured debt. We further expect a lower observed use of unsecured debt for households at or near regulatory thresholds than models predicting more unsecured debt with rising LTV would suggest. This seemingly counter-intuitive finding is caused by certain households repeatedly refinancing the unsecured debt into their mortgages. Regulators' failure to regulate secured and unsecured debt simultaneously might leave households more vulnerable and provide banks

with incentives to increase the supply of unsecured debt beyond the level they would allow if they only depended on customers' ability to repay loans based on income. We analyze households' use of unsecured debt in four stages. First, we observe the relationship between housing prices, regulations, and growth for unsecured debt using a time series across Norway and Sweden, where mortgage regulations are in effect. In the second stage, we use a survey to explore the hypotheses that 1) rising housing prices also affect the supply and use of unsecured credit for homeowners, and 2) due to the prolonged growth in housing prices and LTV regulations in Norway and Sweden, unsecured debt is less dependent on income there compared to Denmark. We employ a survey in all three countries to examine if different factors influence the use of unsecured debt. In the third stage, we examine the effect of household debt, mortgage, and income on the use of unsecured and mortgage debt in households by analyzing a dataset of Norwegian households that includes demographics, income, mortgage, home value, and unsecured debt information. We further examine whether significant effects exist for households at or near the maximum levels of the DTI and LTV regulations on mortgages in Norway.

To this end, we conducted a repeated survey, the first with 4,010 respondents in 2019 and the second with 3,023 respondents in 2021, in three Scandinavian countries, Norway, Sweden, and Denmark. The first stage of our article focuses on studying the differences in the use of unsecured debt between countries with a high, steady growth in housing prices compared to countries whose housing prices received a recent shock.

The societal structures in Norway, Sweden, and Denmark are similar (Fellman et al. 2008), in terms of debt levels and housing price levels relative to income and high levels of homeownership, thus enabling the comparison of these countries, which is important for identifying the effects of exogenous variables. We use the data on unsecured debt market participation in Sweden and

Norway with LTV regulations and compare them with the data from Denmark, which has no LTV regulations. Further, we compare our findings with that of earlier results from a country in a situation with some similarities to that of Denmark from Del Rio and Young (2006), in their study based on the British Household Survey conducted in 1995 and 2000. In doing so, we seek to determine if differences in the recent growth in housing prices influence participation in the unsecured debt market and compare the findings for Denmark, where housing prices dropped after the 2008 financial crisis, and Sweden and Norway, where housing price growth was consistent through the financial crisis. We further explore the effect of LTV limitations on mortgages and differences in the effect on unsecured debt participation between mortgage clients and other respondents. We go beyond previous studies by analyzing unique microdata on 7,385 households with a complete debt record from a Norwegian bank to explore the relationship between LTV [2] and unsecured debt market participation. Additionally, in the third stage of our study, we combine these findings with data from mortgage loan applications to examine refinancing behavior at or near the imposed LTV limits.

In our fourth and final stage, we look at how households who previously have refinanced unsecured debt in the mortgage perceive their economic outlook to analyze if households perceive the risk of increased debt through refinancing unsecured debt in their mortgage.

A cash-out effect can occur when housing prices increase, but a restriction on LTV will limit the ability to increase mortgages for households at or near this limit before

refinancing. If a homeowner perceives continuous growth in housing prices, a binding constriction on LTV today will no longer be binding when housing prices grow further, while unsecured debt can serve as an intermediary as long as the homeowner perceives mortgage refinancing to be possible within a short time horizon. In this case, any such unsecured debt will be short-term, that is, until housing prices increase, such that refinancing costly unsecured mortgage debt is possible. We hypothesize that such a refinancing cycle can explain why the refinancing of unsecured debt is more common than cash-out refinancing in Sweden (Li & Zhang, 2017).

We find support for mortgage clients in countries with LTV regulations employing unsecured debt as an intermediary and as an alternative cash-out refinancing in mortgages that the LTV regulations may restrict. The households cash out by taking on unsecured debt and then refinance once the housing prices have increased, allowing for the refinancing of unsecured debt in the mortgage. Thus, an exhaustive analysis of the effect of mortgage regulations should not just be limited to an analysis of mortgage lending but should also include an analysis of changes in unsecured lending for mortgage holders. We contribute to the literature by explaining why previous research in Sweden (Li & Zhang, 2017) does not find as much cash-out refinancing in mortgage lending as research in the US (Brown et al., 2015; Mian & Sufi, 2011).

We further demonstrate a build-up of households with mortgage debt at or near the LTV limit with a limited ability to refinance unless real estate prices continue growing and income increases. Thus, linking the long-term effect of LTV regulations, leading to financially vulnerable households at or near the LTV limits.

The contribution of this study is three-fold: 1) we expand the knowledge on unsecured debt market participation in countries with LTV regulations, and are the first to study this linked to LTV regulations on mortgages, and contrast our findings with the findings of Del Rio and Young (2006) and our data from Denmark; 2) we expand the knowledge on unsecured debt as a transmission medium in countries with high and consistent growth in housing prices, exploring whether the findings of Li and Zhang (2017) are consistent with those of Mian and Sufi (2011) and Brown et al. (2015); and 3) the study analyzes unique data and provides a novel understanding of how the mortgage and unsecured debt interaction for households can lead to a build-up of financially vulnerable households at or close to regulatory limits on mortgage lending.

The rest of the paper is organized as follows. In the 2 section, we present background information on housing prices, debt, and regulations in Norway, Sweden, and Denmark. We further describe some of the main contributions of earlier research on mortgage lending and the use of unsecured debt. In the 3 section, we describe the dataset. Thereafter, in the 4 section, we describe the method and, in the 5 section, we summarize selected results and discuss our findings. Finally, the 6 section presents the conclusions and the implications of the results.

2. Literature and Institutional Settings

This section describes the role of unsecured debt in the economy and the link between housing prices and debt growth. We also review previous research on the use of unsecured debt as it relates to mortgage debt and housing prices. Further, we present

the institutional settings and describe regulations on household debt in general and in Norway, Sweden, and Denmark, in particular, to lay a foundation for discussing the differences between these countries. Finally, we describe the differences in growth in housing prices between the three countries as a background for exploring the differences between them in unsecured lending and borrowing.

2.1. Literature

Household debt is a major determinant of both economic growth and slowdown (Mian et al., 2017). To address the unknown consequences of growing household debt levels, the extant research has focused on how macro-prudential regulations can reduce future crisis risk (Aikman et al., 2019) and how regulation affects the price and volume of credit (Defusco et al., 2020). The supply and use of unsecured debt in countries where growth in debt and housing prices lead to macro-prudential mortgage regulations can differ from the use and supply in other countries. An improved understanding of the combined use of different sources of debt introduces additional complexity (Livshits, 2015). The spillover effect between mortgage debt and unsecured debt has been proposed in prior studies (Reite & De Lange, 2017, Kim, 2020). These spillover effects are important, as unsecured debt is generally much more expensive than mortgage debt and combined debt, and the debt servicing cost of households determines their financial vulnerability. We believe that research on spillover effects, refinancing behavior of households at or near regulatory limits on mortgage lending, and long-term effects on refinancing ability are important and should be expanded as the acceptance of mortgage regulations as an integral part of the policy toolkit increases (Aikman et al., 2019).

Del Rio and Young (2006) studied British households in 1995 and 2000 following the 1990s housing price crash in Britain. This study was performed in a country without the LTV regulations later imposed in several countries and in a scenario similar to the housing price change experienced in Denmark after the 2008 financial crisis. A survey conducted five years after the housing prices started increasing after a significant fall also confirm Del Rio and Young (2006) findings on the link between income, education, age, and the use of unsecured debt. In the 5 Section, we contrast this to the findings in Sweden and Norway, where housing prices have steadily grown for three decades without a significant fall.

Scholars have proposed several models and conducted empirical studies on the relationship between housing prices, debt, and consumption (Anundsen & Jansen, 2013; Aoki et al., 2002; Cristini & Sevilla, 2014; Funke & Paetz, 2013; Iacoviello, 2004; Lai et al., 2017). Some studies have also documented the link between mortgage regulations, mortgage lending, and housing prices (Han & Strange, 2016; Igan & Kang, 2011; Kuttner & Shim, 2016). There is also empirical evidence on the accumulation of unsecured debt in affluent households (Magri et al., 2019), consistent with such households wanting to prioritize spending based on future earnings prospects. We hypothesize that the willingness to supply unsecured debt to low-income homeowners can increase during periods of prolonged economic growth and increase housing prices. Furthermore, other scholars also agree that the demand for unsecured loans will increase in such periods (Aron et al., 2012). Studies on how the use of unsecured debt increases in financially

constrained households and how households are more inclined to refinance unsecured debt in mortgages when housing prices increase (Li & Zhang, 2017) also exist. Other studies indicate that housing prices have little effect on indebtedness for households in general (Burrows, 2018).

Borrowing decisions linked to the consumption effect of increasing housing prices, borrowing, and lending are an essential transition mechanism in interacting with housing prices, and previous studies in Sweden and Norway have suggested a two-way interaction (Anundsen & Jansen, 2013; Turk, 2015). Earlier international studies have found the same interaction (Aoki et al., 2001; Mian & Sufi, 2011). The effect of housing prices on debt differs from refinancing for consumption without a down-payment on non-mortgage debt when housing prices grow in the U.S. (Brown et al., 2015; Mian & Sufi, 2011), while there is refinancing with a down-payment on non-mortgage debt/unsecured debt in Sweden (Li & Zhang, 2017). We further study this seemingly rational refinancing behavior, where households refinance the expensive unsecured debt on their mortgages as housing prices grow. An earlier study on Norway also suggests that loan sizes increase for homeowners, and the installments fall with increasing collateral value, leading to a debt build-up and increased non-housing spending as housing prices increase (Jacobsen & Vatne, 2011).

The cycle of obtaining and refinancing unsecured debt can continue until housing prices stop growing or until the total debt level of the customer reaches a level where the LTV, DTI, or the mortgage lenders' willingness to lend limits the household's ability to refinance. This refinancing cycle will lead to certain households steadily refinancing unsecured debt to the maximum of the LTV regulations. Since a proportion of households close to the LTV threshold have recently refinanced unsecured debt, this will, in turn, lead to the lower use of unsecured debt for households at or close to the LTV threshold than a model linking unsecured lending to LTV would suggest. Such a refinancing cycle is consistent with an earlier Swedish study, which found increased socioeconomic heterogeneity within households with mortgages entering foreclosure (Lundholm, 2022).

We attempt to determine if repeated refinancing and positive reinforcement through previous refinancing can lead to a gradual build-up of a problematic level of debt in specific households and what happens to the rational migration to cheaper sources of debt if households build up debt to a level where refinancing is no longer possible. We hypothesize that the extant seemingly conflicting findings lead to the same levels of financial vulnerability and a rapid build-up of debt as housing prices grow. Svensson (2018) suggests that debt build-up is not at a pr†The limit imposed by mortgage regulations on LTV in Norway and Sweden is 0.85. LTV regulations and other limits on mortgage lending may differ for other countries. In Sweden and Norway, they are followed by reporting criteria and have a very limited ability to deviate on individual loans.

oblematic level, but there is an issue of a growing number of mortgage clients reaching levels of debt where they are no longer able to keep increasing unsecured debt and refinance it with their mortgage to reduce service costs. The situation in Denmark also provides insights into how increasing leverage influences spending patterns when housing prices fall. For instance, Andersen et al. (2014) find a robust negative correlation between non-housing spending and pre-crisis leverage when studying the 2008 financial

crisis; this significant reduction in spending from highly leveraged households at or near their maximum debt levels can lead to a smaller number of households having a disproportionate effect on financial stability as a whole.

We propose that LTV ceilings in times of rapidly growing housing prices can provide unsecured lenders with incentives to increase lending, as the net assets of households are available to unsecured lenders in case of a default increase, as suggested by Reite and De Lange (2017). We believe this can lead to differences in the use and supply of unsecured debt, depending on the growth in housing prices and mortgage regulations in different countries. There is also scholarly support for the assumption that such an increase in the supply of unsecured debt and the perceived ease of refinancing can increase the demand for debt itself (Soman & Cheema, 2002).

Chrystal and Mizen (2001) demonstrate that a household's debt balance exists in parallel with the money demand and consumption equations. Reduced access to new credit from home equity loans is a possible reason for the decline in monetary policy effectiveness when the initial debt levels are high (Alpanda & Zubairy, 2019). Therefore, a better understanding of the rational and irrational use of debt is relevant at the macro level where even small groups exhibiting irrational behavior may significantly influence the equilibria (Akerlof & Yellen, 1985; Debelle, 2004).

We investigate and discuss how mortgage regulations affect the ability to change from one source of debt to another and how mortgage regulations influence the use of unsecured debt among households at or near the debt thresholds of these regulations.

2.2. Institutional Setting

Although Norway, Sweden, and Denmark share numerous cultural similarities, there are also substantial differences in the growth of their economies and housing prices. In the aftermath of the financial crisis of 2008, there were significant differences in the development of housing prices in the three countries. In Denmark, the financial crisis burst a small housing bubble, resulting in falling housing prices until the end of 2012 (Oust & Hrafnkelsson, 2017). Thereafter, housing prices have increased for the past eight years but are still below the pre-crisis levels (see Figure 1).

Conversely, Norway and Sweden only had small price corrections in the years after the crisis before falling back into an increasing pattern, as depicted in Figure 1. Norway and Sweden targeted an inflation rate of 2 percent, and inflation in the period was close to the target but more volatile in Norway. In contrast, inflation in Denmark was closer to 1 percent on average from 2006– 2020 (Nasir et al., 2020).

Sweden, Norway, and Denmark also exhibit different patterns of growth in terms of unsecured debt, and regulations on mortgage debt have been implemented at different times, as illustrated in Figure 2. The details of the differences in regulations are provided in Table 1.

3. Data

3.1. The Effect of Mortgage Regulations

In the first part of our analysis, we employ data on housing prices, time of mortgage regulations, and growth in unsecured debt to establish if mortgage regulations lead to
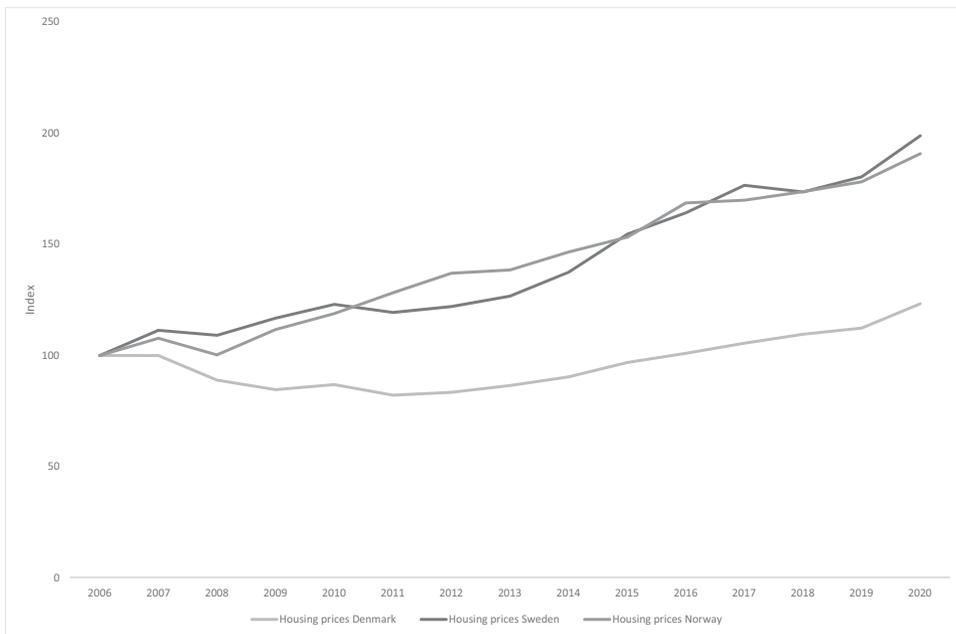
Figure 1. Development in housing prices in Scandinavian countries (real).
Source: OECD, 2021

changes in unsecured debt. The data are collected from statistics published by Statistics Denmark, Statistics Sweden, Statistics Norway, and the Financial Supervisory Authority in Norway. A brief description of mortgage regulations employed as dummy variables follows from Table 1.

3.2. Scandinavian Household Survey

We base the second part of our analysis on an empirical study of a Scandinavian household survey. Our survey was conducted between July 10 and 28, 2019 and involved three representative panels of respondents living in Norway ($N = 2,001$), Sweden ($N = 1,003$), and Denmark ($N = 1,006$). Although we designed the questionnaire to ensure sufficient validity, the survey was conducted by Sentio Research, a company specializing in household and business surveys. Between March 24 and 30, 2021, we conducted a similar survey, which also consisted of three representative panels of respondents living in Norway ($N = 1,010$), Sweden ($N = 1,007$), and Denmark ($N = 1,006$). A panel of similar surveys and micro data over time can enable differentiating between long-term trends in the use of unsecured debt and the effect of shocks and regulations at the household level. Professional translators at Sentio Research translated this survey into local languages to reduce the risk of misinterpretation.[3] We chose the three countries because of their similarities, particularly in terms of culture, labor market, and financial regulations, and because of the differences in housing price development in recent years, as illustrated in Figure 2.

The surveys consisted of two sections: an initial set of socioeconomic questions and a second set of questions related to the past and present use of unsecured credit. The
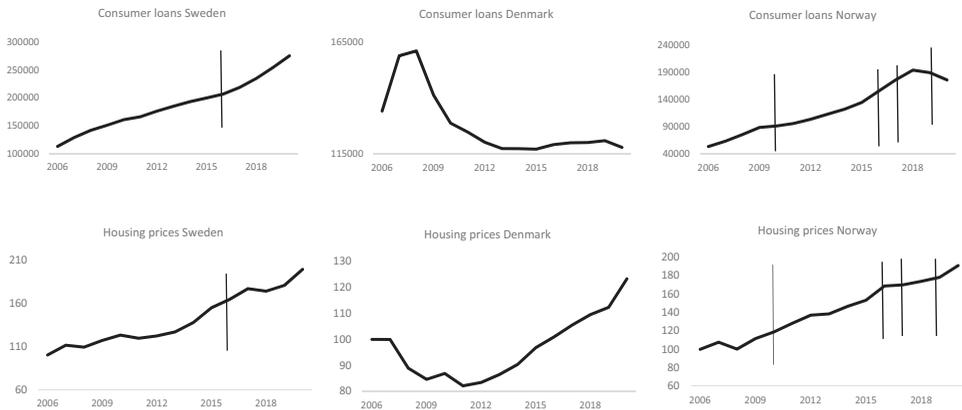
Figure 2. Housing prices and unsecured lending by country (nominal).

Consumer loans. Total unsecured debt—measured in billions in local currency, NOK/SEK/DKK—have comparable real value with the exchange rates within a range of +-50% of each other over the analyzed period.

Times of regulation. The regulations imposed are marked by vertical lines. All lines except the 2019 line in Norway signify stricter mortgage lending regulations. The 2019 line in Norway signifies consumer lending regulations. The regulations are further described in Table 1

Table 1. Brief overview of lending regulations.

Country	Mortgages	Unsecured lending
Sweden	**Mortgage loan ceiling**: Since 2010, the rule has been that a new mortgage may not exceed 85% of a home's value. **Amortization requirement**: Borrowers granted mortgage loans after June 1, 2016, must repay 1% of the total loan principal yearly if the loan-to-value (LTV) ratio is 50-70%. **Debt to income (DTI)**: Stricter from 2019 with increased servicing for DTI above 4.5	Debt register established, but not used by all providers
Norway	**Mortgage loan ceiling**: Since 2010, the rule has been that a new mortgage may not exceed 85% of a home's value. **Amortization requirement**: Borrowers granted mortgage loans after 2010 must repay 2,5% of the total loan principal yearly if the LTV ratio is 70% lowered to 60%. **DTI**: From 2017, a max DTI of 5.	Nodebtregister until June 2019. At the same time, regulations imposed are as follows: a DTI of less than 5 and a check of ability to service
Denmark	**Mortgage loan ceiling**: usually 80% max LTV; 10-year interest-only allowed; relaxed consumer loan regulations and voluntary check of debt register **Amortization requirement**: No regulation **DTI**: No regulation.	Regulated through fair business practices act. Debt register available from 2012, but voluntary check.

a. Regulations per July 2019.
b. Variable "Regulation" is defined as the time period after the implementation of mortgage loan ceiling in Norway and Sweden in 2010.
c. Variable "Debt register" is defined as the time period after the implementation of mortgage loan ceiling in Norway in 2019.
d. Denmark imposed guidelines with requirements on banks measuring exposure and defining internal strategies on mortgages with high DTI and LTV in growth areas in 2016 but does not enforce a limit on such lending.

latter part of the survey explored the distribution of unsecured debt in the population and further examined refinancing behaviors. We define unsecured debt as interest-bearing revolving credit on credit cards and unsecured loans in the survey questionnaire for the respondents.

Table 7 in the Appendix presents the distribution of income and mortgages for the different age and income groups for the three different Scandinavian countries. The descriptive statistics reveal no significant differences in the income distribution of the three countries. The data also show no significant differences in gender and education levels within the survey populations.

The proportion of mortgage holders is consistent across the household surveys in 2019 and 2021, with no significant differences found.

3.3. Micro Data on Refinancing Applications and Households with Mortgages

The data from surveys are more uncertain than administrative data, particularly because using unsecured loans may be considered shameful to some of the population. Therefore, to enhance our study, we also utilize administrative data to study the likelihood of having unsecured debt.

From July to August 2019, the Debt Information Act issued licenses to three companies to collect information about unsecured and credit card debt for all Norwegian households. All regulated banks and financial institutions were required to report their customers' balances to the licensed debt registries. We combined the administrative debt from 7,385 households with data from loan applications at a small Norwegian bank. This dataset includes consumer data such as income and education levels, as well as credit and home value data. We are particularly interested in how mortgages and income affect households' credit behaviors. Using mortgage loan size and home value data, we calculated the LTV both on the application date and during the last observation period to determine whether the amount to be repaid matters. A positive difference in the two calculated LTV ratios, LTVdiff, indicates that a customer has paid down on their mortgage. Note that we kept the home value fixed. DTI is an indicator of a customer's financial situation. The lower the DTI is, ceteris paribus, the lower the estimated credit risk. YearDiff represents the number of years since the customer was granted a mortgage loan. In Norway, loan applicants must pass three essential thresholds: an LTV less than 85%, a DTI less than 5, and a liquidity indicator greater than 1. The liquidity indicator is calculated based on the household income and financing and non-financing costs. A liquidity measure of 1 signifies that the household can cover all household specific and individual costs of maintaining a reasonable living standard based on a standardized budget in addition to tax, debt servicing cost of all mortgage debt, unsecured debt, and other debt such as car loans and student loans, including a buffer for interest rate increases. It is of interest to see if there are non-linearities in the LTV or DTI around these thresholds. Therefore, we include a dummy variable to capture the probability of having an unsecured loan change at or near the regulatory limit imposed on the maximum LTV of a mortgage of 85% and the DTI limit of 5.

During winzorising, to remove outliers due to mistyping or any special events such as temporarily high loans, we set the DTI threshold at 10 and the LTV at 95%.

Furthermore, to rule out the effect of individual characteristics, we control for marital status, age, gender, and economic sector (i.e., whether the customer is self-employed, an employee, or a retiree). We also test whether the household size and the number of children affected the results. We acknowledge that adding those factors to our model does not fully control the applicants' attributes.

We further supplemented our analysis with data on the rejection rate for refinancing unsecured debt in mortgages. In Table 4, we summarize the share of rejected loan applicants with or without current unsecured loans. This dataset is from a small national bank ($N = 5,149$) and was recorded between 2014 and 2019. We observe that the share of rejected applicants with unsecured debt increased at a significantly higher rate than for loan applicants without unsecured loans.

Tables 6a and 6c in the Appendix presents the summary statistics for the administrative data used in this paper.

4. Methodology

A dominant share of the population uses savings or monthly income to finance the purchase of consumer goods. However, we used three different approaches to study the characteristics of those choosing unsecured loans to fund their consumption and financial position. The first approach uses survey data, while the second approach employs a combination of administrative and loan application data. One way to obtain information about individuals' funding choices would have been to ask about their preferred method for funding their consumption. However, for many, this would constitute a highly theoretical question and may have been impossible to answer. Therefore, we chose to ask the respondents if they have or have had unsecured loans—defined as interest-bearing credit card debt or unsecured loans. Under the second approach, we used administrative data to identify individuals with unsecured loans or credit card debt and supplemented these with administrative data on loan applications. The third approach is a study of how respondents' perception of their household economy differs depending on whether they use unsecured debt or have previous experience with refinancing.

4.1. Unsecured Debt Market Participation

As the second approach, we analyze survey data to explore which factors determine unsecured debt market participation following Del Rio and Young (2006). Let $y = 0$ represent the response "Have no unsecured loan" and $y = 1$ the response "Have unsecured loan or revolving credit card debt." In this case, a standard logistic distribution function finds that:

$$\log\left(\frac{y_i}{1 - y_i}\right) = \alpha + C_j\left[X_i\beta_j + Z_i\psi\right] + \epsilon_i \qquad (1)$$

where α is a constant and C_j is a vector of dummy variables, with j representing the country. Moreover, X_i is a vector of observed explanatory variables that might depend on the individual, while the associated parameter vector β and vector of control variables Z_i are not of particular interest in our analysis, with parameter vector ψ.

The elements of X_i are:

$$Xi = \begin{pmatrix} Age\_group \\ Male \\ Income\_level \\ Education\_level \\ Mortgage \end{pmatrix} \tag{2}$$

In our empirical specification, Z_i includes a set of control variables for marital status, the geographic region the client resides in, and the economic sector the client is employed in, while ϵ_i is an independent and identically distributed error term.

4.2. Unsecured Debt Market Participation at or near the LTV Limit on Mortgages

We employ unique administrative data from Norwegian mortgage loan customers in the third analysis. These data enable a detailed analysis of debt market participation at or near the regulatory LTV limit. Our analysis uses the following empirical model with unsecured debt market participation as a dependent variable, and available micro data on each mortgage client as independent variables:

$$\log\left(\frac{y_i}{1 - y_i}\right) = \alpha + C_j\left[X_i\beta_j + Z_i\psi\right] + \epsilon_i \tag{3}$$

where the elements of X_i are:

$$X_i = \begin{pmatrix} LTV \\ ltV85 \\ yearDiff \\ Mortgage \\ DTI \end{pmatrix} \tag{4}$$

LTV (i.e., the customer's current LTV) is calculated with a house value using (a) sales price, (b) an estimated value measure, or (c) estimated value from a real estate agent, depending on whether the house was bought when the customer acquired the loan. The estimated value comes from an automated value model developed by Eiendomsverdi. The performance of the model is high if the house is either in an area with frequent sales or has been sold recently.[4] Next, *Mortgage* is the total amount of the customers' current mortgage debt in NOK (approximately 1/10 EUR); *yearDiff* is the number of years since the customer acquired their first mortgage loan at their current bank; *Age* is the age of the customer (indexed to be 0 at the age of 18, which is the age of the youngest mortgage client); and *LTV* 85 is a dummy equal to 1 if the LTV ratio is close to the regulatory limit for issuing mortgage loans in Norway, which is 85%. We have included all loans between 78 and 85%. The lower bound of 78% is somewhat arbitrary but allows for natural down-payment and housing price growth for a loan granted at or near the 85% LTV, as continuous borrowing at the 85% LTV threshold is unrealistic. Our results are robust, even with minor adjustments to this threshold. To control for any non-linearity, we also include two models with a set of interaction variables. To address selection bias, which is always an issue when studying choice modeling, we study the factors that affect the likelihood of having an unsecured loan using different methods and data types. In this model, we use control variables to reduce selection bias. In our

empirical specification, Z_i includes a set of control variables for marital status, sex, geographic region the client resides in, and the economic sector the client is employed in, while ϵ_i is an independent and identically distributed error term.

The interaction between *Age* and *LTV* is introduced to capture the increased probability of a loan having a lower *LTV* as the customer gets older, has experienced more years of growth in housing prices, and has more time to pay down on the loan. The interaction between *LTV* 85 and variables *yearDiff* and *Mortgage* capture the increased probability of a loan having an LTV close to *LTV* 85 if a short time has passed since the mortgage loan was granted and there is an increased probability that a larger loan is at or near *LTV* 85.

This analysis does not consider the time dimension, which would help strengthen the identification of the factors explaining the likelihood of having unsecured loans.

4.3. Effect of Unsecured Debt and Refinancing Unsecured Debt on the Perception of the Households Economy

We aim to determine if unsecured debt market participation or previous refinancing of unsecured debt in a mortgage influence the perception of a household on its economy. Perceptions regarding the economic outlook are found to be relevant to decisions to take on new debt as described in the 2 section, and we employ the ordered variable *Perceived_Effect_on_household_economy* as a dependent variable in an ordered logit model when we analyze the effect of an exogenous shock to the economy. We apply the same independent variables, where X_i is the same vector of the explanatory variables as above, but also consider if the respondent has previously *Refinanced_Unsecured* in a mortgage. Between our two surveys, the world was affected by a global pandemic. For respondents in 2021, we separately questioned if the COVID-19 pandemic is perceived to influence the household's economy.

In our model, we control the interactions between the country and demographic variables such as education level, income level, gender, and age.

5. Results and Discussion

In this section, we initially examine the evolution of unsecured debt and housing prices. Further, we investigate differences between Denmark with a shorter period of growing housing prices after the 2008 financial crisis, and Norway and Sweden, with steady growth in housing prices through the crisis. We then demonstrate how the growth rate changes after imposing mortgage debt regu-lations. This section explains why we hypothesize differences in unsecured debt market participation in markets with and without LTV regulations. We then present selected differences in unsecured debt market participation between the analyzed countries from our surveys and the factors affecting the likelihood of either having or having had unsecured debt, thereby shedding light on our hypothesis that LTV regulations and the historical growth in housing prices in a country lead to differences in the factors that influence unsecured debt market participation. To further explore the use of debt for households at or near the LTV limits, we then employ microdata and administrative data to determine the customer and loan

attributes that influence the probability of having unsecured debt at an individual level. This is done to investigate the unsecured debt market participation as households' LTV increased to above the LTV threshold imposed in Sweden and Norway as housing prices and debt proliferated. Mortgage regulations can also influence the ability to refinance. We explore how mortgage regulations influence refinancing behaviors and changes in rejection rates on mortgage applications with refinancing as mortgage regulations tighten over time. In the final section, we investigate whether the previous refinancing of unsecured debt in a mortgage influences how a household perceives its economic outlook.

5.1. Differences in Housing Price Growth and Mortgage Regulations

Figure 2 illustrates that growth in housing prices and consumer debt have no clear pattern in Denmark, where housing prices fell due to the 2008 financial crisis and remained low. Conversely, we observe a simultaneous growth in Norway and Sweden's housing prices and consumer debt. We also observe increasing growth in unsecured debt after changes in mortgage debt and a decrease after the 2018 regulation on unsecured debt in Norway. These observations do not imply causality but warrant further analysis of the differences in the distribution of unsecured debt between households in the three countries.

The relationship between housing prices, total debt, and growth in housing prices should, all else being equal, increase homeowners' ability to access liquidity through a mortgage, thereby reducing the need to hold more costly unsecured debt. The higher use of unsecured debt in countries with prolonged growth in housing prices must be due to other mechanisms, increased mortgage cost, or reduced ease of attaining a mortgage. We assume that unsecured debt is more readily available for homeowners in Norway and Sweden. In such a scenario, this may be why refinancing a mortgage for consumption is less common in earlier research on Scandinavia than in other countries and why refinancing a mortgage to repay unsecured loans is more common (Li & Zhang, 2017). Unsecured borrowing can serve as an intermediary source to finance consumption, but the result is similar in countries where the direct refinancing of mortgages for consumption is more commonplace (Brown et al., 2015; Mian & Sufi, 2011).

5.2. Differences in Unsecured Debt Market Participation between Countries with and without LTV-Limits on Mortgage Lending

We model the probability of unsecured debt market participation using the logistic regression framework in Equation 1. This reveals a significant difference in homeowners' use of unsecured debt in the three countries, as illustrated in Table 2.

In Table 2, we find that as respondents got older, the log probability of unsecured debt market participation increased in Denmark and Sweden (Models *D1* and *S1*) . We further find that the coefficients maintain their signs and significance when tested for interactions and split between responses in 2019 and 2020. The size of the coefficients nearly doubled in magnitude when controlling for the fact that age interacts with the probability of having a mortgage (Models *D3* and *S3*) . However, in Norway, a higher age

Table 2. The log probability of having or having had unsecured debt in Denmark (D), Sweden (S) and Norway (N).

	(D1)	(D2)	(D3)	(S1)	(S2)	(S3)	(N1)	(N2)	(N3)
const	−0.3492	−0.4104*	−1.429***	−1.202***	−1.381***	−2.852***	0.3617*	0.1403	−0.1932
	(0.2277)	(0.2337)	(0.3665)	(0.2427)	(0.2477)	(0.4368)	(0.1852)	(0.1907)	(0.2704)
Age group	0.1824***	0.1834***	0.3696***	0.2277***	0.2393***	0.4604***	−0.1173***	−0.1094**	−0.02909
	(0.05164)	(0.05173)	(0.06350)	(0.05074)	(0.05123)	(0.06486)	(0.04188)	(0.04275)	(0.05402)
Male	0.3600***	0.3598***	0.3573***	0.4592***	0.4618***	0.4514***	0.3040***	0.3095***	0.3154***
	(0.09597)	(0.09603)	(0.09705)	(0.09569)	(0.09670)	(0.09839)	(0.07651)	(0.07737)	(0.07750)
Income group	0.1868***	0.1846***	0.4152***	0.09206***	0.08192**	0.1601	0.06990***	0.06323**	0.1278
	(0.03530)	(0.03536)	(0.1290)	(0.03442)	(0.03444)	(0.1383)	(0.02510)	(0.02533)	(0.09219)
Education	−0.2333***	−0.2296***	−0.05815	0.01033	−0.05499	0.2049	−0.2028***	−0.2002***	−0.1841**
	(0.07085)	(0.07092)	(0.1417)	(0.07643)	(0.07763)	(0.1628)	(0.05720)	(0.05760)	(0.09370)
Mortgage	0.2997	0.3061	0.870*	0.6769***	0.7319***	3.607***	0.5634***	0.6043***	1.473***
	(0.1928)	(0.1927)	(0.4560)	(0.1012)	(0.1026)	(0.4258)	(0.07767)	(0.07850)	(0.3056)
Income@Mortgage			−0.0328			−0.2259***			−0.06671
			(0.07254)			(0.07182)			(0.05018)
Age@Mortgage			−0.7001***			−0.7279***			−0.2348***
			(0.1208)			(0.1164)			(0.09011)
Income@Education			−0.08052			−0.1045*			−0.01373
			(0.05178)			(0.05526)			(0.03533)
Dummy2021		0.1086	0.09766		0.6373***	0.6603***		0.5770***	0.5780***
		(0.09476)	(0.09606)		(0.09904)	(0.09783)		(0.08126)	(0.08143)
n	1972	1972	1972	1938	1938	1938	2967	2967	2967
R\bar2	0.0359	0.0364	0.0517	0.0511	0.0674	0.0873	0.0250	0.0374	0.0397

a. Significance levels: *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.
b. R^2 is McFadden's pseudo R^2
c. The model explains a low proportion of variation
d. Standard errors in parenthesis

reduces the log probability of using unsecured debt slightly but significantly in Model *N1*. The significance and absolute value of the coefficient decline when we control whether the responses stem from 2019 or 2020 in Model *N2*. It is rendered insignificant when controlling for the interaction between age and having a mortgage (Model *N3*) . Less use of unsecured debt for older mortgage-holding households is consistent with the life cycle theory (Yilmazer & DeVaney, 2005), but also by the smaller need for unsecured debt caused by easier access to mortgage lending.

Men use unsecured debt to a greater extent in all three countries. The coefficients in the different model specifications range from 0.3040 (*0.07651*) to 0.4592 (*0.09569*) and are highly significant in all model specifications.

One notable observation is that increased income leads to a significantly higher probability of using unsecured debt in Denmark (Model *D1*) , and the coefficients more than double, as it becomes the single most important factor (0.4152 (*0.1290*) when controlling for the interaction terms in Model *D3*. In Sweden and Norway, we initially found a smaller but still highly significant increase in log probability when the income level increased (Models *S1* and *N1*) . This significant increase in the probability of having unsecured debt wVhen the income level increase is less prominent when controlling for the year of response (Models *S2* and *N2*) . Furthermore, the income effect in Sweden and Norway is insignificant when also controlling for the interaction terms (Models *S3* and *N3*) . An increase in the use of unsecured debt with higher income in Denmark is not in accordance with this higher income, leading to a lower need for credit, but is in accordance with income smoothing if the economic outlook in Denmark is especially favorable. Conversely, the economic outlook in Denmark after the 2008 financial crisis has remained less positive than in Norway and Sweden.

Thus, we find the expected similarities with respect to debt market participation decreasing with age and increasing with income in Denmark. However, in contrast to the findings of Del Rio and Young (2006), we find that participation in the unsecured debt market is not dependent on income level in Norway and Sweden but somewhat more dependent on having a mortgage. This lower importance of income is consistent with our hypothesis that steady housing prices can lead to a combination of more positive expectations and a higher willingness to supply unsecured debt to low-income households with home equity.

As income increases, both Del Rio and Young (2006) and our results from Denmark suggest significantly higher participation in the unsecured debt market. It is not intuitive that low income leads to low use of unsecured debt, but it is rational to limit the supply of unsecured debt to low-income households from a bank's perspective, as low-income households are more likely to default on debt. In contrast to these findings, the insignificant income effect in Norway and Sweden can be an effect of the difference in the supply of unsecured debt. From a lender's perspective, it is less risky to supply credit to households with a higher income. The fact that the use of unsecured credit is linked to higher income in Denmark can, thus, result from the higher relative supply of unsecured credit to high-income households in Denmark and the lower relative supply to other groups. This is in accordance with our hypothesis and demonstrates that factors influencing the probability of unsecured debt market participation in Denmark are in line with the findings of Del Rio and Young (2006) but markedly different in Norway and Sweden.

Participation in the unsecured debt market is also lower for respondents with low qualifications in all the three countries in our survey and the Del Rio and Young (2006) survey.

Positive expectations of financial situation also lead to greater use of unsecured debt. We investigate this to find a link between prior refinancing of unsecured debt in a mortgage and a more positive view of the household's economic outlook. A more positive view can increase the probability of a household taking on new unsecured debt after a successful refinancing of unsecured debt in a mortgage and expand on the Del Rio and Young (2006) findings.

From Table 2, having a mortgage increases the probability of using unsecured debt in Denmark, Sweden, and Norway (Models *D1*, *S1*, and *N1*). However, the coefficient is much lower and insignificant at the 10% level in Denmark (0.2997 (*0.1928*)) compared to those of Sweden (0.6769 (*0.1012*)) and Norway (0.5634 (*0.007767*)). Furthermore, when controlling for interactions, both coefficients increase, the relative importance of having a mortgage also increases, and the significance remains above the 1% level in Norway and Sweden. As illustrated in Figure 1, the real housing price growth in Denmark has stabilized in recent years and has even reached the pre-2008 levels. In a country with steadily growing housing prices and LTV regulations, having a mortgage or owning a home is a stronger signal of net wealth than in a country with limited growth in housing prices and no mortgage regulations. This can explain the increased effect of home-ownership and having a mortgage on unsecured debt market participation in Norway and Sweden from a lender's perspective, and why our findings from these countries differ from the results from Denmark and the earlier British study (Del Rio & Young, 2006).

We find a significant and sizable increase in the log probability of using unsecured credit in 2020 in Sweden and Norway. In these countries, having unsecured debt is less dependent on income, and more low-income homeowners hold unsecured debt. Low-income households have a higher demand for unsecured debt, but bank supply can limit access to such debt. A larger growth in housing prices can serve as an alternative source of liquidity for low-income homeowners, and their demand for unsecured debt in countries such as Norway and Sweden was not expected to be higher than in countries with lower growth in housing prices such as Denmark.

To explain why income matters less for the use of unsecured debt in Norway and Sweden, we can turn to the supply side, which presents a plausible explanation for why banks are more willing to supply unsecured debt to mortgage holders, as unsecured lenders can access excess value from the house in case of a default.

Still, providing unsecured debt to homeowners with limited liquidity can make sense to a financial institution. They have security in the equity part of the house value, which, according to regulations, a mortgage lender cannot use as collateral when refinancing. The access to collateral in case of default typically carries a lower risk than other unsecured debt based on the customer's ability and willingness to pay. Sizable net assets also contribute to the willingness to pay, as the homeowner stands to lose this net equity if an unsecured lender takes recourse against the net equity. However, the mechanisms we explore might increase the risk of regulations on mortgage lending, leading to a shortterm increase in the vulnerability of specific households.

Therefore, this difference supports our hypothesis that a prolonged growth in housing prices and economic outlook can incline banks to lend more than what can be supported by the incomes of their borrowers.

Table 3. Factors affecting the probability of having unsecured debt from micro-data.

	(1)	(2)	(3)	(4)	(5)
const	−2.598***	10.348	11.235	11.461	12.061
	(0.116)	(229.505)	(229.434)	(229.451)	(231.322)
LTV	3.077***	3.217***	1.681***	1.359***	1.291***
	(0.158)	(0.172)	(0.384)	(0.434)	(0.472)
Mortgage	−0.007	−0.013	−0.016	−0.027*	−0.024*
	(0.016)	(0.017)	(0.014)	(0.015)	(0.017)
LTI	0.002	0.007			0.004
	(0.015)	(0.016)			(0.015)
yearDiff	0.034**	0.031**	0.029**	0.023*	0.021*
	(0.013)	(0.014)	(0.014)	(0.014)	(0.011)
LTV85				−0.700***	−0.640***
				(0.266)	(0.199)
Age		0.005*	−0.023***	−0.025***	−0.021***
				(0.007)	(0.008)
yearDiff @ LTV85		(0.003)	(0.007)	0.206***	0.200**
				(0.075)	(0.099)
LTV @ Age			0.050***	0.055***	0.049***
			(0.011)	(0.012)	(0.011)
Mortgage @ LTV85				0.137***	0.110***
				(0.048)	(0.044)
sq_Age					−0,822*
					(0,581)
sq_DTI					−0,011*
					(0,007)
sq_LTV					0,908
					(0,918)
Marital status		✓	✓	✓	✓
Male	✓	✓	✓	✓	✓
Geographic region	✓	✓	✓	✓	✓
Economic sector	✓	✓	✓	✓	✓
n	7,041	7,041	7,041	7,041	7,041
Pseudo R^2	0.0981	0.1026	0.1063	0.1101	0.1204

a. Dependent variable: $y = 1$ if Unsecured debt > 0, else $y = 0$. The model is estimated using a logit model, $Pr(y = 1) = F(V(\gamma + \epsilon_i))$.
b. Significance levels: $^*p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.
c. Interactions terms noted with @.
d. Standard errors in parenthesis.
e. Economic sector is the sector the client is employed in i.e. Retired, Private sector, Student, Unemployed or Public sector.

5.3. Unsecured Debt Market Participation for Households at or near LTV Regulatory Limits on Mortgage Lending

We extended our analysis of household lending behaviors by analyzing two variables included in mortgage regulations, namely Loan-To-Value, LTV, and Debt-To-Income, DTI, from Table 1, and how the size of a mortgage loan and other descriptive variables influences the likelihood of having unsecured debt. We estimate Equation 3 using micro data on loan customers from a medium-sized bank in Norway.

The empirical results in Table 3 demonstrate that the likelihood of having an unsecured loan increases with LTV. The loan-to-income ratio does not affect the estimated relationship. The size of the client's mortgage loan is insignificant in the baseline model 2. It is also of interest to note that yearDiff is small but positive and significantly affects the probability of having an unsecured loan.

We expected this result as customers refinance existing unsecured loans into their mortgages.

We know from the data that younger customers have a higher LTV than older ones, which is not surprising from both a risk and a household perspective. Models *3* and *4* in Table 3 suggest that the interaction term is positive and it alone reduces the direct effect of LTV on unsecured loan. However, the introduction of an interaction term indicates that the likelihood of having unsecured debt is higher among older customers than among younger ones with the same LTV.

Model *4* illustrates a significant effect of adding an interaction term for LTV around the regulatory threshold (see section 4.2 for details about the threshold). This reveals that for households with low LTVs, it is those with smaller mortgage loans that have unsecured loans. This interaction is counter-intuitive at first. However, this is in line with what banks are experiencing. One reason for this might be that unsecured loans are far more easily accessible for households than increasing the existing mortgage loan, with many banks known for long response times when responding to customer requests. Thus, if one has a small mortgage loan, the debt servicing costs are low and all else given, the debt servicing cost makes up a smaller share of one's income than for customers with higher mortgage loans and makes one less price-sensitive to the higher interest rate on an unsecured loan.

A typical homeowner in a country can also become less price-sensitive to debt sources and prefer easy access to unsecured loans as a short-term solution before planned refinancing in a mortgage with a lower interest rate. An increase in housing prices also leads to a more positive economic outlook in a household, and over time, this increases the willingness to lend. We expect the willingness to lend unsecured to be connected to the overall willingness to take on debt and that other factors like higher mortgage price or limitations in DTI will be more pronounced for households as LTV increases. This hypothesis follows growing participation in the unsecured debt market as LTV increases. When the household refinances a mortgage, this refinancing is limited to the LTV threshold. Households with unsecured debt can therefore refinance all debt if their total debt is less than 85% of the value of their home. Close to the LTV threshold, we expect a more significant proportion of households refinancing as housing prices grow, maxing out the ability to refinance their mortgage, and when unsecured debt and mortgage debt combined exceed 85%, they no longer have the ability to refinance all debt in a mortgage. Another thing worth noting is that even though our data is cross-sectional, a significant proportion of households with a loan close to the LTV threshold indicate a tendency to max out the mortgage repeatedly as housing prices grow since we calculate LTV with updated real estate values, and the annual growth in housing prices in the data is approximately 10%.

In model *5* we introduce a control for the square of Age, DTI, and LTV to test if the findings are robust for the non-linearity of selected variables. We find a diminishing effect of Age and DTI as they increase but retain significance in the variables discussed in model *4*.

5.4. The Effect of Mortgage Regulations on the Rejection Rate on Applications to Refinance Unsecured Debt in a Mortgage

We then proceed with an analysis of households' ability to refinance unsecured debt in their mortgage after the implementation of mortgage regulations by employing bank microdata.
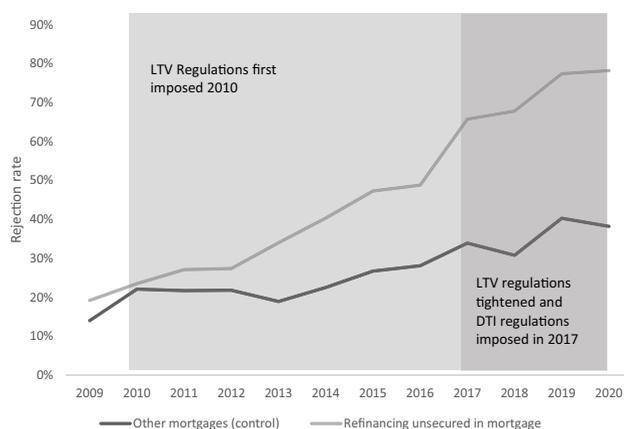
Figure 3. Rejection rate on refinancing applications and mortgages without refinancing of unsecured debt in Norway.
LTV Regulations From 2010, a LTV limit of 0.85 is imposed on mortgage debt
LTV and DTI regulations From 2017, LTV regulations were combined with DTI regulations.
Debt register of all unsecured debt introduced in 2019. Details on regulations are further described in Table 1

To study the ability to refinance unsecured debt, we segment mortgage refinancing applications into two. One where the applicant wants to refinance unsecured debt as part of the refinancing applications, and another segment where the refinancing is cash-out refinancing or refinancing to switch banks without increasing the mortgage amount.

The different mortgage regulations, the corresponding rejection rates on mortgage refinancing applications for applicants who seek to refinance unsecured debt as part of their refinancing, and other applicants are illustrated in Figure 3 and summarized in Table 4. The two breakpoints in 2010 and 2017 mark the implementation of the first LTV regulations in Norway and the following tightening of regulations with limits on DTI as detailed in Table 1.

We observe from Figure 3 that the difference between the rejection rate on loan applications to refinance unsecured debt and applications for mortgage refinancing without refinancing unsecured debt increased after mortgage regulations on LTV were first imposed in 2010 and further increased after mortgage regulations were tightened with regulations also on DTI in 2017.

In Table 4 we observe a large increase in the proportion of refinancing applications rejected when mortgage regulations tighten.

Further, the DTI and LTV on accepted applications fall as mortgage regulations tighten and include a DTI limit of 5 on mortgage loans from 2017. Most notably, the LTV on accepted loans falls from 0.85 *(0.12)* to 0.76 *(0.13)* as the DTI limit also becomes a binding restriction on refinancing. We further find that the amount of unsecured debt on applications increases steadily on accepted loans from 180,000 *(90,000)* to 290,000 *(120,000)* and rejected loans from 240,000 *(180,000)* to 440,000 *(230,000)*, indicating both an increase in unsecured debt for households seeking refinancing and an increasing difference in the unsecured debt for households where a refinancing application is accepted versus households where applications are rejected. Table 4 further

Table 4. Percentage of mortgage refinancing applications rejected in a Norwegian bank in selected time periods (N = 5,149 rejected loans).

	Rejected 2014-2016	Rejected 2017-2018	Rejected 2019
Mortgages without refinancing unsecured debt[a]	27.20 %	31.70 %	40.30 %
Refinancing unsecured debt in mortgage	46.40 %	66.80 %	77.40 %
LTV rejected	0.97 (0.2)	0.94 (0.3)	0.91 (0.4)
DTI rejected	5.7 (1.1)	5.5 (1.3)	5.4 (1.5)
Unsecured on rejected[b]	240 (180)	350 (120)	440 (230)
LTV accepted	0.85 (0.12)	0.78 (0.11)	0.76 (0.13)
DTI accepted	4.4 (1.3)	5.2 (0.6)	4.9 (0.5)
Unsecured on accepted	180 (90)	240 (150)	290 (120)
Credit score accepted[c]	635 (168)	645 (170)	648 (158)
Credit score rejected[c]	390 (198)	445 (213)	475 (231)

[a]Refinancing mortgages where applicants do not hold or refinance unsecured debt.
[b]Unsecured debt in thousand Norwegian krone, approximately 1/10 Euro.
[c] On a scale from 1-1000, where 1000 is perfect credit score.
[d]Standard errors in parenthesis.

demonstrates that deteriorations in applicants' credit scores do not explain the increase in rejection rates.

Most notably, Table 4 illustrates how the LTV on accepted loans fall from 0.85 (0.12) to 0.76 (0.13) as the DTI limit also becomes a binding restriction on refinancing. This is in line with a similar analysis by the Swedish Financial Supervisory Authority (Finansinspektionen, 2020) and indicates that refinancing unsecured debt in mortgages in both Norway and Sweden has become increasingly difficult. Mortgage holders with unsecured debt applying for refinancing can, on average, no longer use mortgage refinancing to relieve their debt servicing cost, regardless of the value of their assets, as their average debt level has reached the limit of debt-to-income as per Norwegian and Swedish regulations.

Unsecured debt with higher interest rates and lower duration carries higher risks, especially if house prices fall. If households build up unsecured debt with a plan to refinance and are no longer able to do so, this can lead to these households becoming financially vulnerable when refinancing a mortgage is no longer possible.

5.5. Changes in the Perception of Household Finances after Successful Refinancing of Unsecured Debt

Finally, we analyze the factors that determine a household's perception of its economic outlook to investigate possible enforcing effects that can influence refinancing and the use of unsecured debt. From Table 5, the households that have refinanced unsecured debt by refinancing their mortgage have a significantly more positive perception of their economic outlook than other households in all model specifications. Furthermore, after controlling for the differences between the countries, we find that unsecured debt contributes significantly to a negative perceived impact on a household's economic outlook.

From Table 5 we observe that males have a significantly more positive perception of the household's economic outlook, and this effect is significant after controlling for dummies and interactions.

Table 5. Factors contributing to a households perception of economic outlook; Ordered Logit estimates.

	(1)	(2)	(3)	(4)
Refinanced unsecured	0.611***	0.613***	1.580***	1.572***
	(0.161)	(0.161)	(0.382)	(0.384)
Unsecured	−0.284***	−0.283***	−0.275**	−0.277**
	(0.108)	(0.108)	(0.119)	(0.119)
Male	0.339***	0.339***	0.422***	0.426***
	(0.076)	(0.076)	(0.103)	(0.103)
Age group	−0.004*	−0.004*	−0.003	−0.004
	(0.002)	(0.002)	(0.003)	(0.003)
Income	0.186***	0.183***	0.209***	0.187***
	(0.027)	(0.028)	(0.040)	(0.062)
Education	0.172***	0.180***	0.166**	0.287**
	(0.058)	(0.059)	(0.076)	(0.121)
cut1	−0.696***	−0.743***	−0.753***	−0.550
	(0.194)	(0.197)	(0.248)	(0.347)
cut2	2.242***	2.196***	2.297***	2.501***
	(0.199)	(0.202)	(0.256)	(0.354)
COVID-19 influence on perception			✓	✓
Country dummies		✓	✓	✓
Demographic interactions			✓	✓
Homeownership differences				✓
Mortgage debt Interactions				✓
n	7,001	7,001	2,867	2,867
%correct	60.4	60.4	67.7	67.7

a. Dependent variable: My households economic outlook is; improving (1), stable (0), worsening (-1).
b. Refinanced Unsecured: Have the respondent previously refinanced unsecured debt by refinancing/increasing their mortgage.
c. COVID-19 influence on perception: Has the COVID-19 pandemic led your household to have more money to spend or less or has it not affected your household's finances?; more to spend (1), not affected (0), less to spend (-1).
e. Significance levels: *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.
f. Standard errors in parenthesis.

Table 5 also illustrates that a higher income bolsters such a positive outlook.

The strongly significant effect of education on a positive outlook is reduced to a 5% significance when controls and interactions are introduced in model 3.

The most significant interaction effect in the model in Table 5 is between mortgage debt and unsecured debt on the log probability of having a positive perception of the economic outlook of the household. The coefficient increase and the significance is retained when we control the household's perceived effect of the COVID-19 pandemic on the household's ability to spend money in models 3, 4, and 5.

Access to credit can increase a household's perception of wealth (Soman & Cheema, 2002), and it is plausible that experience from the previous refinancing of unsecured debt in mortgage debt can have a similar effect. The relief on liquidity by reducing cost, postponing amortization, and enabling new unsecured lending can affect a household's willingness to take on new unsecured debt. This willingness is also supported by the large proportion of households that take on new unsecured debt after refinancing a mortgage. The increased use of unsecured debt by homeowners can also increase, as the steady growth of housing prices and refinancing of unsecured debt in the mortgage make homeowners view unsecured debt as a short-term solution to a liquidity need. Homeowners then plan to refinance the costly debt in a mortgage after a short time, and the accessibility of unsecured debt outweighs the difference in cost between unsecured debt and mortgage debt. Our results demonstrate that households in

countries with the steepest growth in housing prices refinance unsecured debt in mortgages to a larger extent, but this does not lead to fewer of them having unsecured debt. This finding can be ascribed to the self-enforcing effect, where households increase unsecured borrowing based on the steady increase in the value of a mortgage holder's home as they continue to use unsecured debt to tap into the growing housing equity.

6. Conclusion

The difference in unsecured debt market participation between countries with and without LTV regulations holds after robustness tests, as does the effect of income on the probability of obtaining unsecured debt in countries with low housing price growth. The effect of income on unsecured debt market participation from Del Rio and Young (2006) is dominated by having a mortgage when we consider Sweden and Norway, where there is a steady growth in housing prices and LTV regulations are in effect. Conversely, we find that LTV regulations coincide with the growth in unsecured debt.

When exploring the mortgage–unsecured debt interaction for households at or close to regulatory limits on mortgage lending, we find that debt market participation increases with LTV. However, households at or near the LTV threshold in our data have significantly lower use of unsecured debt than the relationship between LTV and unsecured debt predicts.

This is consistent with the repeated refinancing of unsecured debt in mortgage debt. This lower increase in the use of unsecured debt close to the regulatory LTV threshold points to housing equity consumed, but readily available unsecured loans used as an intermediary before refinancing unsecured debt in a mortgage. Our hypothesis points to an overall less rational use of debt, with expensive debt being refinanced in cheaper mortgage debt as housing prices grow, as proposed by Li and Zhang (2017). In effect, the pattern of consumption financed by an increase in housing equity is more in line with the cash-out refinancing observed when housing prices increased in the UK and the US (Brown et al., 2015; Mian & Sufi, 2011). We further demonstrate a build-up of households with LTV close to the regulatory limit despite growing housing prices. These households refinance to an LTV of 0.85 as housing prices grow and as long as the bank and other limits do not restrict them.

The build-up of households at the LTV regulatory limit coincides with a gradual increase in the percentage of refinancing applications being declined.

We further find that having unsecured debt increases the probability of a negative perception of a household's economic outlook. Counter-intuitively, prior refinancing of unsecured debt leads to a positive perception of a household's economic outlook. We attribute this to these households feeling less reluctant and more able to access liquidity through both mortgage and unsecured debt. A more positive perception of a household's economic outlook can lead to an increased willingness of households to take on new debt and refinance again if they can do so within mortgage regulation limits.

The switch from cash-out mortgage lending to using unsecured lending as an intermediary comes at a price. A household switching its credit supply will pay a much higher interest and have a shorter amortization period. Demonstrating the link between the regulatory levels of maximum LTV on mortgages and the probability of having unsecured debt is one of the contributions of our analysis. To prevent a major increase in the supply of unsecured

debt and destabilizing households, we suggest regulating total debt and unsecured debt simultaneously and with the same rigor as regulations curbing growth in housing prices.

Our study faces limitations in our cross-sectional approach to debt market participation through surveys and our cross-sectional micro data on mortgage clients from a bank. We thus propose conducting surveys over longer periods and in multiple countries to further highlight how home prices and regulations influence the dynamics of using different sources of debt. This understanding is crucial for regulators and modeling consumption and financial distress.

We surmise that other countries might expect the same concentration effect on combined debt in certain households if house prices increase over an extended period, leading to an increase in the supply of unsecured debt. Earlier research points to the overall effectiveness of LTV regulations. Our findings point to a gradual build-up of households with debt levels close to the regulatory threshold and certain households continuously refinancing up to the regulatory thresholds of mortgage loans. These households, over time, have less ability to refinance unsecured debt on their mortgage, but despite this, seem to have an optimistic outlook on the economic outlook of their household. The combination of a positive perception of the economic outlook, dependence on refinancing unsecured debt in the mortgage, and gradually reduced ability to refinance makes them vulnerable to a shock when refinancing is no longer possible.

Notes

1. We define unsecured credit as interest-bearing credit card debt and unsecured loans.
2. The limit imposed by mortgage regulations on LTV in Norway and Sweden is 0.85. LTV regulations and other limits on mortgage lending may differ for other countries. In Sweden and Norway, they are followed by reporting criteria and have a very limited ability to deviate on individual loans.
3. As the original questionnaire was in the local language, an English translation was prepared for this paper and is attached in Appendix Table 8
4. A brief explanation of the proprietary automated value model can be found here: https://spabol.sparebank1.no/articles/eiendomsverdi-automated-valuation-company-for-residential-real-estate.

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Appendix

Table 6. Overview of data.
(a) Summary statistics micro data from bank ($N = 7, 041$)

Statistic	Mean	St. Dev.	Min	Max
LTV	0.520	0.212	0.000	0.950
Mortgage (mill. NOK)	2,598	2,072	−0,028	31,252
yearDiff	3.530	2.180	1	19
unsecDebt	0.308	0.462	0	1
Age	49.546	13.131	18	99
DTI	4.333	2.405	0.000	10.000
Male	0.648	0.348	0	1
LTV85	0.111	0.314	0	1
Unsecured debt (NOK)	64,670	218,491	22,950	5,741,009

(b) Summary Statistics, categorical variables using the observations ($N = 7, 033$)

Statistic	Mean	St. Dev.	Min	Max
Male	0.503	0.500	0.000	1.00
Age	46.4	16.7	18.0a	80.0
Age group	2.97	0.911	1.00	4.00
Income level[b]	2.60	1.53	0.000	5.00
Education level[c]	2.36	0.672	0.000	3.00
Have unsecured now	0.356	0.479	0.000	1.00
Had unsecured	0.209	0.406	0.000	1.00
Have or have had unsecured	0.564	0.496	0.000	1.00
Refinanced in mortgage[d]	0.165	0.372	0.000	1.00
Have mortgage	0.455	0.498	0.000	1.00
Perception economic outlook	0.270	0.642	−1.00	1.00
Effect of COVID-19 on household	−0.0433	0.628	−1.00	1.00

a. Minimum age to respond to survey and minimum legal age to borrow. Grouped in four groups of 20 years in Age group.
b. Income level within country grouped in five 20 percentiles.
c. Education grouped in non-secondary (0), post-secondary (1), tertiary education/bachelor (2), master or above (3).
d. Previously refinanced unsecured debt in mortgage debt.

(c) Summary statistics mortgage loan applications refinancing unsecured ($N = 5,149$)

	Rejected 2014-2016	Rejected 2017-2018	Rejected 2019
LTV rejected	0.97 (0.2)	0.94 (0.3)	0.91 (0.4)
DTI rejected	5.7 (1.1)	5.5 (1.3)	5.4 (1.5)
Unsecured on rejected (tnok)	240 (180)	350 (120)	440 (230)
LTV accepted	0.85 (0.12)	0.78 (0.11)	0.76 (0.13)
DTI accepted	4.4 (1.3)	5.2 (0.6)	4.9 (0.5)
Unsecured on accepted (tnok)	180 (90)	240 (150)	290 (120)

aStandard errors in parenthesis.

Table 7. Survey respondents by age group, country and income.

Income group							
	0	1	2	3	4	5	Total
Sweden	219	136	498	540	340	277	2010
18-22	29	31	38	30	15	10	153
23-35	47	52	119	140	69	60	487
36-55	66	36	142	190	140	140	714
56-80	77	17	199	180	116	67	656
Denmark	260	105	450	694	249	254	2012
18-22	28	39	32	23	7	15	140
23-35	37	42	101	147	52	46	425
36-55	75	14	138	265	113	131	736
56-80	120	10	179	259	77	62	707
Norway	538	358	601	712	411	405	3011
18-22	71	69	29	20	19	21	229
23-35	112	97	130	149	82	82	652
36-55	177	126	243	289	178	199	1212
56-80	178	66	199	254	132	89	918
Sum	1,017	599	1,549	1,946	1,000	922	7,033
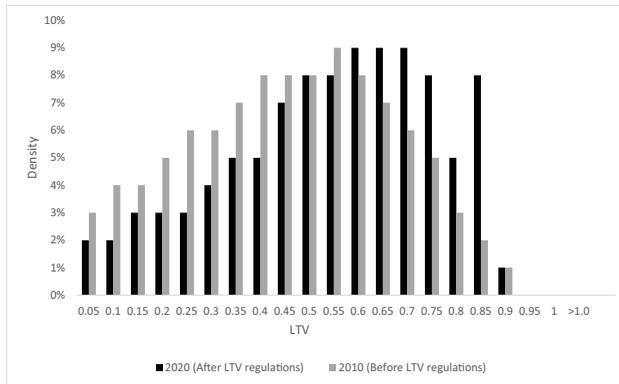
Figure 4. Distribution of mortgage clients in a bank by Loan to Value.
LTV Regulations From 2010, a LTV limit of 0.85 has been imposed on mortgage debt. The table illustrates the distribution of mortgage clients by LTV prior to regulations and after ten years of regulations on LTV and subsequent tightening of regulations in 2017 when LTV regulations were combined with DTI regulations.

Table 8. Survey Questionnaire.

Do you have a consumer loan or credit card debt for which you pay interest?
Yes—GO TO Q3 No—GO TO Q2
Have you previously had consumer debt that is now fully repaid? Have you ever accumulated consumer loans or credit card debt in new consumer loans?
Do you have a mortgage?
IF YES:
Have you repaid a credit card, unsecured debt, or major bills by borrowing on your home?
Do you think you would be able to increase your mortgage if you had a loan need?
In 2021:
Has the COVID-19 pandemic caused you to change your consumer debt?
Yes, consumer debt has reduced a lot.
Yes, consumer debt has reduced somewhat. No, consumer debt has remained unchanged. Yes, consumer debt has increased somewhat. Yes, consumer debt has increased a lot.
Has the COVID-19 pandemic caused you to change your mortgage?
Yes, housing debt has reduced a lot.
Yes, housing debt has reduced somewhat. No, housing debt has remained unchanged. Yes, housing debt has increased somewhat. Yes, housing debt has increased a lot.
Has the COVID-19 pandemic led to you save more or less, or has it not affected your savings?
I have saved more.
It has not affected my savings. I have saved less.
Has the COVID-19 pandemic led your household to have more money to spend or less, or has it not affected your household's finances?
I have more money to spend.
It has not affected my household finances. I have less money to spend.