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# Describing Interest-Only Mortgage Borrowers' Savings and Spending using Danish Register Data

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Interest-only mortgages (IOMs) were popular before the 2007-2008 financial crisis, e.g. in the US and UK, and remain common in a few countries today, including the Netherlands, Sweden and Denmark. We use Danish administrative data, covering all mortgage loans originated between 2010 and 2019, to compare savings and spending of IOM borrowers to that of non-IOM borrowers using their mortgage origination year in an event study design. Conditional on time and individual fixed effects, we show that homeowners aged 50 and above increased spending in connection with taking out an IOM, while homeowners below this age predominantly accelerated non-mortgage debt repayments.

## Keywords

Home financing | Banking and mortgage credit | Consumption | Savings

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**Abstract**

Interest-only mortgages (IOMs) were popular before the 2007-2008 financial crisis, e.g. in the US and UK, and remain common in a few countries today, including the Netherlands, Sweden and Denmark. We use Danish administrative data, covering all mortgage loans originated between 2010 and 2019, to compare savings and spending of IOM borrowers to that of non-IOM borrowers using their mortgage origination year in an event study design. Conditional on time and individual fixed effects, we show that homeowners aged 50 and above increased spending in connection with taking out an IOM, while homeowners below this age predominantly accelerated non-mortgage debt repayments.

**Keywords:** Mortgage; interest-only; deferred amortisation; savings behaviour
**JEL Classification:** G51; D14

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# 1 Introduction

Interest-only mortgages (IOMs) were popular before the financial crisis in 2007-2008, e.g. in the US and UK.[1] Today, IOMs remain popular in the Netherlands, Sweden and Denmark. In fact, the IOM share has been increasing in Denmark since 2020, and by the end of 2022, IOMs made up half of all mortgage loans in Denmark. Understanding how these loans affect savings and spending behaviour in households is important for policymakers and lenders in order to assess potential risks to macroeconomic volatility and financial stability pertaining to deferred amortisation.

The key feature of IOMs is that homeowners can free up liquidity today and defer mortgage amortisation for a number of years. The question is how homeowners use this liquidity. Is it used to smooth consumption, is it placed in savings accounts as a precaution to buffer against future shocks? Or is it used to optimise savings portfolios, e.g. by accelerating repayments on other, more expensive debt or by investing in other asset classes?

This paper uses loan level data covering all mortgages originated in Denmark between 2010 and 2019. We link the information to individual level panel data on income and wealth as well as individual characteristics based on Danish administrative registers from 2002 to 2021. This allows us to study savings and spending patterns of borrowers up to eight years before and after taking out a new mortgage. By normalising the origination year of all mortgage loans, we construct a simple event study design that allows us to compare behaviour of homeowners who take out an IOM to homeowners who take out a traditional mortgage with amortisation, which we will refer to as a non-IOM, within the same calendar year.

Although IOM and non-IOM borrowers have almost similar pre-trends in savings outcomes, and despite that we control for individual fixed-effects, we cannot reject that some unobserved factors drive certain homeowners into selecting IOMs. We cannot fully account for this type of selection bias in our setup which is also why we remain cautious in interpreting our findings as causal. Nonetheless, our paper sheds new light on how savings and spending behaviour actually have changed for homeowners who deferred mortgage repayments.

[1] See Demyanyk and Van Hemert (2009), Case and Shiller (2009) and Amromin (2018) for the prevalence of interest-only mortgages in the US. The proportion of interest-only mortgages to total mortgages in the UK had increased from 28% to 38% between 2000 and 2008, with a peak of 43% in 2007. After the crisis, lenders tightened their lending standards and interest-only mortgages became less prevalent (Authority, 2013).

Our results point to age and leverage ratios as being two strong predictors of how individual savings and consumption behaviour change in connection with taking out an IOM. While spending increased substantially for older homeowners, younger homeowners predominantly started to accelerate repayments of non-mortgage debt, that is debt in commercial banks, covering consumer credit, car loans, as well as loans in non-mortgage banks with property serving as collateral. In addition, liquid savings started to rise for younger borrowers after taking out an IOM.

An important leverage threshold in Denmark seems to be the 60% Loan-to-Value (LTV) threshold. While marginal propensities to consume (MPCs) out of deferred mortgage repayments tend to be larger for LTVs below this 60% threshold, we find limited spending response above the threshold. Usually, and in accordance with a standard lifecycle framework, we expect that the most indebted households have higher MPCs, but the pattern that we observe is likely caused by regulation and lending policies that effectively increase IOM borrowing costs relative to that of non-IOMs above this 60% LTV cutoff.

We estimate MPCs of 40–64% for homeowners who are older than 50 and 0–17% for homeowners younger than 50. The younger age group predominantly accelerated repayments of non-mortgage debt after taking out an IOM compared to their peers who took out a non-IOM. Interestingly, however, we find no clear evidence that the accelerated pace of non-mortgage debt repayments reduced total borrowing cost for IOM borrowers. Non-mortgage debt typically carries higher interest rates than mortgage debt, so substituting for mortgage debt could reduce overall interest payments. However, IOMs come with an additional administration cost and this may very well exceed the money saved by paying off non-mortgage debt at a faster pace.

Apart from quantifying the savings and spending behaviour of IOM borrowers, we also observe borrower characteristics before and after the year of mortgage origination. Two important takeaways stand out. Firstly, disposable income growth is higher for home buyers opting for IOMs compared to home buyers who opted for non-IOMs. We rationalise this by anticipating that these borrowers wish to smooth consumption intertemporally using deferred amortisation on their mortgage. Secondly, delinquency ratios tend to increase more for IOM than non-IOM borrowers after mortgage origination. This is particularly clear for refinancers—and even more so for highly leveraged refinancers. Both findings underpin that there might be important selection into type of mortgage loan, i.e, households expecting rising incomes may be more likely to opt for IOM and more risk-loving borrowers may also be more likely to opt for IOMs.

The next section provides a short overview of related literature and section 3 explains the Danish mortgage system. Then we turn to presenting our data set in section 4 and empirical model to estimate marginal propensities to consume in section 5. Sections 6, 7 and 8 examine borrowing cost, borrower characteristics and indebtedness of homeowners, while section 9 concludes the paper.

# 2 Existing Literature

The theoretical literature shows that IOMs could enhance life-cycle consumption smoothing.[2] Identifying such effects empirically are challenging though. First, because access to loan level data and savings and spending information of borrowers are not easily available, not least in a panel data setting. Second, because savings and spending decisions are affected by a range of circumstances and preferences. Being able to isolate the effect of deferred mortgage repayments from other factors is challenging. Few studies have made important contributions to this issue. Cocco (2013) showed that UK homeowners who expected rising incomes were more likely to take out a mortgage with lower initial payments, such as IOMs. Their work also points to the borrowers using these non-standard mortgages as an opportunity to diversify savings by investing more in equities, and to buy a larger home initially and thereby having to move less frequently.[3]

Bernstein and Koudijs (forthcoming) have recently used Dutch data and a policy reform that increased amortisation requirements on new house purchases to document that net savings remained unaffected when mortgage repayments increased. Home buyers would rather reduce spending or leisure to finance mortgage repayments than draw down savings. The nature of the study does not, however, allow the authors to test if these results also hold when amortisation requirements are relaxed rather than tightened. Work by Larsen et al. (forthcoming) indicates, however, that there is a spending effect when relaxing amortisation requirements. Using Danish administrative data they show that spending growth increased for older borrowers when IOMs were introduced in Denmark in 2003.

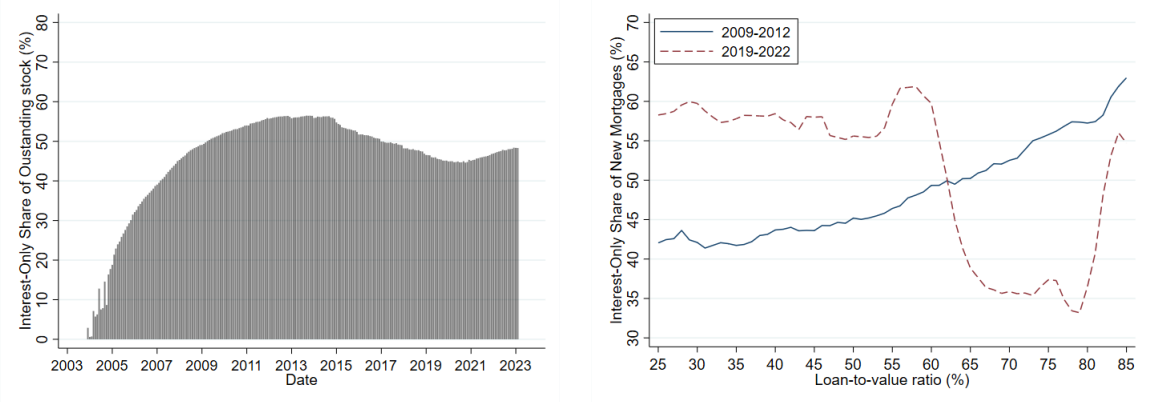
[2]See e.g. Cocco (2004), Gomes and Cocco (2012) and Amromin and Paulsen (2011).

[3]This latter finding was supported by the work of Amromin (2018) based on US data who documented that high income borrowers used such mortgage types to purchase even more expensive properties. In this context, Bäckman and Lutz (2020) showed that although transactions and housing turnovers increased when introducing IOMs in Denmark, affordability was unchanged, indicating that house prices also increased.

The literature holds few empirical studies that, to our best knowledge, are able to identify the effect of IOMs on households' behaviour. The contribution of our paper is descriptive by nature but it could lay the grounds for further analysis using the Danish administrative data. For the same reasons our estimates should be used with caution as future research may be able to fully overcome challenges with selection bias.

# 3 The Danish Mortgage System

IOMs were introduced in Denmark in October 2003 and six years later they made up more than half of the outstanding mortgage stock. The left panel in Figure 1 shows this. Ten years later, the deferred amortisation period came to an end for the first IOMs issued. This coincided with renewed attention towards which types of households were offered IOMs as new regulation put forward in 2013–2014 set out to limit IOM lending. The regulation effectively made lenders direct IOMs towards their more creditworthy customers.[4] For instance, lenders started to charge an additional fee when issuing IOMs to highly indebted borrowers, particularly borrowers with loan-to-value (LTV) ratios above 60%.




(a) Outstanding Mortgages

(b) New Mortgages

Figure 1: Interest-Only Mortgage Share

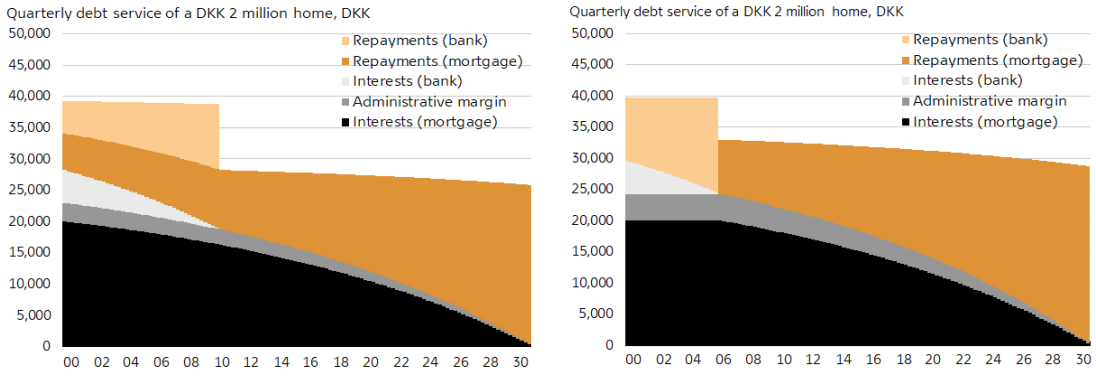
The right panel in Figure 1 shows the IOM share of new mortgages issued. The solid line is the earliest data available, 2009–2012, while the dashed line is 2019–2022. Both lines are shown across LTV ratios. During the earliest years, the IOM share was monotonically increasing in LTVs but in recent years, the IOM share is substantially

[4]See more details in Andersen et al. (2021).

higher for LTV ratios below 60%. Above this point, the IOM share of new mortgages drops significantly. This indicates that the regulatory changes in 2013–2014 have to a large extent targeted new lending with deferred amortisation to the less indebted borrowers.

The IOM share remains high for LTV ratios at 80–85%. Households can fund properties with mortgage debt up to maximum 80% of the property value. 15% can be financed in non-mortgage banks, while the remaining 5% are down payments. The spike at 80–85% in Figure 1 covers borrowers with the maximum leverage in mortgage banks, e.g., first-time buyers.[5]

Mortgage debt has the first order of priority, which is why debt in non-mortgage banks typically carries higher interest rates than debt in mortgage banks. Borrowers may opt for IOMs to accelerate repayments on non-mortgage debt. Figure 2 exemplifies this by showing annuity payments of a DKK 2 million home purchase, about the average home price for single-family homes in Denmark. The y-axis shows quarterly debt servicing cost, covering interest payments, administrative margins charged by the mortgage bank and debt repayments. The left panel of Figure 2 shows annuity payments using a standard amortising mortgage as well as a 10 year supplementary bank loan.




(a) Standard Amortising Mortgage (b) Interest-only Mortgage

Figure 2: Illustration of the difference in 30-year annuities between standard amortising and interest-only mortgages, conditional on almost similar payments in year 1

[5]Transaction costs in connection with taking out a new mortgage typically amount to up to 5% of the mortgage. These cost can be financed by the mortgage itself, which explains why the LTV ratio exceeds the otherwise stated maximum LTV ratio of 80%.

The right panel of Figure 2 shows annuity payments using an IOM. Here, mortgage repayments are deferred for six years and the proceeds from doing so are used to make extraordinary payments on the bank loan. In other words, the IOM is used to amortise the bank loan in six rather than 10 years. Payments in the first year are almost identical in both panels, meaning that both mortgage types take up the same share of the borrowers' budget when they take out the loans. By calculating the net present value of total borrowing cost in each panel, we know that the IOM option is in fact more expensive. As we will show in section 6, this is predominantly because of the fact that the administrative margin is substantially higher for IOMs compared to standard amortising mortgages.

# 4 Data

We use Danish mortgage data, containing detailed information on all outstanding mortgages in Denmark by the end of each year during 2009–2019. The information is reported at the loan level by mortgage banks to Danmarks Nationalbank and covers, e.g. origination date and amortisation profile, which will be key variables used in this study. Unique personal identifiers enable us to merge the mortgage data to several administrative registers from Statistics Denmark. These registers cover borrower characteristics, income and wealth. We impute spending according to Browning and Leth-Petersen (2003), such that we take disposable income and subtract the change in annual net savings including pension contributions.

Our data are restricted to include new mortgages originated in the period 2010–2019. We classify each borrower within each calendar year into two groups, based on whether or not the new mortgage is an IOM. Throughout the paper, we refer to these two groups as IOM and non-IOM borrowers, respectively. Individuals who take up both types of mortgages are classified as IOM borrowers. We also split our sample between individuals who buy new property at the time of loan origination (home buyer) and individuals who take up a new loan to refinance an existing mortgage (refinancer).

Since we focus on differences in behaviour between IOM and non-IOM borrowers in the years after taking up the loan, we drop individuals who already have an IOM in the year before taking up the new loan. Also, as two final sample restrictions, we exclude self-employed borrowers because we are not able to distinguish their personal income

from their business income, and we exclude individuals who buy or sell property again within the eight years that follow the year of mortgage origination.

Table 1: Summary Statistics

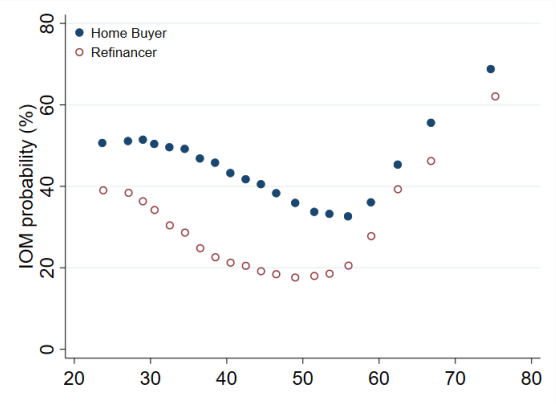
| | Home Buyer | | | | Refinancer | | | |
|---|---|---|---|---|---|---|---|---|
| | IOM | | Non-IOM | | IOM | | Non-IOM | |
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Disposable income (DKK 1,000) | 234 | 91 | 245 | 97 | 248 | 99 | 265 | 92 |
| Mortgage debt (DKK 1,000) | 52 | 200 | 67 | 217 | 396 | 385 | 507 | 345 |
| Bank debt (DKK 1,000) | 114 | 185 | 85 | 164 | 224 | 279 | 133 | 194 |
| Liquid wealth (DKK 1,000) | 122 | 207 | 182 | 254 | 154 | 241 | 129 | 193 |
| Pension wealth (DKK 1,000) | 172 | 308 | 193 | 313 | 580 | 562 | 516 | 469 |
| Age | 35.6 | 11.4 | 36.9 | 11.0 | 53.4 | 15.1 | 48.8 | 11.2 |
| Age>65 (%) | 3.2 | 17.6 | 1.6 | 12.6 | 24.0 | 42.7 | 7.6 | 26.4 |
| Already homeowner (%) | 20.5 | 40.4 | 23.2 | 42.2 | 100.0 | 0.0 | 100.0 | 0.0 |
| Low cash-on-hand (%) | 23.3 | 42.3 | 17.6 | 38.1 | 30.5 | 46.0 | 27.8 | 44.8 |
| Delinquency ratio (%) | 4.3 | 20.4 | 5.6 | 22.9 | 1.2 | 11.0 | 1.1 | 10.6 |
| N | 114,617 | | 128,546 | | 105,926 | | 267,403 | |

Table 1 shows end-of-year summary statistics for the sample, measured the year before mortgage origination. While there are large differences between home buyers and refinancers, e.g. in age, wealth and debt, there are fewer pronounced differences between IOM and non-IOM borrowers within these two segments. However, for both home buyers and refinancers, the share of borrowers with low cash-on-hand, measured by having less than one month's worth of income in their savings accounts, is higher for IOM than for non-IOM borrowers.

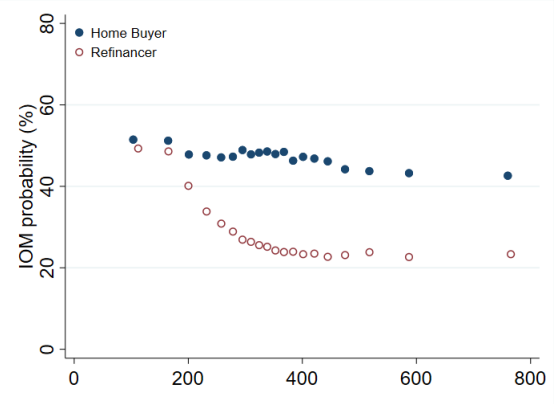
## 4.1 Interest-Only Mortgage Borrower Characteristics

Figure 3 shows the probabilities of taking out an IOM as a function of three borrower characteristics, all measured at the end of the year before they take out a new mortgage.

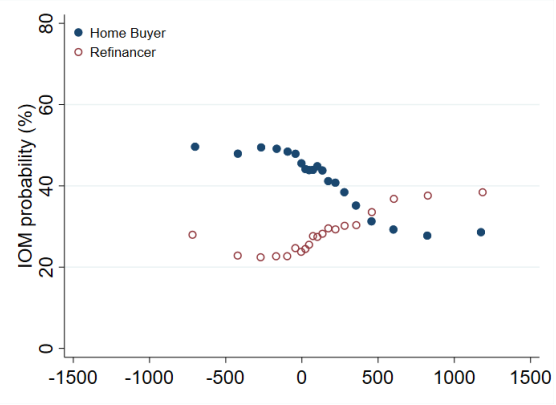
The probability of taking out an IOM is u-shaped across age. This is true for both home buyers and refinancers, although the IOM probability is generally higher for home buyers. The IOM probability is similar for home buyers and refinancers in the lowest income segments, around 50%. However for increasing incomes, the IOM probability declines to 40% for home buyers in the highest income segments, while the IOM probability drops to 20% for refinancers in the highest income groups. Finally, looking at net financial assets, we see a high probability of taking out an IOM for home buyers when net financial assets are low, or even negative, meaning that borrowers




(a) Age




(b) Income (DKK 1,000)




(c) Net assets (DKK 1,000)

Figure 3: Interest-only mortgage (IOM) probability across borrower characteristics

in these bins had more debt than financial assets before taking out the loan. The exact opposite pattern is seen for refinancers, where the probability of taking out an IOM increases in net financial assets for positive values of net assets.

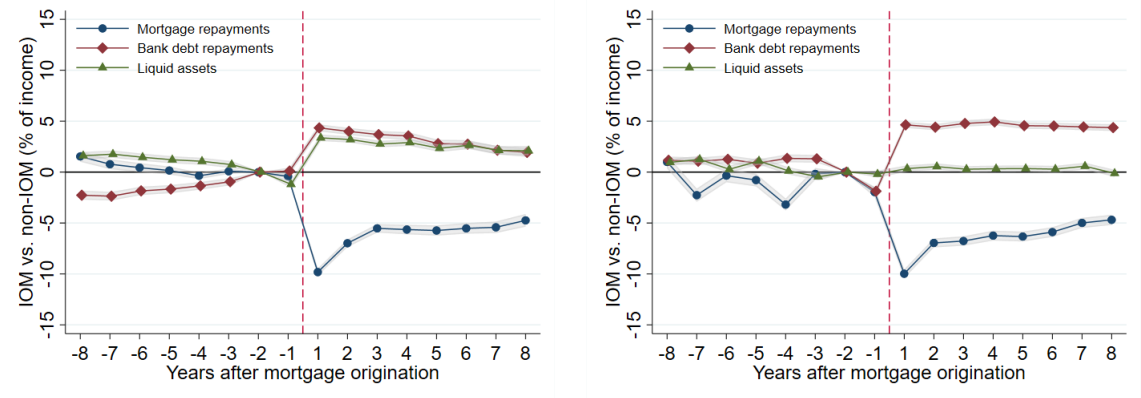
# 5 Empirical Model

We use an event study design to quantify changes in savings and spending of each borrower after taking out a new loan. By normalising the origination year to zero for each mortgage loan taken out during the period 2010 to 2019, we can compare outcomes of borrowers with IOMs to that of borrowers with non-IOMs before and after the time of origination. The difference in behaviour is formalised in a differences-in-differences

regression model.

$$y_{i,t} = \alpha + \beta_1^t etime_t + \beta_2 IOM_i + \beta_3^t etime_t \times IOM_i + \omega_i + \lambda_t + \eta_m + \varepsilon_{i,t}, \quad (1)$$

where $y_{i,t}$ is either mortgage repayments, non-mortgage debt repayments, or savings in liquid assets for borrower $i$ in year $t$, where $t = 0$ is the mortgage origination year. On the right-hand side, $etime_t$ is an integer counting the years after mortgage origination, $IOM_i$ is a dummy variable that takes the value 1 if the mortgage taken out has deferred amortisation, otherwise zero. Also, we include individual fixed effects to account for variation between individuals in savings preferences which is likely to be constant for each saver across time. Year fixed effects account for macroeconomic developments that affect all savers equally but accounts for the fact that macroeconomic conditions and outlook for mortgages taken out in one calendar year may be different from a mortgage taken out in another calendar year. We also include municipality fixed effects to control for the fact that property markets and labour markets are likely to vary geographically, e.g. as house price expectations and job opportunities may be more favourable in more populated areas, which could affect the savings and spending decisions of borrowers.




(a) Home Buyer

(b) Refinancer

Figure 4: Liquid assets and debt repayments

Figure 4 shows the difference between IOM and non-IOM borrowers in each mentioned outcome variable, by plotting the $\beta_3^t$ coefficients from Equation 1. The y-axis shows the change in mortgage debt repayments (blue line), bank debt repayments (red line) and liquid assets (green line), normalised by lagged disposable income.[6] The

[6]In practice, the blue and red line are first differences in mortgage debt and bank debt, respectively, which have been multiplied by -1. This makes interpretation of the figure easier. However, it's important to clarify that any increase in debt is also captured by the two measures.

x-axis counts 1, 2, ... years after taking out a new mortgage, while negative numbers count the years before mortgage origination in a similar fashion.[7] Panel (a) includes all home buyers and panel (b) covers all mortgage refinancers in our data.

The first observation to take note of is that mortgage repayments drop substantially when taking out an IOM compared to taking out a non-IOM. This can be thought of as a first stage in our empirical design, which effectively quantifies the size of deferred mortgage repayments. Bank debt repayments, on the other hand, increase after mortgage origination. This indicates that IOM borrowers tend to accelerate repayments on bank debt after taking out the mortgage. The intuition behind this pattern is that IOM borrowers could substitute repayments on mortgage debt for repayments on non-mortgage debt using the interest-only feature on their mortgage. These developments are evident in both panel (a) and (b), meaning that substitution takes place both in the case of a home purchase and mortgage refinancing. Finally, home buyers increase savings in liquid assets more when their mortgage has deferred amortisation. In other words, IOM borrowers may build liquid buffers out of deferred mortgage repayments. The difference in savings through liquid assets is close to zero for refinancers, on average.[8]

We turn to an almost identical model specification to examine the age dynamics of the savings pattern observed above.

$$y_{i,t} = \alpha + \beta_1 POST_t + \beta_2 IOM_i + \beta_3 POST_t \times IOM_i + \omega_i + \lambda_t + \eta_m + \varepsilon_{i,t}, \qquad (2)$$

where the only change is that $etime_t$ has been replaced by $POST_t$. This new explanatory variable takes the value 1 in years after mortgage origination, that is when $etime_t > 0$, otherwise zero. By doing this, $\beta_3$ captures the average change in the dependent variable, measured over all the years after mortgage origination compared to all years before mortgage origination. We follow borrowers until 2021 which means that for mortgages taken up after 2013, we measure the average effect for a shorter period than eight years.[9]

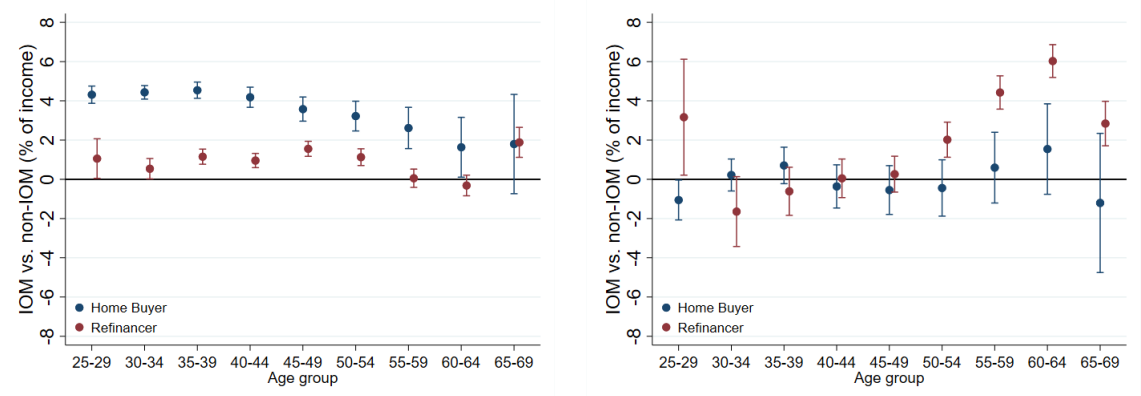
Next, we divide all borrowers in five-year age bins and regress equation 2 within

[7] We drop $t = 0$ because savings outcomes change substantially in the year that the mortgage is taken out, particularly for home buyers. This is for example because home buyers might have capital gains from other house transactions. We have also tried to drop one additional year on each side of $t = 0$, which has no implications for our results (not reported).

[8] By collapsing the data to household level, rather than the individual level, we find similar movements in outcomes. These are shown in the appendix Figures 10.

[9] The average number of years after mortgage origination in our sample is six years.

each bin. Figure 5 presents the $\beta_3$ coefficients. Panel (a) shows that liquid assets increased by about 4% of income for younger home buyers and about 2% of income for older borrowers. Similar patterns are observed for refinancers, although younger refinancers tend to increase liquid assets by about 1% of income and no statistically significant effect for older refinancers—except from the oldest group above age 65.




(a) Liquid assets

(b) Spending

Figure 5: Differences across age between IOM and non-IOM borrowers

In a similar fashion, we estimate and plot changes in spending within each age bin, shown in Figure 5, panel (b). Spending increased for borrowers older than 50, although only statistically significant for refinancers. Borrowers younger than 50 tend to not change spending when they take out IOMs vis-á-vis non-IOM borrowers. One exception is the youngest age group in which refinancers did in fact increase spending. The 95% error bars are, however, quite wide for this age group, reflecting that there are only few refinancers in this age bin. The next section refines our empirical model in order to test substitution effects directly in the data and to take into account other characteristics of the borrowers, i.e., their leverage ratios.

## 5.1 Estimating substitution of savings and consumption

In this section we set up a two-stage-least-squares regression model to estimate the marginal propensity to consume (MPC) out of deferred amortisation. Spending decisions are likely endogenous to changes in mortgage debt, e.g. if borrowers reduce spending because they want to increase mortgage repayments. Homeowners could also choose to do an extraordinary high or low mortgage debt repayment in one year which is not directly connected to their spending decision, e.g. because of an unexpected

income shock. The 2SLS model estimates changes in spending that pertain directly to the deferred amortisation feature. The model is specified as

$$y_{i,t} = \alpha + \beta_1 POST_t + \beta_2 IOM_i + \beta_3 \hat{z}_{i,t} + \omega_i + \lambda_t + \eta_m + \varepsilon_{i,t} \quad (3)$$

$$z_{i,t} = \gamma + \delta_1 POST_t + \delta_2 IOM_i + \delta_3 POST_t \times IOM_i + \omega_i + \lambda_t + \eta_m + r_{i,t}, \quad (4)$$

where the first stage in equation 4 is identical to equation 2 using annual changes in mortgage repayments as dependent variable. The second stage is similar to the first stage equation but has non-mortgage debt repayments, savings in liquid assets, or spending as dependent variable. The model is regressed separately for each outcome. The interaction term $POST_t \times IOM_i$ has been replaced by the fitted values from the first stage, $\hat{z}_{i,t}$. Now, the coefficient $\beta_3$ quantifies how much each of the mentioned outcomes have changed when mortgage repayments decline caused by the interest-only feature.

The identifying assumption hinges on the fact that the outcomes of interest are affected by mortgage repayments only through the initiation of the deferred repayments. This means that other shocks occurring over the sample period are not affecting the parameter value unless the shock is connected to the decision of taking out an IOM over a non-IOM. The blue lines in Figure 4 panels (a) and (b) show that the pre-trends in mortgage repayments are fairly stable and close to zero during the eight years before mortgage origination. This indicates that the behaviour of IOM and non-IOM borrowers would likely have been similar had they chosen the same type of mortgage. By graphical inspection, we consider that the identifying assumption, $cov(z_{i,t}, \varepsilon_{i,t}) = 0$, is not violated. Moreover, the interaction term serves as a relevant and strong instrument given that $\beta_3$ is statistically significant, $cov(z_{i,t}, POST_t \times IOM_i \neq 0)$ and given that the F-statistic is very large.

Table 2 reports the first stage equations in columns (1) and (5) for home buyers and refinancers, respectively. The parameter values are -6.8 and -5.7, respectively, estimating the magnitude of deferred mortgage debt repayments as a percentage of income. In other words, this is how much IOM borrowers postponed mortgage debt repayments relative to the non-IOM borrowers each year over the eight-year period that followed mortgage origination, corresponding to the blue lines in Figure 4.

Columns (2)–(4) and (6)–(8) show the substitution parameters for home buyers and refinancers, respectively. The parameters of interest are in the row saying "Mortgage". In column (2), the parameter shows that bank debt repayments increased by an amount corresponding to 62.7% of the deferred mortgage repayments by home buyers. Column

Table 2: Spending and savings behaviour of interest-only borrowers

| | Home Buyer | | | | Refinancer | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| VARIABLES | Mortgage | Bank debt | Liquid assets | Spending | Mortgage | Bank debt | Liquid assets | Spending |
| $POST_t$ | -0.003*** | -0.015*** | -0.125*** | 0.099*** | 0.010*** | 0.032*** | -0.028*** | -0.002** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| $POST_t \times IOM_i$ | -0.068*** | | | | -0.057*** | | | |
| | (0.001) | | | | (0.001) | | | |
| Mortgage | | -0.627*** | -0.294*** | -0.154*** | | -0.710*** | -0.012 | -0.317*** |
| | | (0.014) | (0.011) | (0.020) | | (0.017) | (0.011) | (0.020) |
| Observations | 3,031,040 | 3,031,040 | 3,031,040 | 3,031,040 | 5,523,486 | 5,523,486 | 5,523,486 | 5,523,486 |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Age FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Individual FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistic | 2,632 | | | | 951 | | | |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(3) shows that, in addition, liquid assets increased by an amount corresponding to 29.4% of deferred mortgage repayments. Finally, in column (4), we find that the marginal propensity to consume out of deferred mortgage repayments is 15.4%, on average, for home buyers. For refinancers, column (6) shows that bank debt repayments increased by an amount corresponding to 71% of deferred mortgage repayments, on average. While there was no statistically significant increase in liquid assets in column (7), the marginal propensity to consume by refinancers was 31.7%, on average.

## 5.2 Marginal propensities to consume across LTV ratio and age

Based on Figure 5, panel (b), we expect that the marginal propensity to consume out of deferred amortisation increases with age, particularly after age 50. We test this by estimating equations (3) and (4) separately for age bins. In practice, we re-estimate the coefficients in columns (4) and (8) from Table 2, but do so for four age groups: 21–34, 35–49, 50–64 and 65+. Table 3 clearly shows that the overall marginal propensity to consume is driven by borrowers older than 50 – both for home buyers and refinancers. For home buyers, MPCs range between 40–64%, and for refinancers, MPCs range between 53–64%. For refinancers below age 50, there is no statistically significant spending response when deferring mortgage repayments. For home owners in age bin 35–49, we estimate an MPC of 17%, while there is no statistically significant response for younger home buyers.

Apart from age, we anticipate that LTVs predict MPCs of IOM-borrowers. In a

Table 3: Marginal propensity to consume across age

| | Home Buyer | | | | Refinancer | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| VARIABLES | 21-34 | 35-49 | 50-64 | 65+ | 21-34 | 35-49 | 50-64 | 65+ |
| Mortgage | -0.051* | -0.174*** | -0.404*** | -0.639*** | 0.080 | 0.045 | -0.639*** | -0.534*** |
| | (0.029) | (0.034) | (0.065) | (0.127) | (0.088) | (0.058) | (0.025) | (0.029) |
| $POST_t$ | 0.073*** | 0.135*** | 0.104*** | 0.113*** | -0.170*** | 0.027*** | 0.020*** | 0.008*** |
| | (0.002) | (0.003) | (0.004) | (0.009) | (0.008) | (0.002) | (0.001) | (0.003) |
| Observations | 1,591,310 | 984,352 | 369,611 | 85,767 | 573,370 | 2,271,343 | 1,964,765 | 714,008 |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Age FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Individual FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

standard life-cycle model with constraints, only liquidity constrained consumers should increase spending when being able to defer amortisation. This implies that high LTVs should predict high MPCs. However, in the Danish setting, there is an important LTV cutoff at 60% to notice. This is illustrated in Figure 1, panel (b). Administrative margins are generally higher for IOM loans but for LTVs above the 60% cutoff, the relative difference between the administrative margins increases. This effectively increases the relative borrowing cost on IOMs when LTVs exceed 60%. Based on this, we anticipate that MPCs increase in LTVs—but only up to the 60% cutoff.

Table 4 shows estimated MPCs for home buyers and refinancers split into LTV bins, ranging from 1–20, 21–40, 41–60, and 60+. LTVs are measured the year before mortgage origination in order not to be endogenous to the savings and spending decision estimated. The estimates show that MPCs generally increase in LTVs but drop substantially for LTVs above 60%. The highest MPCs are in fact estimated for the 21–40 LTV bins, with MPCs at 50–73%. For the 41–60 LTV bins, MPCs range between 35–52%. Above LTV 60, MPCs were 10–17%, on average.

The large number of observations in our data allows us to split homeowners both on leverage and age. Table 5 presents the results. For LTVs above 60, we find MPCs at 39–56% for 50+ year-olds and 0–7% for borrowers below age 50. For LTVs below 60, we find similar MPCs for 50+ year-olds, at 52–56% and MPCs at 0–25% for those below age 50. To sum up, older borrowers in our data increased spending substantially when deferring mortgage repayments irrespective of their LTVs. For younger borrowers, the spending response is small and driven by borrowers below the LTV 60% threshold.

Table 4: Marginal propensity to consume across loan-to-value ratio

| | Home Buyer | | | | Refinancer | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| VARIABLES | 1-20 | 21-40 | 41-60 | 60+ | 1-20 | 21-40 | 41-60 | 60+ |
| Mortgage | -0.300*** | -0.501*** | -0.348** | -0.099*** | -0.100** | -0.729*** | -0.518*** | -0.167*** |
| | (0.104) | (0.149) | (0.169) | (0.022) | (0.048) | (0.049) | (0.050) | (0.051) |
| $POST_t$ | 0.092*** | 0.089*** | 0.125*** | 0.101*** | -0.016*** | 0.034*** | 0.035*** | 0.015*** |
| | (0.009) | (0.009) | (0.011) | (0.002) | (0.004) | (0.002) | (0.002) | (0.002) |
| Observations | 160,122 | 75,947 | 102,932 | 2,691,266 | 1,123,089 | 925,543 | 1,297,335 | 2,168,584 |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Age FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Individual FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Marginal propensity to consume across loan-to-value ratio and age

| | Home Buyer | | | | Refinancer | | | |
|---|---|---|---|---|---|---|---|---|
| | LTV<60 | | LTV>60 | | LTV<60 | | LTV>60 | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| VARIABLES | 21-49 | 50+ | 21-49 | 50+ | 21-49 | 50+ | 21-49 | 50+ |
| Mortgage | -0.248** | -0.526*** | -0.067*** | -0.386*** | -0.011 | -0.564*** | -0.013 | -0.562*** |
| | (0.101) | (0.094) | (0.023) | (0.075) | (0.044) | (0.022) | (0.072) | (0.063) |
| $POST_t$ | 0.136*** | 0.067*** | 0.099*** | 0.126*** | -0.014*** | 0.014*** | 0.012*** | 0.037*** |
| | (0.010) | (0.005) | (0.002) | (0.005) | (0.003) | (0.002) | (0.003) | (0.003) |
| Observations | 162,879 | 176,895 | 2,412,783 | 278,483 | 1,306,778 | 2,048,124 | 1,537,935 | 630,649 |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Age FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Individual FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

## 5.3 Crowding out in savings

IOMs can help borrowers build liquid assets, e.g. to buffer against future shocks to income. We anticipate that such behaviour should be driven by constrained borrowers or borrowers who expect to be constrained in the near future. Using the same model specification as in the section above, we estimate how much is saved in liquid assets out of deferred mortgage repayments. Table 6 presents the estimates.

Home buyers with LTVs above 60% have the largest crowding out in liquid assets, measuring 36% and 23% for 21–49 and 50+ year olds, respectively. For refinancers, also

with high LTVs, we find much smaller crowding out at 6% for 21–49 year-olds. For 55+ year-olds in this LTV segment, there was no crowding out in liquid assets. For home buyers in the low LTV segment, we find 17% in the older age group and no effect in the younger age group. For refinancers, we find no crowding out in liquid assets for the low LTV segment. Together, our findings support the notion that high-LTV segments are more likely to use deferred mortgage repayments to increase liquid assets.

Table 6: Crowding out in liquid assets across loan-to-value ratio and age

| | Home Buyer | | | | Refinancer | | | |
|---|---|---|---|---|---|---|---|---|
| | LTV<60 | | LTV>60 | | LTV<60 | | LTV>60 | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| VARIABLES | 21-49 | 50+ | 21-49 | 50+ | 21-49 | 50+ | 21-49 | 50+ |
| Mortgage | -0.018 | -0.174** | -0.361*** | -0.231*** | -0.021 | 0.015 | -0.064*** | 0.004 |
| | (0.053) | (0.077) | (0.012) | (0.054) | (0.019) | (0.018) | (0.022) | (0.040) |
| $POST_t$ | -0.105*** | -0.079*** | -0.133*** | -0.101*** | -0.050*** | -0.021*** | -0.028*** | -0.021*** |
| | (0.006) | (0.004) | (0.001) | (0.003) | (0.001) | (0.001) | (0.001) | (0.002) |
| Observations | 162,879 | 176,895 | 2,412,783 | 278,483 | 1,306,778 | 2,048,124 | 1,537,935 | 630,649 |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Age FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Individual FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Finally, Table 7 presents estimated crowding out in non-mortgage debt repayments out of deferred mortgage repayments. Borrowers younger than 50 increased non-mortgage debt repayments to a large extent when deferring mortgage repayments, as we estimate substitution effects at 69–108% for this age group.[10] For the 50+ year-olds, substitution is much lower at 31–49%. Clearly, substituting debt repayments from mortgages for bank loans seems to take place across both age and LTV dimensions. The next section aims to examine if borrowing costs are in fact reduced by doing so.

[10]The point estimate of the crowding out parameter can be larger than 100%, but as long as it includes 100% in the statistical confidence bands, we interpret this as full crowding out.

Table 7: Crowding out in bank debt repayments across loan-to-value ratio and age

| | Home Buyer | | | | Refinancer | | | |
|---|---|---|---|---|---|---|---|---|
| | LTV<60 | | LTV>60 | | LTV<60 | | LTV>60 | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| VARIABLES | 21-49 | 50+ | 21-49 | 50+ | 21-49 | 50+ | 21-49 | 50+ |
| Mortgage | -0.711*** | -0.311*** | -0.686*** | -0.448*** | -0.992*** | -0.434*** | -1.083*** | -0.486*** |
| | (0.082) | (0.054) | (0.016) | (0.046) | (0.039) | (0.014) | (0.075) | (0.051) |
| $POST_t$ | -0.031*** | 0.008*** | -0.018*** | -0.012*** | 0.057*** | 0.010*** | 0.031*** | -0.003 |
| | (0.008) | (0.003) | (0.001) | (0.003) | (0.002) | (0.001) | (0.003) | (0.002) |
| Observations | 162,879 | 176,895 | 2,412,783 | 278,483 | 1,306,778 | 2,048,124 | 1,537,935 | 630,649 |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Age FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Individual FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

# 6 Borrowing costs

The previous sections showed that the most common use of the liquidity from deferring mortgage repayments in Denmark was to accelerate repayments of bank debt. This covers all sorts of debt in commercial banks, ranging from consumer loans and revolving credit accounts, that carries relatively high interest rates, to car loans and loans collateralised by property with lower interest rates. Our data does not allow for dissecting the debt into any of these categories. We anticipate, though, that debt in commercial banks is typically more expensive than mortgage debt.

Figure 6 plots the average interest rates on all outstanding mortgage and non-mortgage debt across calendar years in our data. The numbers are computed by dividing interest paid by the outstanding amount of debt.[11] Although the spread has narrowed over the past decade, mortgage interest rates are 1–2%-points lower than that of non-mortgage debt in our data.

Using equation 1, we plot the interest payments as a share of income in Figure 7 for home buyers and refinancers in panel (a) and (b), respectively. The figures are based on a sub-sample of homeowners who do not shift from fixed-rate mortgages to adjustable-rate mortgages or vice versa as this would impact their interest payments substantially. Also, refinancers are included only if they do not extract home equity

[11]Specifically, we compute the interest rate as $i_t = \frac{r_t}{d_t \times 0.5 + d_{t-1} \times 0.5}$, where $r_t$ is the interest payments and $d$ is the debt stock.

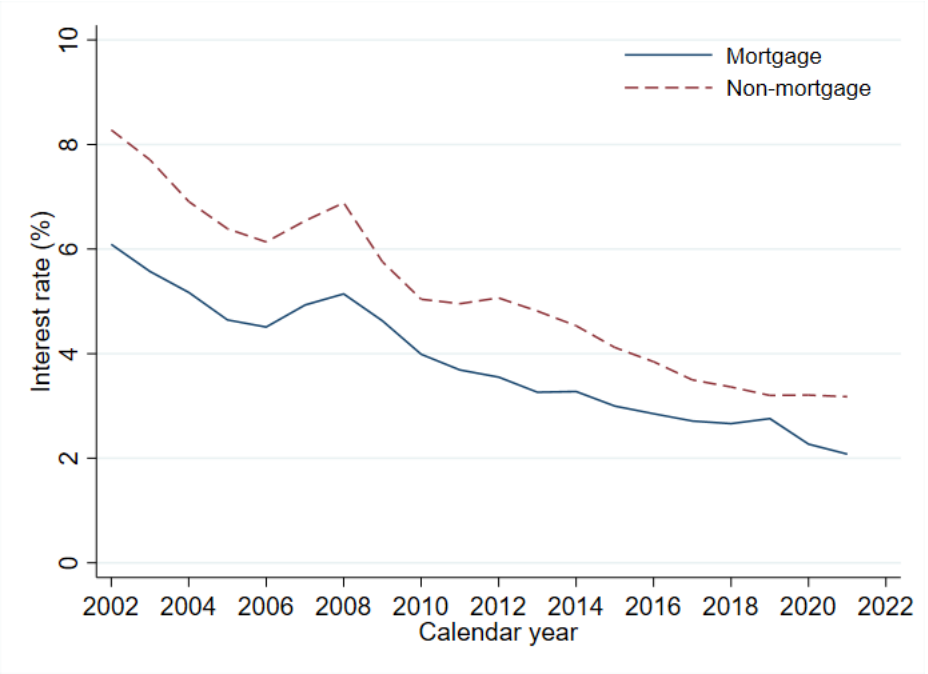
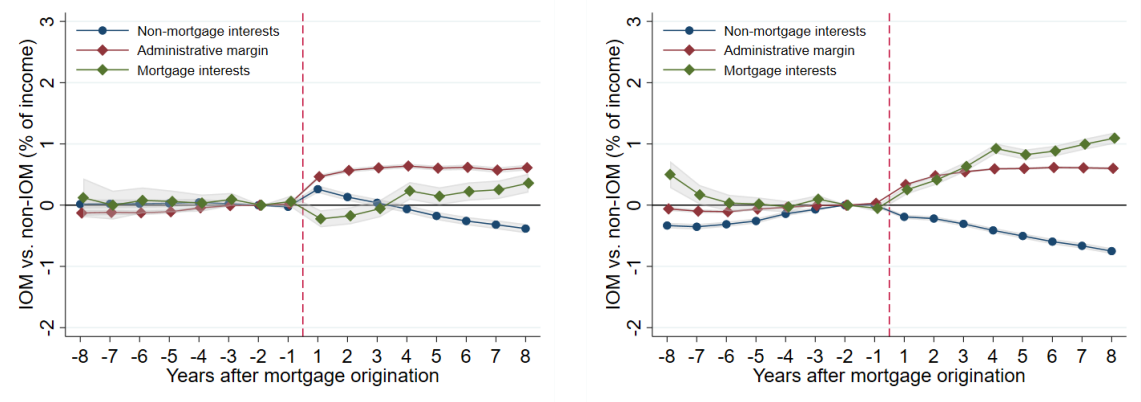



Figure 6: Interest rates on mortgage and non-mortgage debt

when taking out a new mortgage to replace the old one. By doing this, we aim to quantify the difference in interest payments between IOM and non-IOM borrowers.

The working hypothesis is that interest payments on non-mortgage debt should decline more rapidly for IOM borrowers as they tend to accelerate non-mortgage debt repayments out of deferred mortgage repayments. Both for home buyers and refinancers, Figure 7 supports this, as the average difference in interest payments is almost identical prior to mortgage origination and then declines in the years thereafter. Mortgage interest payments should, on the other hand, increase more for IOM borrowers than for non-IOM borrowers after mortgage origination. The outstanding mortgage debt amount does not change in the years where mortgage amortisation is deferred, implying that their payments must be larger than that of non-IOM borrowers whose outstanding mortgage debt declines. Figure 7 shows exactly this in both panels. In addition to this, IOM borrowers pay a supplement fee to the mortgage bank for the option to defer mortgage repayments. Figure 7 shows how the administrative margin increases for IOM borrowers vis-á-vis non-IOM borrowers after taking out the new mortgage.

To quantify these effects, we use equation 2 and omit the first five years immediately after mortgage origination. We do this to compare the years 6–8 to all pre-origination years, as we anticipate that it takes some time to benefit from substituting mortgage




(a) Home Buyer (b) Refinancer

Figure 7: Borrowing costs paid to mortgage and commercial banks

repayments with non-mortgage debt repayments. Table 8 shows that IOM borrowers reduced non-mortgage interest payments by 0.1% and 0.3% of income after five years compared to non-IOM borrowers for home buyers and refinancers, respectively. However, because of increased mortgage interest payments and administrative margins, IOM borrowers' total interest expenses at 0.5% and 0.7% of income were higher than that of non-IOM borrowers. This indicates that accelerating non-mortgage debt repayments by deferring mortgage repayments did not—for this sub-sample—help borrowers reduce total borrowing cost.

Table 8: Borrowing cost after mortgage origination

| | Home Buyer | | | | Refinancer | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| VARIABLES | Bank | Mortgage | Admin. | Total | Bank | Mortgage | Admin. | Total |
| $POST_t$ | 0.003*** | 0.019*** | 0.005*** | 0.027*** | -0.001*** | -0.013*** | -0.001*** | -0.015*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| $POST_t \times IOM_i$ | -0.001*** | -0.001 | 0.006*** | 0.005*** | -0.003*** | 0.005*** | 0.005*** | 0.007*** |
| | (0.000) | (0.001) | (0.000) | (0.001) | (0.000) | (0.000) | (0.000) | (0.000) |
| Observations | 275,924 | 197,515 | 197,515 | 197,515 | 1,737,152 | 1,241,248 | 1,241,248 | 1,241,248 |
| R-squared | 0.298 | 0.346 | 0.257 | 0.304 | 0.356 | 0.547 | 0.084 | 0.532 |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Age FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Individual FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

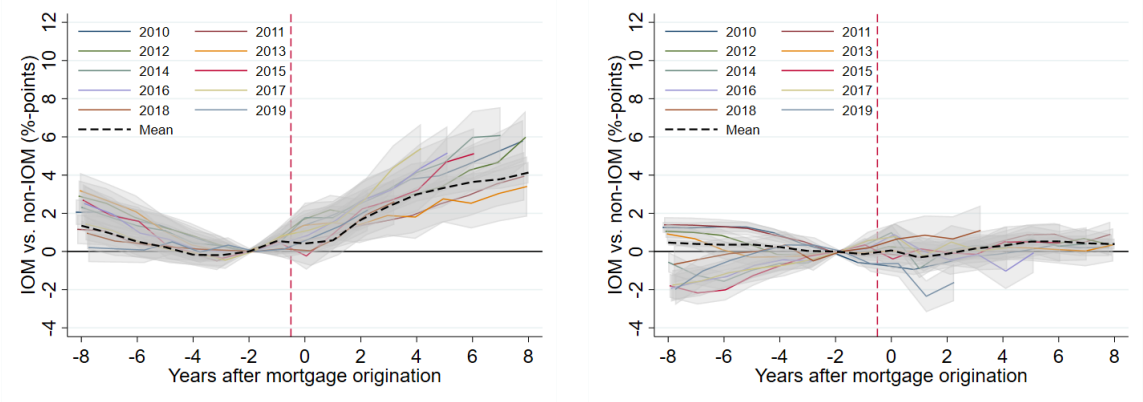
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Due to the extra administrative margin paid for IOMs, the spread between interest rates on mortgages and non-mortgages must be substantial in order to obtain a lower total interest payment. We cannot reject that some borrowers do in fact reduce total

borrowing cost by substituting repayments from mortgages for non-mortgages. However, on average, the potential gain from engaging in such substitution activity seems limited. Alternative explanations could also be at play, e.g. if borrowers prefer not to have non-mortgage debt and are willing to pay a premium to collect all their debt as mortgage debt. We cannot examine such explanations in our data.

# 7 Borrower characteristics

Our empirical design allows us to examine the characteristics of borrowers who opt for IOMs and compare them to that of borrowers who take out standard mortgages. Figure 8 shows the difference in disposable income between IOM and non-IOM borrowers. Here, income is measured in growth rates and the coloured lines show each calendar year where a mortgage is taken out. The dashed black line represents the average across all years. Panel (a) shows that home buyers opting for IOMs increased their income substantially compared to non-IOM home buyers over the eight years that followed mortgage origination. For refinancers, there were no statistically significant differences between IOM and non-IOM borrowers.




(a) Home Buyer (b) Refinancer

Figure 8: Disposable income growth

Table 9 formalises the average difference in income growth for IOM versus non-IOM borrowers five years after mortgage origination. Columns (1) and (4) show that disposable income growth is 2.5%-points higher for IOM borrowers compared to non-IOM borrowers who buy a home when taking out a mortgage. For refinancers, who take out a mortgage without changing home, there is no difference in disposable

income growth for IOM borrowers relative to non-IOM borrowers. In a similar fashion, the IOM versus non-IOM difference in unemployment rates is estimated in columns (2) and (5) for home buyers and refinancers, respectively. The unemployment rate is 0.4%-points lower for IOM borrowers compared to non-IOM borrowers for home buyers, while there is no statistically significant difference for refinancers. This points to home buyers opting for IOMs having slightly stronger labour market outcomes with higher income growth and lower unemployment rates, albeit with very small differences compared to non-IOM borrowers.

Table 9: Borrower characteristics five years after mortgage origination

| | Home Buyer | | | Refinancer | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| VARIABLES | Income | Unemployed | ARM | Income | Unemployed | ARM |
| $POST_t$ | 0.122*** | -0.040*** | -0.149*** | 0.024*** | -0.000 | -0.019*** |
| | (0.001) | (0.001) | (0.005) | (0.000) | (0.001) | (0.001) |
| $POST_t \times IOM_i$ | 0.025*** | -0.004*** | 0.139*** | 0.001 | 0.001 | 0.212*** |
| | (0.001) | (0.001) | (0.007) | (0.001) | (0.001) | (0.003) |
| Observations | 3,030,955 | 3,031,040 | 1,291,043 | 5,523,459 | 5,523,486 | 3,246,845 |
| R-squared | 0.623 | 0.023 | 0.017 | 0.514 | 0.029 | 0.046 |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Age FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Individual FE | Yes | Yes | Yes | Yes | Yes | Yes |

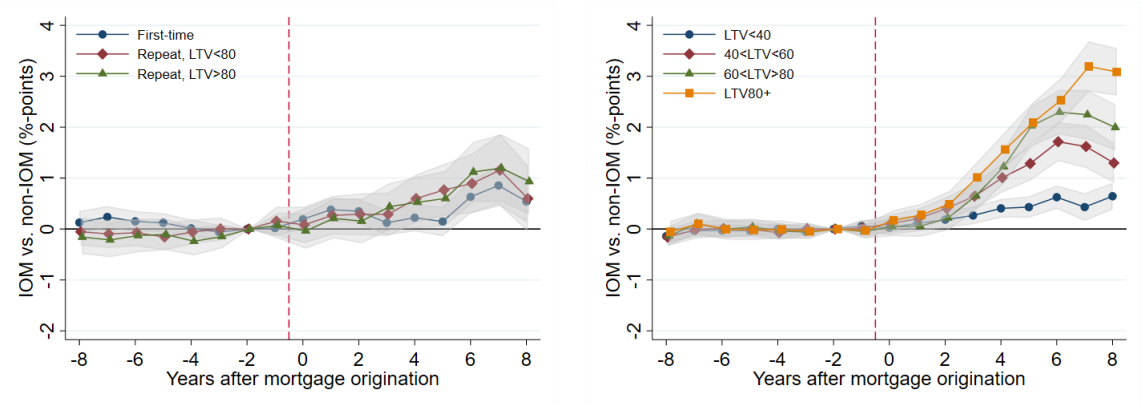
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Columns (3) and (6) in Table 9 show that IOM borrowers have 14% and 21% higher propensity to take out an adjustable-rate mortgage than non-IOM borrowers for home buyers and refinancers, respectively. This indicates that borrowers who opt for an IOM seek to reduce interest payments too. The implication is that IOM borrowers take on more interest rate risk exposure compared to non-IOM borrowers.

One challenge in our empirical design is that our baseline estimates of substitution and spending responses to deferred mortgage payments are potentially affected by borrowers shifting from fixed-rate mortgages to adjustable-rate mortgages. This reduces their interest expenses, allowing them to increase spending. To test that such behaviour is not driving our baseline results, we perform a robustness test where we re-estimate Table 2 but leave out borrowers who shift from fixed-rate to adjustable-rate mortgages, or vice versa. The robustness test shows no important change in overall substitution patterns (Appendix Table 12), indicating that our baseline results are not

affected by changes in interest rate fixation.

Next, we turn to delinquency ratios. Lenders in Denmark report to the Danish tax authorities if a customer has been late on loan payments during the year. We use this data to examine if IOM borrowers have higher or lower probability of being delinquent compared to non-IOM borrowers. We anticipate that the difference in delinquency ratios could be higher if more risky borrower types opt into IOMs. But we also expect that delinquency ratios could be lower for IOMs as they could use the deferred amortisation period to repay other debt that they would otherwise risk to repay on time.




(a) Home Buyer

(b) Refinancer

Figure 9: Delinquency ratio

Figure 9, panels (a) and (b), shows the difference in delinquency ratios for home buyers and refinancers, respectively. Moreover, each line represents various LTV segments. For home buyers, there is a slight increase in the propensity to be delinquent for IOM borrowers vis-à-vis non-IOM borrowers. The effects do, however, seem very muted and there is no difference across the LTV distribution. For refinancers, on the other hand, there is a clear increase in delinquency ratios for IOM borrowers compared to non-IOM borrowers. This is particularly clear for the higher LTV segments[12].

We use our baseline setup to measure the difference in delinquency ratios between IOM and non-IOM borrowers and the results are reported in Table 10. This shows that five years after mortgage origination, refinancers with LTVs around 80% have a 3% higher probability of being delinquent for IOM borrowers than for non-IOM borrowers.

[12]We redo panel (b) in Figure 9 but mark only borrowers as delinquent if they miss payments on an account that is larger than DKK 2,000 (USD 300). The pattern is identical, although the level of probability is much lower. This is shown in Appendix Figure 11.

Table 10: Delinquency ratio across loan-to-values, five years after mortgage origination

| | Home Buyer | Refinancer | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| VARIABLES | All | 0-40 | 40-60 | 60-80 | 80+ |
| $POST_t$ | -0.026*** | -0.011*** | -0.020*** | -0.006* | -0.021*** |
| | (0.002) | (0.001) | (0.003) | (0.003) | (0.004) |
| $POST_t \times IOM_i$ | 0.006*** | 0.006*** | 0.016*** | 0.022*** | 0.029*** |
| | (0.001) | (0.001) | (0.002) | (0.002) | (0.002) |
| Observations | 2,009,691 | 1,357,212 | 882,822 | 755,453 | 761,364 |
| R-squared | 0.040 | 0.031 | 0.032 | 0.039 | 0.047 |
| Year FE | Yes | Yes | Yes | Yes | Yes |
| Age FE | Yes | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes | Yes |
| Individual FE | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

For refinancers in the lowest LTV segment, the excess probability is 0.6%, identical to that of all home buyers.

# 8 Indebtedness

Finally, we turn to measure if IOM borrowers take on more debt than non-IOM borrowers. Using equation 2 and limiting the sample period from one year before mortgage origination to one year after mortgage origination, we find that the average debt-to-income (DTI) ratio of home buyers increased by 39% more for IOM-borrowers compared to non-IOM borrowers after mortgage origination. This is reported in Table 11. For refinancers, the average DTI ratio increased by 47% more for IOM borrowers compared to non-IOM borrowers. LTV ratios also increased more for IOM borrowers around the time of mortgage origination. For home buyers, the excess LTV was 4% and for refinancers, the excess LTV was 10%. Together the numbers point to IOM borrowers becoming more indebted after taking out a new mortgage than borrowers who opt for a standard mortgage.

Repeat buyers and refinancers can easily extract home equity when taking out a new loan. Home equity extraction is a confounder in our empirical design as extracted home equity could affect savings and spending behaviour differently for IOM and non-IOM borrowers. Specifically, if home equity is more likely to finance spending for IOM borrowers compare to non-IOM borrowers, this is the effect that we could be picking up

Table 11: Changes in debt-to-income (DTI) and loan-to-value (LTV) ratios

| | Home Buyer | | Refinancer | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| VARIABLES | DTI | LTV | DTI | LTV |
| $POST_t$ | 1.004*** | 0.264*** | 0.449*** | 0.165*** |
| | (0.009) | (0.003) | (0.003) | (0.001) |
| $IOM_i$ | -0.228*** | 0.032*** | -0.223*** | -0.056*** |
| | (0.009) | (0.003) | (0.004) | (0.001) |
| $POST_t \times IOM_i$ | 0.475*** | 0.041*** | 0.581*** | 0.101*** |
| | (0.012) | (0.004) | (0.005) | (0.002) |
| Constant | 1.679*** | 0.250*** | 1.654*** | 0.327*** |
| | (0.341) | (0.093) | (0.071) | (0.025) |
| Observations | 106,696 | 87,422 | 746,707 | 740,669 |
| R-squared | 0.301 | 0.338 | 0.155 | 0.317 |
| Year FE | Yes | Yes | Yes | Yes |
| Age FE | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes |
| Individual FE | No | No | No | No |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

in our estimated parameters. We perform two robustness tests by re-estimating column (8) in Table 2. First, we introduce a dummy that takes the value 1 if the borrower has extracted home equity in connection with the mortgage origination, otherwise zero. Secondly, we measure the change in debt from before to after mortgage origination and include this variable as a control variable. Inclusion of these new measures in the model specification does not change our results in any significant way. This can be seen in Appendix Table 17.

# 9 Conclusion

This paper uses Danish administrative data, covering all mortgages issued in 2010–2019, to quantify changes in savings and spending of homeowners who take out a new mortgage with deferred repayment. The behaviour of these Interest-Only Mortgage (IOM) borrowers is compared to the behaviour of borrowers who took out a traditional mortgage (non-IOM).

Our results indicate that the availability of IOMs for homeowners is likely affecting spending and savings decisions. Our data shows substantial heterogeneity across age

and leverage ratios. While homeowners aged 50 or over tended to raise their spending after IOM origination, younger households tended to repay other debt and increase liquid wealth.

Regulation in the Danish mortgage system plays a crucial role. We find that homeowners with Loan-to-Value (LTV) ratios above 60% have been less inclined to increase spending when opting for IOMs. This is potentially because the administrative costs of IOMs increase substantially above this LTV-threshold, making IOMs a relatively expensive way to raise spending.

Finally, we document that home buyers who opted for IOMs had increasing income, on average, in the years after taking out the mortgage. On the other hand, we show that refinancers have higher probability of arrears after taking out an IOM. Both findings indicate that certain borrowers opt into IOMs. Future research should aim to identify the causal effect of introducing IOMs on household spending and savings behaviour across age and leverage ratios.

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# A Appendix

## A.1 Tables

Table 12: Marginal propensity to spend across loan-to-value ratio and age, limiting sample to no shifts between interest rate fixation

| | Home Buyer | | | | Refinancer | | | |
|---|---|---|---|---|---|---|---|---|
| | LTV<60 | | LTV>60 | | LTV<60 | | LTV>60 | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| VARIABLES | 21-49 | 50+ | 21-49 | 50+ | 21-49 | 50+ | 21-49 | 50+ |
| Mortgage | -0.379** | -0.694*** | 0.349 | -0.530 | -0.243** | -0.794*** | 0.222 | -0.576*** |
| | (0.152) | (0.126) | (0.589) | (0.647) | (0.117) | (0.036) | (0.163) | (0.084) |
| $POST_t$ | 0.127*** | 0.065*** | 0.254*** | 0.066** | 0.040*** | 0.029*** | 0.030*** | 0.036*** |
| | (0.014) | (0.008) | (0.077) | (0.030) | (0.004) | (0.002) | (0.003) | (0.003) |
| Observations | 87,415 | 79,462 | 87,348 | 21,699 | 762,270 | 1,181,174 | 998,389 | 442,515 |
| R-squared | 0.428 | 0.388 | -0.418 | 0.474 | 0.305 | 0.404 | -0.237 | 0.514 |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Age FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Individual FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13: Marginal propensity to spend across loan-to-value ratio and age

| | Home Buyer | | | | | | Refinancer | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LTV<60 | | | LTV>60 | | | LTV<60 | | | LTV>60 | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| VARIABLES | 21-49 | 50-64 | 65+ | 21-49 | 50-64 | 65+ | 21-49 | 50-64 | 65+ | 21-49 | 50-64 | 65+ |
| Mortgage | -0.248** | -0.595*** | -0.292 | -0.067*** | -0.243*** | -0.784*** | -0.011 | -0.671*** | -0.468*** | -0.013 | -0.479*** | -0.933*** |
| | (0.101) | (0.097) | (0.241) | (0.023) | (0.090) | (0.153) | (0.044) | (0.028) | (0.034) | (0.072) | (0.075) | (0.111) |
| $POST_t$ | 0.136*** | 0.071*** | 0.062*** | 0.099*** | 0.122*** | 0.156*** | -0.014*** | 0.015*** | 0.009*** | 0.012*** | 0.037*** | 0.048*** |
| | (0.010) | (0.006) | (0.012) | (0.002) | (0.005) | (0.014) | (0.003) | (0.002) | (0.003) | (0.003) | (0.003) | (0.009) |
| Observations | 162,879 | 136,286 | 40,609 | 2,412,783 | 233,325 | 45,158 | 1,306,778 | 1,397,580 | 650,544 | 1,537,935 | 567,185 | 63,464 |
| R-squared | 0.296 | 0.323 | 0.182 | 0.091 | 0.180 | 0.297 | 0.055 | 0.372 | 0.272 | 0.096 | 0.473 | 0.525 |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Age FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Individual FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 14: Crowding out in liquid assets across loan-to-value ratio and age

| | Home Buyer | | | | | | Refinancer | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LTV<60 | | | LTV>60 | | | LTV<60 | | | LTV>60 | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| VARIABLES | 21-49 | 50-64 | 65+ | 21-49 | 50-64 | 65+ | 21-49 | 50-64 | 65+ | 21-49 | 50-64 | 65+ |
| Mortgage | -0.018 | -0.115 | -0.506** | -0.361*** | -0.254*** | -0.149 | -0.021 | 0.005 | 0.041 | -0.064*** | -0.006 | 0.049 |
| | (0.053) | (0.078) | (0.217) | (0.012) | (0.059) | (0.131) | (0.019) | (0.023) | (0.029) | (0.022) | (0.045) | (0.089) |
| $POST_t$ | -0.105*** | -0.069*** | -0.112*** | -0.133*** | -0.102*** | -0.106*** | -0.050*** | -0.021*** | -0.022*** | -0.028*** | -0.022*** | -0.021*** |
| | (0.006) | (0.005) | (0.011) | (0.001) | (0.003) | (0.012) | (0.001) | (0.002) | (0.002) | (0.001) | (0.002) | (0.007) |
| Observations | 162,879 | 136,286 | 40,609 | 2,412,783 | 233,325 | 45,158 | 1,306,778 | 1,397,580 | 650,544 | 1,537,935 | 567,185 | 63,464 |
| R-squared | 0.024 | 0.024 | -0.087 | -0.244 | -0.075 | 0.035 | 0.020 | 0.018 | 0.026 | 0.017 | 0.016 | 0.005 |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Age FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Individual FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 15: Crowding out in bank debt repayments across loan-to-value ratio and age

| | Home Buyer | | | | | | Refinancer | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LTV<60 | | | LTV>60 | | | LTV<60 | | | LTV>60 | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| VARIABLES | 21-49 | 50-64 | 65+ | 21-49 | 50-64 | 65+ | 21-49 | 50-64 | 65+ | 21-49 | 50-64 | 65+ |
| Mortgage | -0.711*** | -0.320*** | -0.250** | -0.686*** | -0.536*** | -0.163** | -0.992*** | -0.364*** | -0.517*** | -1.083*** | -0.576*** | -0.079 |
| | (0.082) | (0.058) | (0.115) | (0.016) | (0.057) | (0.073) | (0.039) | (0.018) | (0.022) | (0.075) | (0.064) | (0.067) |
| $POST_t$ | -0.031*** | 0.002 | 0.029*** | -0.018*** | -0.012*** | -0.009 | 0.057*** | 0.009*** | 0.014*** | 0.031*** | -0.002 | -0.006 |
| | (0.008) | (0.004) | (0.006) | (0.001) | (0.003) | (0.006) | (0.002) | (0.001) | (0.002) | (0.003) | (0.002) | (0.005) |
| Observations | 162,879 | 136,286 | 40,609 | 2,412,783 | 233,325 | 45,158 | 1,306,778 | 1,397,580 | 650,544 | 1,537,935 | 567,185 | 63,464 |
| R-squared | -1.118 | 0.053 | 0.061 | -0.447 | -0.315 | 0.004 | -2.107 | -0.044 | -0.155 | -5.087 | -0.904 | 0.020 |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Age FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Individual FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 16: Crowding out in pension contributions across loan-to-value ratio and age

| | Home Buyer | | | | Refinancer | | | |
|---|---|---|---|---|---|---|---|---|
| | LTV<60 | | LTV>60 | | LTV<60 | | LTV>60 | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| VARIABLES | 21-49 | 50+ | 21-49 | 50+ | 21-49 | 50+ | 21-49 | 50+ |
| Mortgage | -0.014*** | -0.013* | 0.003*** | -0.002 | 0.007*** | -0.004** | 0.018*** | 0.008** |
| | (0.004) | (0.007) | (0.001) | (0.004) | (0.001) | (0.002) | (0.002) | (0.004) |
| $POST_t$ | -0.003*** | -0.002*** | -0.000*** | -0.003*** | 0.000*** | 0.000*** | -0.000 | -0.000** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Observations | 162,879 | 176,895 | 2,412,783 | 278,483 | 1,306,778 | 2,048,124 | 1,537,935 | 630,649 |
| R-squared | -0.081 | 0.026 | 0.007 | 0.032 | -0.010 | 0.042 | -0.452 | 0.013 |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Age FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Individual FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 17: Marginal propensity to consume for refinancers

| VARIABLES | (1) Spending | (2) Spending | (3) Spending | (4) Spending |
|---|---|---|---|---|
| Mortgage | -0.364*** | -0.320*** | -0.455*** | -0.428*** |
| | (0.016) | (0.017) | (0.013) | (0.014) |
| $POST_t$ | 0.012*** | 0.008*** | 0.023*** | 0.019*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| $IOM_i$ | 0.030*** | 0.032*** | 0.033*** | 0.034*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Equity extract | | -0.000*** | | -0.000*** |
| | | (0.000) | | (0.000) |
| Mortgage level$_{t-2}$ | | | -0.000*** | -0.000*** |
| | | | (0.000) | (0.000) |
| Constant | 0.513*** | 0.549*** | 0.586*** | 0.628*** |
| | (0.012) | (0.013) | (0.012) | (0.013) |
| Observations | 5,523,486 | 5,369,336 | 4,400,209 | 4,281,095 |
| Year FE | Yes | Yes | Yes | Yes |
| Age FE | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes |

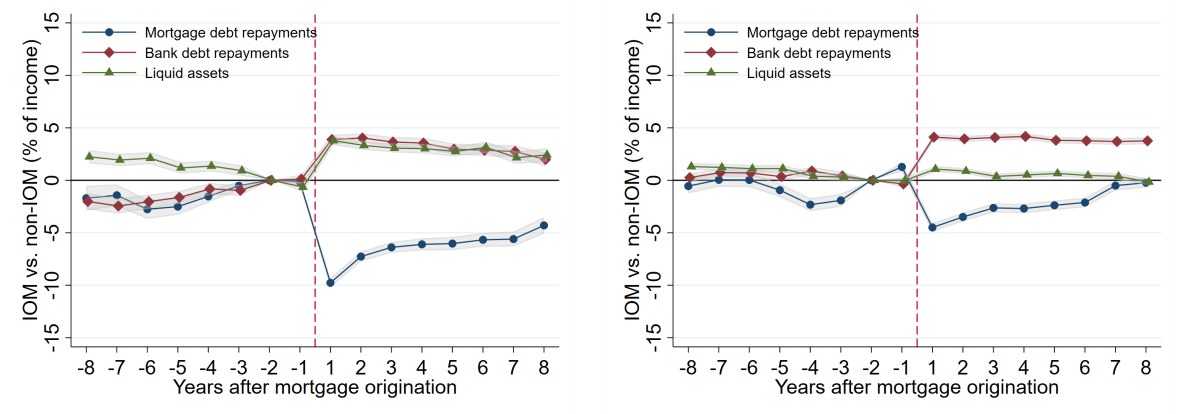
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 18: Delinquency ratio across loan-to-values, five years after mortgage origination, cut-off DKK 2,000

| | Home Buyer | Refinancer | | | |
|---|---|---|---|---|---|
| VARIABLES | (1) All | (2) 0-40 | (3) 40-60 | (4) 60-80 | (5) 80+ |
| $POST_t$ | -0.017*** | -0.005*** | -0.006*** | -0.006*** | -0.010*** |
| | (0.001) | (0.001) | (0.001) | (0.002) | (0.002) |
| $IOM_t$ | 0.002*** | 0.000 | 0.001*** | 0.003*** | 0.003*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| $POST_t \times IOM_i$ | 0.001*** | 0.002*** | 0.003*** | 0.004*** | 0.009*** |
| | (0.000) | (0.000) | (0.001) | (0.001) | (0.001) |
| Constant | -0.026*** | -0.005*** | -0.006*** | -0.004*** | -0.007*** |
| | (0.000) | (0.001) | (0.000) | (0.001) | (0.001) |
| Observations | 2,009,691 | 1,357,212 | 882,822 | 755,453 | 761,364 |
| R-squared | 0.010 | 0.005 | 0.003 | 0.003 | 0.005 |
| Year FE | Yes | Yes | Yes | Yes | Yes |
| Age FE | Yes | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

## A.2 Figures




(a) Home Buyer (b) Refinancer

Figure 10: Debt repayments and liquid savings normalised to the year of mortgage origination, measured at the household level

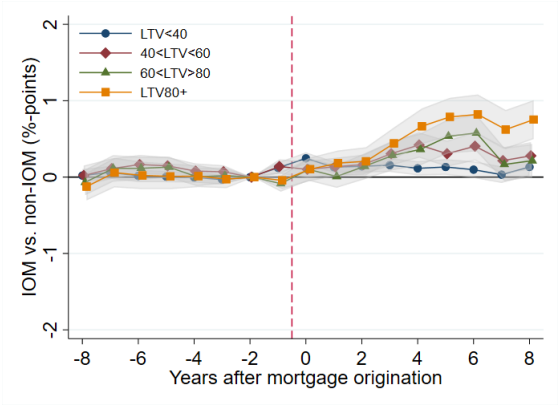



Figure 11: Delinquency ratio, minimum DKK 2,000 (USD 300)

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