DANMARKS
NATIONALBANK

WORKING PAPERS

September 2015 | No. 97

LOAN TYPES, LEVERAGE, AND SAVINGS BEHAVIOUR OF DANISH HOUSEHOLDS

Andreas Kuchler
Danmarks Nationalbank

DANMARKS
NATIONALBANK

The Working Papers of Danmarks Nationalbank describe research and development, often still ongoing, as a contribution to the professional debate.

The viewpoints and conclusions stated are the responsibility of the individual contributors, and do not necessarily reflect the views of Danmarks Nationalbank.

As a general rule, Working Papers are not translated, but are available in the original language used by the contributor.

Danmarks Nationalbank's Working Papers are published in PDF format at www.nationalbanken.dk. A free electronic subscription is also available at this Web site.

The subscriber receives an e-mail notification whenever a new Working Paper is published.

Please direct any enquiries to
Danmarks Nationalbank,
Communications,
Havnegade 5,
DK-1093 Copenhagen K
Denmark
E-mail: kommunikation@nationalbanken.dk

Nationalbankens Working Papers beskriver forsknings- og udviklingsarbejde, ofte af foreløbig karakter, med henblik på at bidrage til en faglig debat.

Synspunkter og konklusioner står for forfatternes regning og er derfor ikke nødvendigvis udtryk for Nationalbankens holdninger.

Working Papers vil som regel ikke blive oversat, men vil kun foreligge på det sprog, forfatterne har brugt.

Danmarks Nationalbanks Working Papers er tilgængelige på www.nationalbanken.dk i pdf-format. På hjemmesiden er det muligt at oprette et gratis elektronisk abonnement, der leverer en e-mail notifikation ved enhver udgivelse af et Working Paper.

Henvendelser kan rettes til:
Danmarks Nationalbank,
Kommunikation,
Havnegade 5,
1093 København K.
E-mail: kommunikation@nationalbanken.dk

ISSN (online) 1602-1193

DANMARKS
NATIONALBANK
WORKING PAPERS

LOAN TYPES, LEVERAGE, AND SAVINGS BEHAVIOUR OF DANISH HOUSEHOLDS

Contact for this working paper:

Andreas Kuchler
Danmarks Nationalbank
aku@nationalbanken.dk

ABSTRACT

Using Danish household level data, we find that a relatively large share of total interest-only mortgage debt is held by families with few liquid assets and high loan to value ratios. This may arise because families with interest-only loans do not fully use the lower instalments to increase their savings or to amortise more expensive debt. This is in particular the case for the families who choose interest-only loans with a variable interest rate, which is the most common loan type in Denmark, and the largest difference is found for those families who have the lowest savings propensity, and those with a high loan to value ratio. Furthermore, first time borrowers choosing interest-only loans take loans of higher initial sizes and have higher loan to value ratios than first time borrowers choosing amortising loans.

RESUME

Husholdninger med få likvide aktiver og høje belåningsgrader holder en større andel af den afdragsfrie realkreditgæld end af realkreditgælden med afdrag. En medvirkende årsag er formentlig, at husholdninger med afdragsfrie lån ikke i fuldt omfang bruger ydelsesbesparelsen til at spare mere op eller afdrage anden gæld. Det er særligt tilfældet for familier, der vælger variabelt forrentede afdragsfrie lån, som er den mest populære låntype i Danmark. Den største forskel i opsparingstilbøjeligheden på tværs af låntyper findes blandt de familier, som sparer mindst op og dem med høje belåningsgrader. Desuden tager førstegangskøbere, som vælger afdragsfrie lån, større lån og har højere belåningsgrader end førstegangskøbere, som vælger lån med afdrag.

KEY WORDS

Mortgage loans; loan types; savings; financial stability.

JEL CLASSIFICATION

D14; E21; G21; R31.

ACKNOWLEDGEMENTS

The author wishes to thank colleagues from Danmarks Nationalbank for useful comments on preliminary versions of this paper. The author alone is responsible for any remaining errors.

1. INTRODUCTION

The Danish mortgage system was largely untouched by the financial crisis and the sovereign debt crisis. During the debt crisis, mortgage bonds traded at lower yields than many other comparable European bonds and the yield spread between Danish government and mortgage bonds is narrow compared with the equivalent spreads in other countries (Gundersen et al., 2011). However, the mortgage system has been through rapid changes over the past 20 years. Variable interest loans were introduced in 1996 while interest-only loans were introduced in 2003. At the end of 2014, two thirds of the balance of outstanding mortgage loans had a variable interest rate, more than half were interest only, and 44 per cent had a combination of the two features. Three quarters of all families have only one type of mortgage loan[1], even though the trade-off between risk and price could be argued to imply that such a corner solution is suboptimal for many families.

Most of the focus has centered on the use of interest-only (henceforth referred to as IO) loans, which in principle have several advantages. For example, the possibility of using the revenue from the reduced mortgage instalments of IO-loans to repay more expensive debt or increase the savings buffer has been mentioned as a significant advantage of IO-loans. However, the revenue generated by the lower initial instalments can also be used for consumption. Further, it might also be argued that some households may have taken advantage of the lower initial repayments implied by IO-loans to take larger loans than what would have been possible to service, or than what would have been granted by the mortgage bank, for an amortising loan. Motivated by these questions, this paper provides a descriptive analysis and extracts a number of stylized facts regarding how savings behaviour, income, assets and leverage vary with types of mortgage loans. The analysis of savings behaviour extends descriptive evidence found by Andersen et al. (2012) by providing a formal econometric analysis and focusing on a more detailed breakdown of loan types as well as on the interplay between loan types and LTV.

The mortgage banks have granted many households IO-loans right up to the loan-to-value (LTV) limit of 80 per cent. That makes the mortgage credit system vulnerable if house prices fall. It is essential to design the mortgage credit system in such a way that bonds remain secure and the system is still robust in periods when house prices fall. Danmarks Nationalbank (2014b) has therefore proposed that legislation should be introduced to reduce the LTV-limit for IO-loans as a ratio of the value of the home at the time of mortgaging. In this way, borrowers will automatically build up a certain distance to the LTV limit over time. That will further underscore the mortgage credit system's high degree of security, even if house prices are plummeting.

The stylized facts found in this paper can be summarised as follows. First, compared to other loan types, a larger share of total IO-debt is held by families with fewer liquid assets and higher LTV-ratios.[2] Second, we find that families with IO-loans do not fully use the lower instalments for savings or for amortising more expensive debt, while families with variable rate (henceforth referred to as VR) loans have slightly higher savings rates than families with fixed interest loans. Families with the combination of IO and VR have the lowest savings rates of all loan types, also when controlling in a flexible way for a wide range of family characteristics. The difference is largest for those families who have the lowest savings propensity, and those with high LTV-ratios. Third, we find that new borrowers who choose IO-loans take loans of higher sizes and end up with higher loan to value ratios than families who choose amortising loans. These latter findings may

[1] The group of families who have more than one type of mortgage loan includes households who own more than one piece of real estate. The share of families with more than one loan type with their primary home as collateral is therefore smaller.

[2] The definition of the LTV-ratio used in this paper is the ratio of total debt (including debt not secured by real estate) to the real estate value. Unfortunately, the data does not allow us to separately identify bank debt secured by real estate. See section 3 for further details.

be interpreted as a confirmation of previous macro-based findings regarding the link between house prices and financial liberation through introduction of new loan types (see e.g. Dam et al., 2011).

The paper proceeds as follows. The next section provides a brief overview of the Danish mortgage system. Section 3 presents the data, while the following sections presents analyses of the pool of families with different loan types, loan types and savings propensity, and loan types and leverage, respectively. The final section provides a few concluding remarks.

2. A BRIEF OVERVIEW OF THE DANISH MORTGAGE SYSTEM

In an international comparison, Danish households have a high level of gross debt (Isaksen et al., 2011). Besides a large funded pension sector, one of the reasons is the widely developed Danish mortgage system, which is characterised by being relatively large, well established and inexpensive[3].

Mortgage banks exclusively provide loans secured on real property. The loans are solely financed by issuing bonds - mortgage banks are not allowed to accept customer deposits - and for that reason the mortgage banks are the largest bond issuers in Denmark. Like banks, mortgage banks must meet e.g. capital requirements as well as organisational and managerial requirements. Furthermore, mortgage banks are subject to a number of specific rules on risk management, bond issuance, property valuation, registration of the collateral and liabilities, etc. Most loans are issued as 20 or 30-year loans, and households can only obtain loans from mortgage banks of up to 80 per cent of the initial value of properties used as permanent residences – the remaining (more insecure) part of the funding may be provided by commercial banks.

Several factors ensure that investment in mortgage bonds is associated with very low credit risk (Gundersen et al., 2011). First, the balance principle and the close link between loans and bonds mean that mortgage banks do not assume significant market risks. Second, the credit risk that the mortgage banks can assume is limited by fixed loan-to-value ratios and rules on valuation of the collateral. And third, due to a strong legal framework and a well-functioning register of property, mortgage banks have reliable access to fast foreclosure. Finally, mortgage loans are more secure than bank loans as they have priority over bank loans in the event of repayment problems.

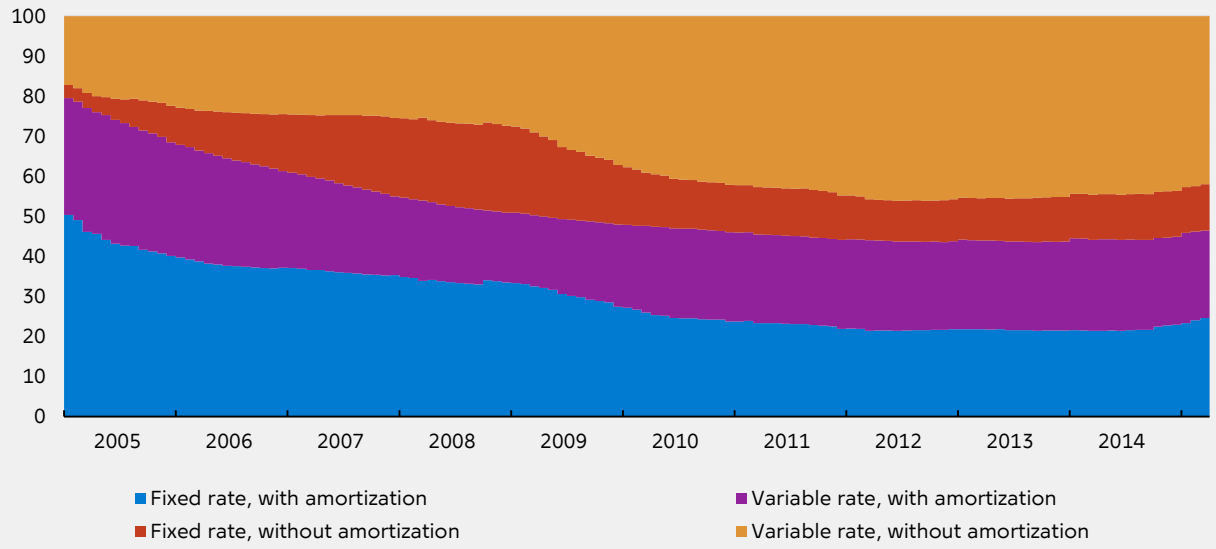
The Danish mortgage system has been functioning for two centuries, but rapid changes have occurred over the past 20 years. Variable interest loans were (re-)introduced in 1996 while interest only loans were introduced in 2003. At the end of 2014, two thirds of the balance of outstanding mortgage loans had a variable interest rate[4], more than half were interest only, and 44 per cent had a combination of the two features, cf. chart 1. The introduction of in particular IO-loans may have increased the risk of short-sighted or irrational behaviour from some groups of households, which focus more on the first-year debt service payments than on the total cost (Dam et al., 2011). Mortgage arrears are, however, still at a low level and recent research has demonstrated that families are generally resilient to interest rate increases and increases in the unemployment rate (Andersen and Duus, 2013).

3 For a more detailed introduction to the Danish mortgage market, see Association of Danish Mortgage Banks (2012).

4 VR-loans (loans with variable interest rate) include both adjustable-rate mortgages, where the interest is fixed in intervals of (commonly) 1, 3, 5 or 10 years, and floating-rate loans (with or without interest rate caps), where the interest rate follows a reference rate and is generally reset in intervals of 3 or 6 months.

Distribution of outstanding mortgage debt across loan types Chart 1

Per cent of total loan balance



Note: Monthly observations.
Source: Danmarks Nationalbank.

3. DATA

The analysis in this paper builds upon a comprehensive dataset constructed from several administrative registers as well as loan level data supplied by all mortgage banks. The data supplied by the mortgage banks covers the population of mortgage loans to Danish households and includes information on loan characteristics such as size, maturity, interest and amortisation profile, loan to value ratio etc. Through the personal identification number we are able to link the mortgage loan data with several administrative registers provided by Statistics Denmark.[5] From these, we obtain information on individual characteristics such as income, savings, pension contributions etc. We use the family identification also provided by Statistics Denmark to aggregate the individual level data to the family level in recognition that most decisions on mortgage financing, savings and consumption are taken at the family level.[6]

Starting from the full population of home-owner families in Denmark, we impose a number of restrictions to obtain the analysis sample. Most importantly, we exclude families in which at least one of the adults is self-employed, since income and wealth are measured imprecisely for those families. Families in which at least one member is not fully liable to taxation in Denmark are also excluded, as are families with a registered income less than 25,000 kr. Finally, we restrict our attention to families who have outstanding mortgage debt. These restrictions mean that the sample consists of nearly one million families, or around 90 per cent of all mortgage borrowers. In

5 See e.g. Kreiner et al. (2015) for an introduction to Danish administrative register data and the link between survey data and register data.

6 A family is defined as either one or two adults plus any children living at home. Two adults are counted as belonging to the same family if they live together, and i) are spouses or registered partners, ii) have at least one joint child registered in the Civil Register (CPR), or iii) are of opposite sex with an age difference of less than 15 years, are not close relatives and live in a household with no other adults. Adults living at the same address who do not meet at least one of the above criteria are counted as members of different families. Children living at home are counted as members of their parents' family if they are under the age of 25, live at the same address as at least one of the parents, have never been married or in registered partnership and have no children registered in CPR. Given these criteria, a family may consist of two generations only. If more than two generations are living at the same address, the family consists of the two youngest generations together.

some of the regressions, we restrict attention further to those families in which the oldest member is less than 60 years, which reduces the number of observations considerably.

A few notes regarding the key variables are necessary. The LTV-ratio is defined as the ratio of total gross debt to the real estate value. The value of real estate is provided by the mortgage banks on an annual basis. As noted in the previous section, the lion's share of property financing in Denmark takes place via specialized mortgage banks. Debt owed to such banks is always secured against real property. However, total debt also includes debt owed to commercial banks and savings banks, which may or may not be secured against property. Unfortunately, our data does not allow us to cleanly separate secured and unsecured debt, and therefore, all debt is included in the nominator. Hence, families with LTV-ratios above 100 per cent are not necessarily insolvent, as they may possess other assets than real estate. Even though the LTV-definition may seem problematic, the following observations justify the use of it. First, results using only loans originated by mortgage banks in the nominator are similar to those presented here. Second, 90 per cent of household debt to commercial banks and mortgage banks is secured by real estate. And third, the total value of cars, which in addition to real estate is the most valuable asset class for most households, corresponds to only around 4 per cent of the value of the housing stock. Therefore, even if cars and unsecured loans are not randomly distributed among the groups of families considered here, which seems likely, the aggregate impact of this is likely to be modest.

Since we have relatively few details regarding bank debt (in contrast to mortgage debt), in the remainder of the paper we will classify households according to their mortgage debt only. That is, when we refer to for example families with IO-loans, we mean families with IO mortgage loans. In the graphical representations, we classify families according to their most 'risky' loan type. That is, a family with a fixed rate loan with amortisation and a variable rate loan without amortisation is classified in the latter category, no matter the relative size of the two loans. In the regression analyses, families with more than one loan type are separately captured by means of a specific dummy variable.

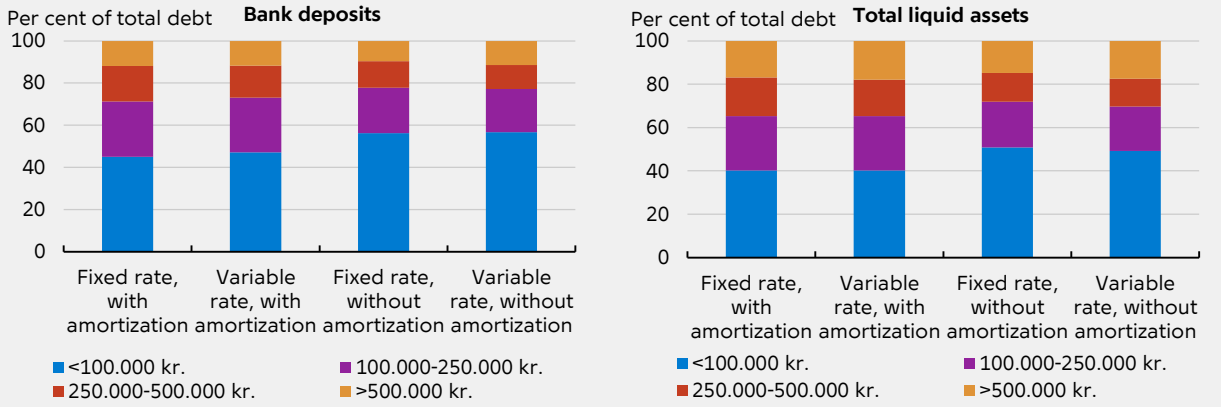
Disposable income is measured as total family income net of taxes, interest payments, alimony, and repaid social benefits. Imputed rent of owner-occupied housing is not included in our measure of disposable income. In addition to the above mentioned restrictions on the families included in the analysis sample, families with extraordinarily large savings rates, loan sizes and LTVs have been excluded from the respective regressions. The cutoff-points have been defined to be approximately equal to the 99^{th} percentile in each case.

4. DIFFERENCES IN THE POOL OF BORROWERS ACROSS LOAN TYPES

We start the analysis of loan types and borrower characteristics by briefly considering the extent to which there is variation in the characteristics of the pool of borrowers with various loan types. A larger share of the IO-debt than the amortising debt is held by families with fewer liquid assets, cf. chart 2. On the other hand, there is no difference in the composition of families across interest rate profiles (fixed vs. variable) within each amortisation profile. The difference is not driven by the pools of families having different age profiles as the same distribution profile is found within more narrow age groups, cf. chart 3. An exception is families in which the oldest member is 60 years or above, in which the pool of families are quite identical measured on their liquid assets across loan types.

Distribution of gross debt by size of households' liquid assets, 2012

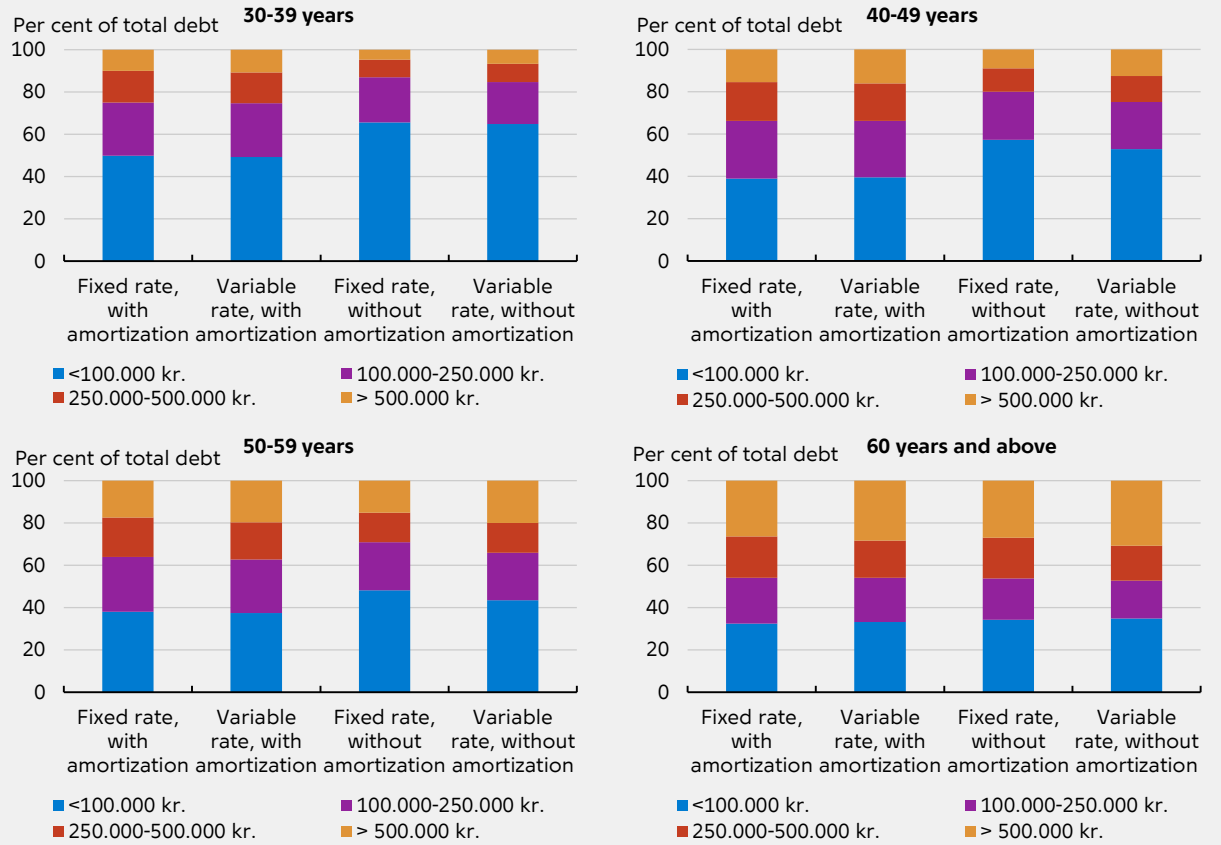
Chart 2



Note: Total liquid assets are defined as bank deposits, market value of bond wealth, market value of mortgage deeds in safe custody and market value of Danish equities and investment fund shares.
Source: Own calculations based on data from the mortgage banks and Statistics Denmark.

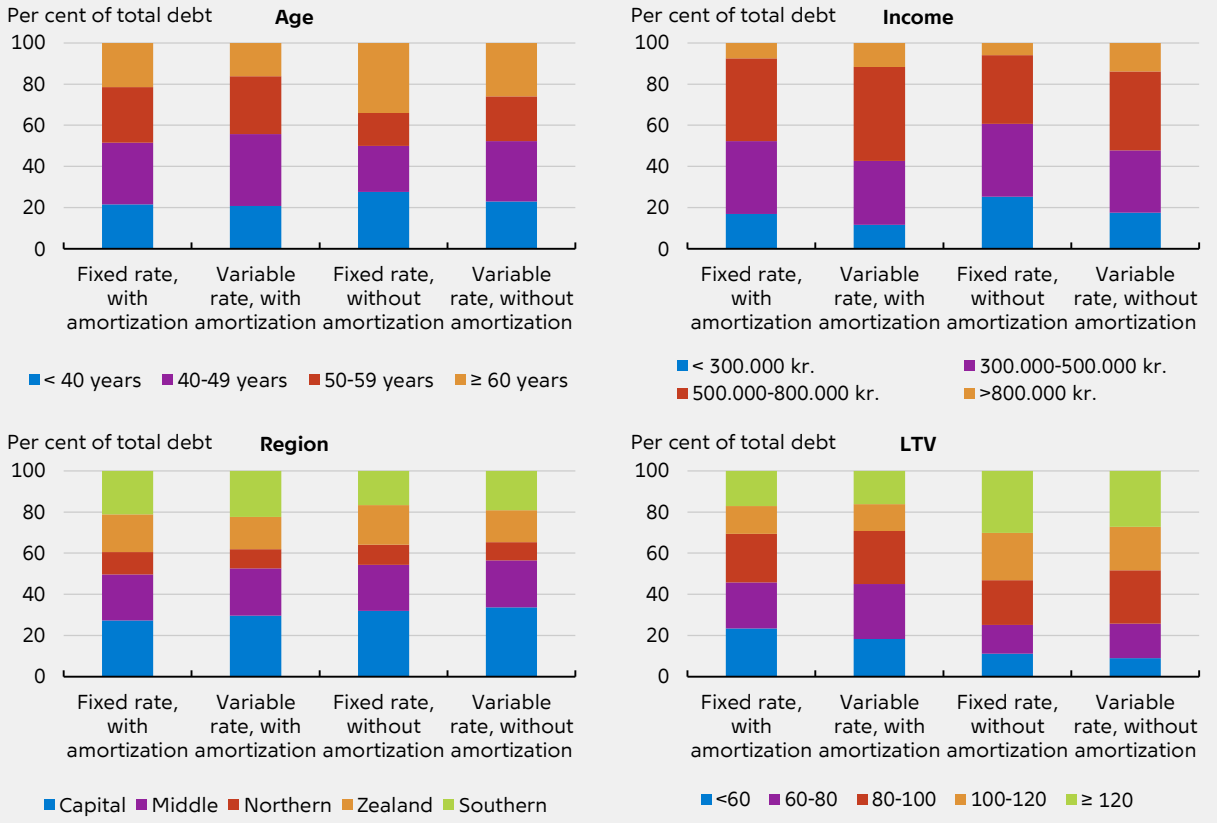
Distribution of gross debt by households' liquid assets, various age groups, 2012

Chart 3



Note: Liquid assets are defined as bank deposits, market value of bond wealth, market value of mortgage deeds in safe custody and market value of Danish equities and investment fund shares.
Source: Own calculations based on data from the mortgage banks and Statistics Denmark.

Distribution of gross debt by families' disposable income, age, region and LTV, 2012 Chart 4



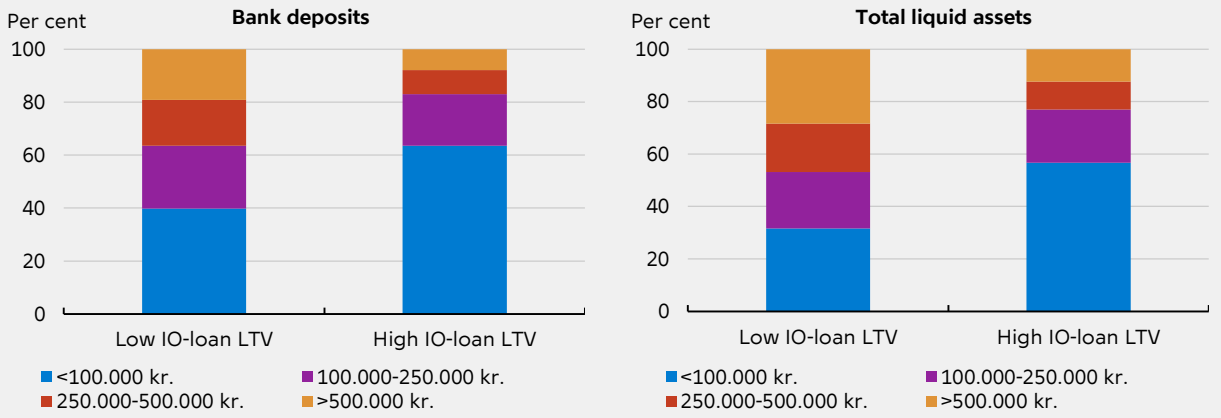
Note: The LTV-ratio is defined as the ratio of total debt (both secured and unsecured) to real estate value. A LTV-ratio above 100 does therefore not necessarily mean that the family is insolvent, as they may have other assets (e.g. cars) than real estate which may or may not be used as collateral for bank loans.
Source: Own calculations based on data from the mortgage banks and Statistics Denmark.

A larger share of the IO-debt is held by older families, cf. chart 4. This is natural, as older families may use IO-loans for e.g. dissaving. Chart 4 also points to a larger share of the VR-debt being held by higher income families, while there is not to the same extent income differences across groups of families with IO and amortising loans.

The breakdown of gross debt by region shows a somewhat higher concentration of IO-debt in the Capital region compared to amortising debt. The final chart of chart 4 is concerned with the distribution of gross debt by the total loan to value ratio (LTV). As discussed in section 3, the nominator in the LTV-calculation includes all debt, also debt which is not secured by real estate, while the denominator includes only the real estate value. A LTV above 100 does therefore not necessarily mean that the family is technically insolvent.[7] A substantially larger share of the IO-debt is held by families with high LTV-ratios. As the following sections will demonstrate, this is likely to be a result of both lower savings and debt reduction rates as well as higher initial LTV-ratios.

7 Results are similar when the LTV is based only on loans from mortgage banks.

Distribution of gross debt by families' bank deposits and total liquid assets, 2012 Chart 5



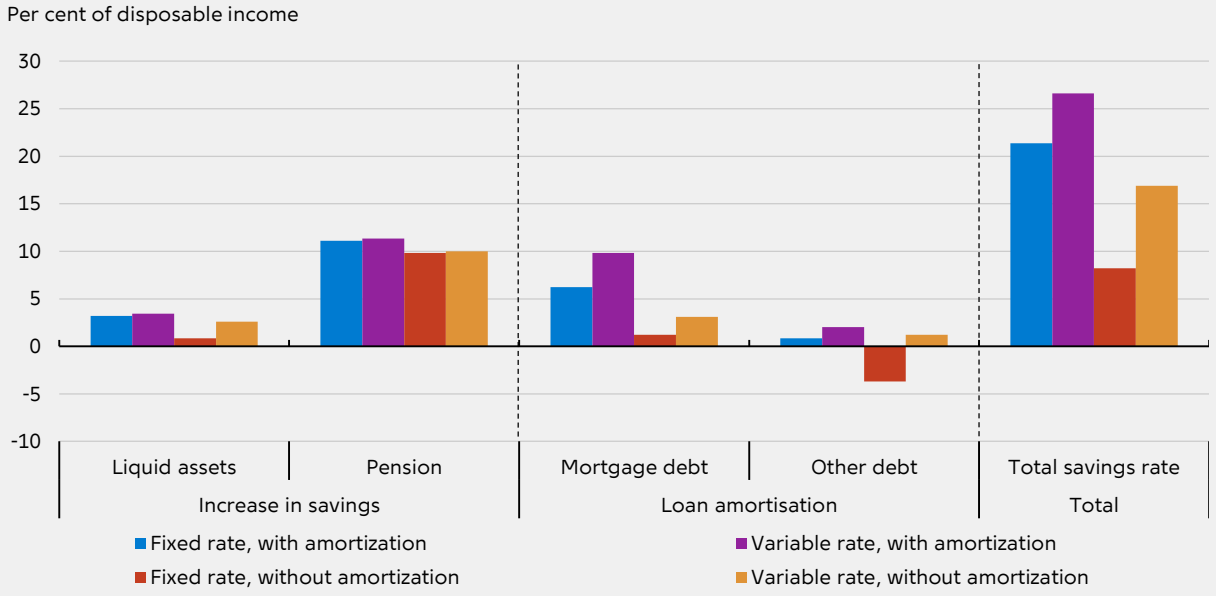
Note: High IO-loan LTV refers to households, which have a loan-to-value ratio with IO-loans of more than 60 per cent. This means that families in the group of low IO-loan LTV may have a total LTV (including fixed rate mortgage debt and other debt) of more than 60 per cent.
Source: Own calculations based on data from the mortgage banks and Statistics Denmark.

The higher share of IO-debt held by families with high LTV-ratios may imply risks to the stability of the mortgage system. Among households with IO-loans, 71 per cent of debt is held by households with IO-loan LTV in excess of 60 per cent (referred to as high LTV). A substantially larger share of the total gross debt is held by families with few liquid assets within the group of families with high IO-loan LTV than within the group of families with IO-loans but lower IO-loan LTV, cf. chart 5. For example, families with high IO-loan LTV and less than 100,000 kr. in liquid assets hold 57 per cent of the total debt, whereas the corresponding share for families with IO-loans but lower IO-loan LTV is 32 per cent. A similar picture (not shown here) emerges when considering VR-loans. Measured by liquid assets, families with high IO-loan LTV do therefore have smaller buffers to cope with unexpected shocks.

5. LOAN TYPES AND SAVINGS PROPENSITY

Having established in the previous section that a larger share of IO-debt than amortising debt is held by families with high LTV-ratios, we in this and following section consider possible reasons for this. In this section, we analyse how savings behaviour varies across families with various loan types, whereas the following section focuses on loan sizes and LTV-ratios at the time of taking the loan.

Average savings rates across loan types, 2012 Chart 6



Note: The data includes all Danish families with mortgage loans, full tax liability in Denmark and total annual income after tax of minimum kr. 25,000 in which the oldest member of the family is under the age of 60, except families including self-employed members and families who bought or sold real property in 2012. The savings surplus is defined as the sum of savings in liquid funds and pensions and debt reduction. Savings in liquid funds cover bank deposits, the market value of equities adjusted for the aggregated development in equity prices (in order to reduce the effect of price fluctuations), the market value of bonds and mortgage deeds in safe custody and foreign assets. Pension disbursements have not been omitted as pension disbursements to people under the age of 60 are seen as insurance disbursements rather than negative savings. Debt reduction has been calculated on a net basis, i.e. new debt raised is included as negative debt reduction. The groups of families are defined such that each family belong to one group only, even if they have multiple loans. The grouping is based on the most 'risky' loan characteristics, e.g. if a family have a combination of loan types including a loan with fixed rate and amortisation and a loan with variable rate without amortisation, it is grouped in the latter no matter the relative size of the loans. In the regression models, families with multiple loan types are separately included.
Source: Own calculations based on data from the mortgage banks and Statistics Denmark.

We start our analysis of savings behaviour by considering the overall savings rate defined as the sum of savings in liquid assets, pension contributions, and amortisation of mortgage debt and other debt, scaled relative to income. Naturally, families with only IO-loans, who do not refinance their loan in a given year, do not amortise their mortgage debt. These families may compensate for the lower mortgage amortisation by reducing other forms of debt or increasing their assets. This is, however, not fully the case, cf. chart 6.[8] Total savings rates are substantially lower for families with IO-loans than for families who only have amortising loans. This is also the case when looking at the individual components of the total savings rate. Hence, for the average borrower, the lower initial repayments associated with IO-loans are not fully used to increase savings in other forms or reduce other, more expensive debt.[9]

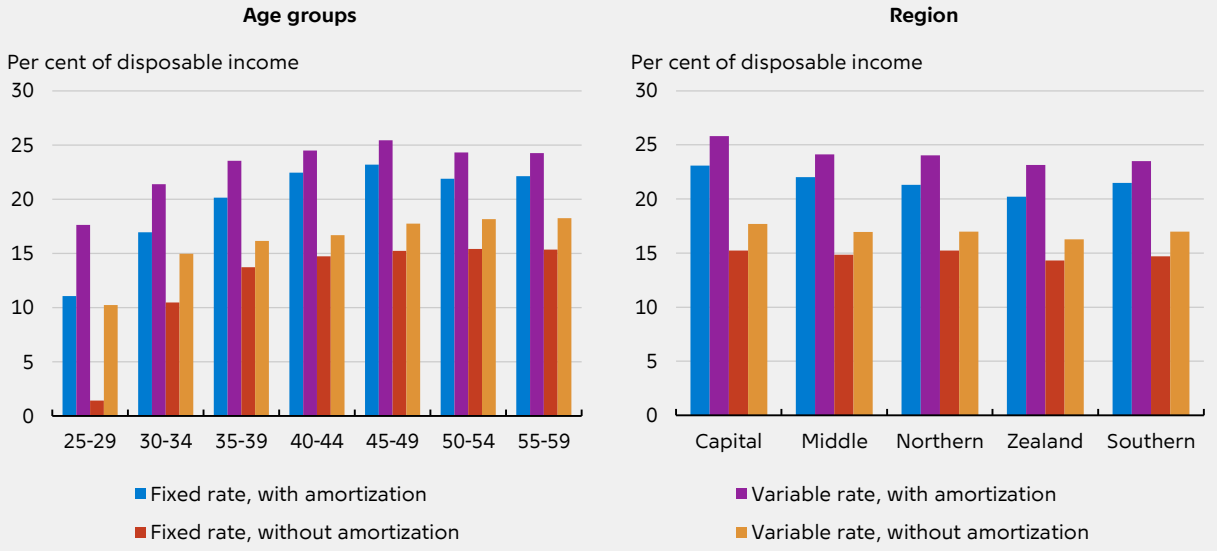
As demonstrated in the previous section, the composition of the four groups of families are not identical. However, the differences in savings rates across loan types are not only a result of different age groups or geographical composition of the groups. Similar differences can be found within groups defined by age and geography, cf. chart 7.

8 The reasons for the positive mortgage amortisation rate observed in chart 6 for families with IO-loans include 1) that families with more than one loan type are classified according to their 'most risky' loan type in the graphical representations, and 2) that reductions of mortgage debt by refinancing a mortgage loan is also counted as amortisation. Families who bought or sold real estate in 2012 are not included in the chart.

9 The median borrower may be more representative than the average borrower. The reason for focusing on the average rather than the median in chart 6 is the more intuitive graphical representation in that the total savings rates can be directly constructed as the sum of the individual components. The same picture emerges when considering medians in stead of averages.

Median savings rates across age groups and regions, 2012

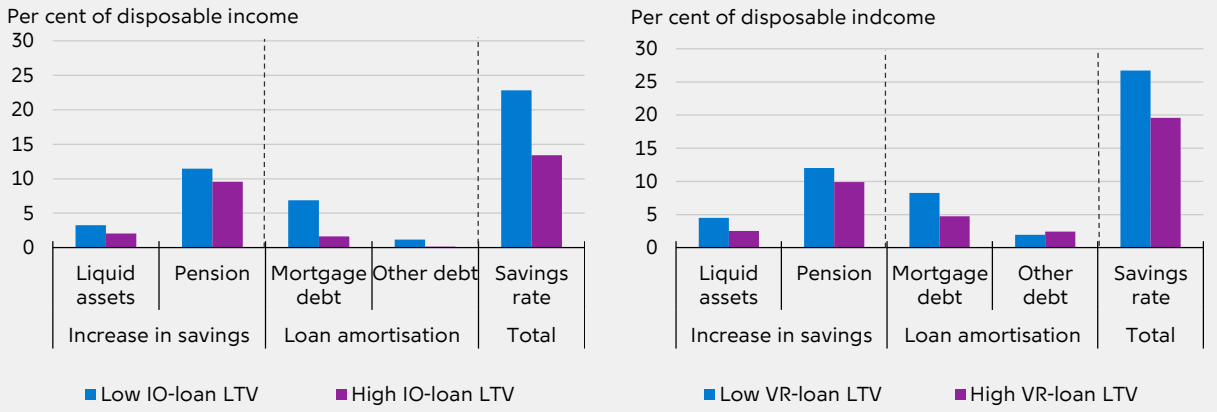
Chart 7



Note: See note to chart 6.
Source: Own calculations based on data from the mortgage banks and Statistics Denmark.

Average savings rates by loan type and LTV, 2012

Chart 8



Note: See note to chart 6. Families in the 'low IO-loan LTV' group have an LTV ratio of up to 60 per cent in IO-loans, while the 'high IO-loan LTV' group comprises families with an LTV ratio of more than 60 per cent in IO-loans. Note that only the ratio of IO-loans is included, so households in the 'low IO-loan LTV' category may also have mortgage loans with amortisation, bank debt or other debt bringing the total LTV ratio to more than 60 per cent. The parallel definitions are applied for VR-loans.
Source: Own calculations based on data from the mortgage banks and Statistics Denmark.

Families with high LTV are more sensitive to house price fluctuations. In particular families with high LTV and IO-loans are sensitive due to the fact that IO-loans do not to the same extent as amortising loans imply that a certain distance to the legal maximum LTV ratios is build up over time. Within the groups of families having IO-loans, those with high IO-loan LTV ratios have substantially smaller savings rates than those with lower IO-loan LTV ratios, cf. chart 8. This is the case both when considering the average rates in chart 8 as well as within more homogeneous groups based on e.g. age and geography (Danmarks Nationalbank, 2014a, pp. 19-20). The same picture, although to a smaller extent, is found for families with VR-loans, cf. chart 8.

Savings propensity is likely to be correlated with various borrower characteristics. For example, savings propensities most likely differ across age groups because of families being in different life-cycle stages. The differential savings behaviour across loan types, which seems to be implied by the charts, may therefore potentially be ascribed to simple composition effects across groups. Hence, it is useful to consider the correlation between loan types and savings propensity in a regression framework, controlling for such borrower characteristics. We therefore estimate the following regression model:

$$S_{it} = \alpha + \delta_1 VR_{it} + \delta_2 IO_{it} + \delta_3 VR_{it} * IO_{it} + \delta_4 ML_{it} + \beta X_{it} + \varepsilon_{it} \quad (1)$$

where the savings rate, denoted by S_{it}, is defined as total savings divided by disposable income. VR_{it} and IO_{it} refer to dummy variables for variable rate and interest only loans, respectively, whereas ML_{it} is a dummy for families having more than one of the four loan types.[10] The subscripts refer to household *i* and year *t*. We estimate the model using data from 2009 and 2012.

The vector of control variables, X_{it}, utilizes the very large number of observations and the rich set of controls available. Included in X_{it} is flexible specifications of age, disposable income and LTV (i.e. dummy variables for age groups in 5 year intervals, income in 50,000 kr. intervals and LTV-ratio in intervals of 20 percentage points). We also include net wealth, stock of liquid assets, number of children, number of years lived at the current address, and dummies for retired family members and higher education in the family.

To further investigate the interaction of loan types and high LTV as illustrated in chart 8, we also estimate an extended version of equation (1), namely:

$$S_{it} = \alpha + \delta_1 VR + \delta_2 IO_{it} + \delta_3 VR_{it} * IO_{it} + \delta_4 ML_{it} + \gamma_1 HLVR_{it} + \gamma_2 HLIO_{it} + \gamma_3 HLVRIO_{it} + \beta X_{it} + \varepsilon_{it} \quad (2)$$

where $HLVR_{it}$ and $HLIO_{it}$ are dummy variables for high loan to value ratio (i.e. over 60 per cent) with VR and IO-loans respectively, and $HLVRIO_{it}$ is a dummy for high loan to value with the combination of VR and IO-loans.[11]

Results from estimation of equations (1) and (2) are presented in table 1. Columns (1) and (4) of the table expresses the 'raw' differences between average savings rates across families with various loan types, i.e. equation (1) without the control variables, βX_{it}. In 2012, for example, savings rates of families with IO-loans are on average 7.8 percentage points lower than families with amortising loans. Savings rates for families with VR-loans are on average 1.7 percentage points higher than for families with fixed rate loans. The combination of VR and IO-further reduces average savings rates by an insignificant -0.1 percentage points (in the specification without control variables), meaning that families with this combination of loans on average have savings rates that are 6.3 percentage points lower than families with fixed rate and amortisation (the sum of the coefficients on VR, IO and VR*IO). These effects are sizeable given that the average savings rate for the whole population is 9.5 per cent, and for families with fixed rate and amortisation is 19.3.

[10] If a family has more than one loan type, the family is classified as $ML_{it} = 1$, $VR_{it} = 0$ and $IO_{it} = 0$.

[11] Note that the conditions for these dummy variables are that the LTV ratio *for the VR / IO / VR and IO loans* should be high. Families with the full loan amount in e.g. IO-loan, but with a total LTV less than 60 per cent, are thus not covered by the definition. Families with two or more loans are only covered by the definition if the LTV for the VR / IO / VR and IO loan is more than 60 per cent.

Regression models of savings rates Table 1

	2009			2012		
	(1)	(2)	(3)	(4)	(5)	(6)
Variable Rate (VR)	2.037***	3.494***	2.290***	1.690***	1.416***	0.694***
	(0.121)	(0.117)	(0.136)	(0.110)	(0.109)	(0.132)
Interest Only (IO)	-9.634***	-3.972***	-3.017***	-7.838***	-4.210***	-3.016***
	(0.127)	(0.128)	(0.214)	(0.137)	(0.141)	(0.254)
VR * IO	0.424**	-1.409***	-0.787***	-0.144	-0.975***	-0.785**
	(0.182)	(0.175)	(0.288)	(0.175)	(0.175)	(0.308)
Combination of types	1.506***	2.924***	2.412***	0.443***	0.312***	0.055
	(0.093)	(0.092)	(0.102)	(0.086)	(0.088)	(0.102)
High VR-loan LTV			2.145***			1.119***
			(0.128)			(0.115)
High IO-loan LTV			-1.021***			-1.294***
			(0.210)			(0.237)
High VR-loan LTV * High IO-loan LTV			-1.469***			-0.543*
			(0.286)			(0.290)
Control variables	No	Yes	Yes	No	Yes	Yes
No. of. obs.	609,638	606,721	606,721	590,132	549,398	549,398
R squared	0.023	0.104	0.105	0.020	0.067	0.067

Note: All households, in which the oldest member is less than 60 years, are included in the regressions. Households where the oldest member is 60 years or above are excluded due to their different savings profile and due to the fact that pension savings should otherwise be treated differently for this group (payouts from pension schemes are here defined as income and not dissaving). Control variables include age, income, LTV, net wealth, stock of liquid assets, number of children, number of years lived at the current address, and dummies for retired and higher education.
Source: Own calculations based on data from the mortgage banks and Statistics Denmark.

Controlling for potential differences among groups of families with various loan types reduces the absolute magnitudes of the VR and IO coefficients to 1.4 and -4.2, respectively, in 2012 (column 5). However, families with the combination of VR and IO-loans have a further significant reduction in the expected savings rate of 1.0 percentage points, meaning that the large group of families with the combination of VR and IO-loans have an average savings rate which is 3.8 percentage points lower than families with fixed rate and amortisation, controlling for differences between groups. Families who have more than one type of loan have an average savings rate which is 0.3 percentage points higher than families with fixed rate and amortisation.

Columns (3) and (6) of table 1 considers the extent to which families with high loan to value ratios and VR and IO-loans differ in their savings propensity. Again, we focus on 2012. When we include the indicators of high LTV within individual ('risky') loan types, the estimated coefficients on the loan type variables (the δ's) become numerically smaller, while the coefficients on the interaction variables (the γ's from equation 2) are significant and point in the same direction as those on the corresponding δ's. This indicates that the savings behavior implied by each of the loan types is reiterated if households have high LTV's using the specific loan types. Combining the estimated coefficients, we find that families with high LTV's in the combination of VR and IO-loans on average have a savings rate which is 3.8 percentage points lower than families with fixed rate and amortising loans and LTV within the same range.[12] This is almost exactly the same point

[12] Note that the LTV is included in the control variables, represented by dummy variables in 20 percentage points intervals. Coefficient estimates on these variables (not reported in the table) indicate that savings rates are considerabely lower for higher values of LTV. The relation is highly non-

estimate as the one obtained for the combined VR and IO group overall. For families with the combination of VR and IO-loans with low LTV, the average savings rate is still 3.1 percentage points lower than similar households with fixed rate and amortising loans, meaning that the additional effect of high LTV with VR and IO is in the range of -0,7 (the sum of the γ-estimates).

In light of these substantial differences in savings rates across families with various loan types, it can be useful to consider a decomposition into individual components of the savings rate. Recall that the savings rate is defined as the increase in liquid assets, pension contributions and reduction of debt (mortgage debt and other debt). Table 2 displays estimates of equation (1) using the individual savings components as dependent variables. Obviously, families with IO-loans reduce their mortgage debt by far less than families with amortising loans. They do, however, use a higher fraction of their income to repay other debt than families with amortising loans. The fraction of disposable income, which families with IO-loans use for amortising other debt, is on average 1.5 percentage points higher than families with amortising loans. For families with the combination of VR and IO-loans, the fraction is 1.9 percentage points higher than families with fixed rate amortising loans. Overall, however, this is not enough to bring amortisation rates up to the level of families with amortising mortgage loans.

Regression models of the components of savings, 2012

Table 2

	Increase in savings		Reduction of debt	
	Liquid assets	Pension	Debt to mortgage banks	Other debt
Variable Rate (VR)	-0.580***	-0.093***	2.861***	-0.770***
	(0.099)	(0.032)	(0.032)	(0.098)
Interest Only (IO)	-0.616***	0.043	-5.167***	1.530***
	(0.128)	(0.042)	(0.042)	(0.126)
VR * IO	0.846***	-0.448***	-2.481***	1.107***
	(0.158)	(0.051)	(0.052)	(0.156)
Combination of types	-1.021***	-0.287***	1.588***	0.032
	(0.080)	(0.026)	(0.026)	(0.078)
Control variables	Yes	Yes	Yes	Yes
No. of. obs.	549,398	549,398	549,359	549,398
R squared	0.024	0.116	0.191	0.007

Note: Coefficient estimates from regressions of equation (1), with the individual components of the savings rate as dependent variables. Liquid assets is defined as the sum of bank deposits, market value of equities adjusted for the aggregate development in equity prices, market value of bonds and mortgage deeds in safe custody and foreign assets. All households, in which the oldest member is less than 60 years, are included in the regressions. Payouts from pension schemes are deducted from pension savings as it is considered income and not dissaving for households in the working age groups. Control variables include age, income, LTV, net wealth, stock of liquid assets, number of children, number of years lived at the current address, and dummies for retired and higher education.

Source: Own calculations based on data from the mortgage banks and Statistics Denmark.

An alternative way to save than reducing debt may be to increase savings in liquid assets. Families with VR and IO-loans have on average lower savings rates than families without these loan types. The differences are statistically significant, but not large in magnitude. Families with the combination of VR and IO on average use 0.4 percentage points less of their income to increase their savings in liquid assets. The final component of the savings rate is pension contributions. Differences in the fraction of income used for pension contributions are not large,

linear, meaning that the group of families with LTV's exceeding 100 per cent have by far lower savings rates than other families with similar characteristics but lower LTV.

which would also be as expected given that compulsory pension schemes are widely used, and since we control for e.g. income and life cycle characteristics. Families with the combination of VR and IO-loans do, however, use approximately 0.5 percentage points less of their income for pension contributions.

We conclude the analysis of savings behaviour by investigating whether variation in savings propensity with loan types is the same for families with different savings propensities. We do this by estimating a series of quantile regressions of equation (1).

Results are presented in chart 9. The savings rate differential between families with VR loans and families with fixed rate loans is increasing in the (conditional) savings rate quantile. This indicates that the positive association between VR-loans and savings rates found in table 1 is mostly caused by families with high savings propensities saving more, whereas the difference is smaller or non-existing for families with low savings propensities.

In contrast, we find that the savings rate differential between families with IO-loans and families with amortising loans is somewhat larger for families with high savings propensities than for families with low savings propensities. However, the differences between families with high and low (conditional) savings rates are relatively small, and the effect is significantly negative and sizeable also for families with low savings propensities.

The interaction term of the VR and IO variables included in equation (1) was found to be significant and negative in the results presented in table 1. The quantile regression estimates demonstrate that this result is mainly driven by the families with low savings propensities.[13] Combining the effects of VR, IO and the interaction term yields the third chart of chart 9, which is perhaps the most relevant of the four charts since the combination of VR and IO-loans is the most prevalent combination on an aggregate scale. We clearly see that the savings rate differential between families with fixed rate amortising loans and families with variable rate IO-loans is largest for the families with the lowest savings propensity. This indicates that in particular families with a low savings propensity seems to take advantage of the lower instalments required by IO-loans to reduce their savings rate.

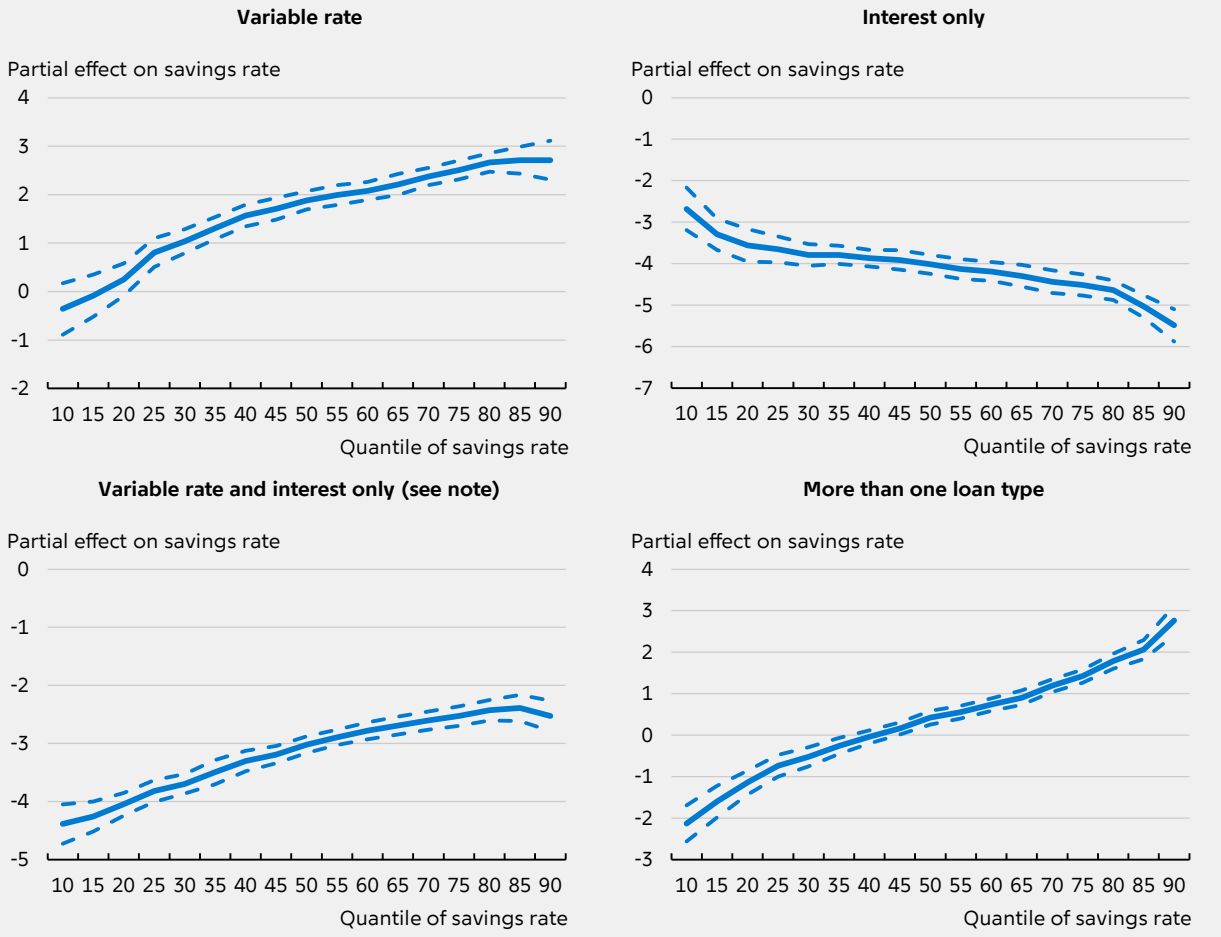
Finally, we see that the savings rate differential between families with more than one loan type and families with only fixed rate amortising loans varies substantially across the (conditional) savings rate. In particular, this indicates that there is substantial heterogeneity within the group of families with more than one loan type. Households with high savings propensities seem to use a combination of loan types to increase their savings even further, whereas families with low savings propensities save less when they have multiple loan types than similar families with fixed rate amortising loans.

Overall, we conclude that families with IO-loans in general have lower savings rates than families with amortising loans, and in particular that families with the combination of VR and IO-loans have lower savings rates. The difference is largest for those families who have the lowest savings propensity, and those with a high LTV. This indicates that some groups of families use the relatively lower initial payments associated with IO-loans to reduce their savings rate. We cannot by our results rule out that these families would have found other ways to reduce their savings rate in the absence of the possibility to take an IO-loan. On the other hand, the existence of IO-loans has likely facilitated lower savings for those families.

[13] This is not directly visibe in the chart, since the third chart of chart 9 displays the sum of the coefficients on the IO and VR variables and the interaction term.

Quantile regression estimates, 2012

Figur 9



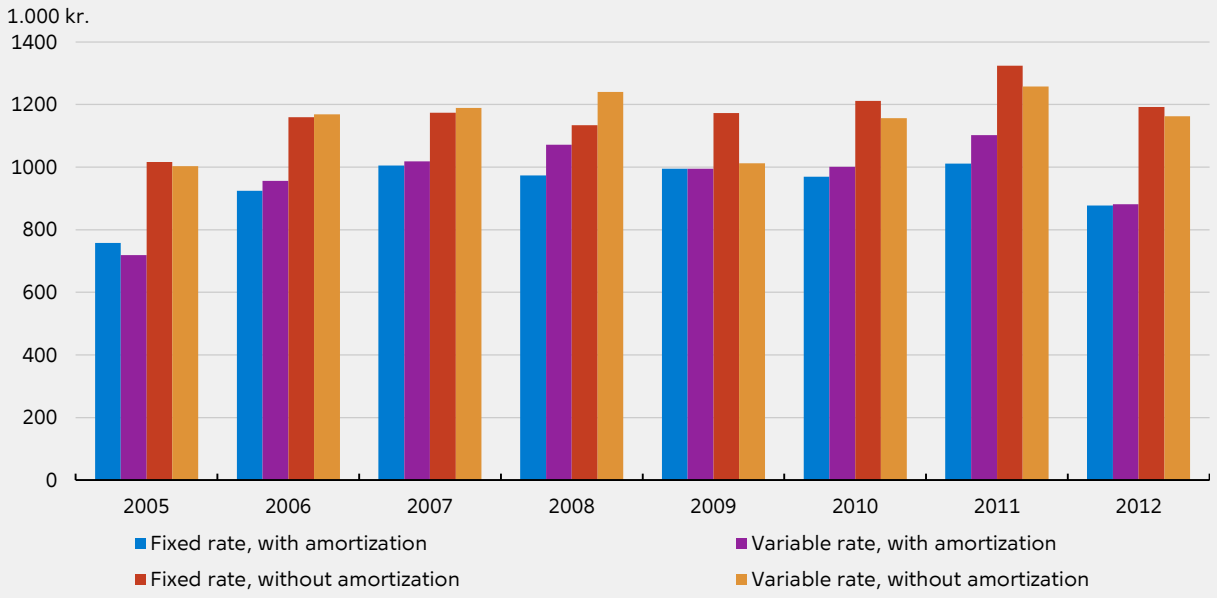
Anm.: Quantile regression estimates of equation (1). Solid lines indicate quantile regression estimates, while dashed lines indicate 95 per cent confidence intervals. Geographical variables are excluded from the models due to computational limitations. The chart for the combination of variable rate and interest only loans has been constructed by a separate set of quantile regressions with a dummy for this combination and a dummy for more loan types included along with the control variables. This method has been chosen in order to obtain a comparable confidence interval. Point estimates are similar to those obtained by summing the quantile regression estimates of coefficients on the VR, IO and VR*IO variables by equation (1).

Kilde: Own calculations based on data from the mortgage banks and Statistics Denmark.

6. LOAN TYPES AND LEVERAGE

In addition to savings behaviour after loan uptake, a concern in the debate has also been that families with VR or in particular IO-loans may be more concerned with the repayment obligations in the first years of the loan than in the more distant future (Dam et al., 2011). This may give rise to differences in initial loan sizes across loan types, and may also contribute to a more volatile house price development. In particular, the introduction of IO-loans may have lead some families to take larger loans than they would have done, if they had needed to start amortising the loan partly or in full from the date of loan uptake.

Median loan size at uptake of loan, first time borrowers Chart 10



Note: Loan size is defined as the change in outstanding debt (including non-mortgage debt) during year of loan take-up. First time borrowers are defined as families, which did not have any mortgage debt at the end of the previous year. For the years prior to 2009, data only include families who still have the loan outstanding at the end of 2009. For 2009 and subsequent years, all loans taken in the given year, which is still outstanding at the end of the year, are included.
Source: Own calculations based on data from the mortgage banks and Statistics Denmark.

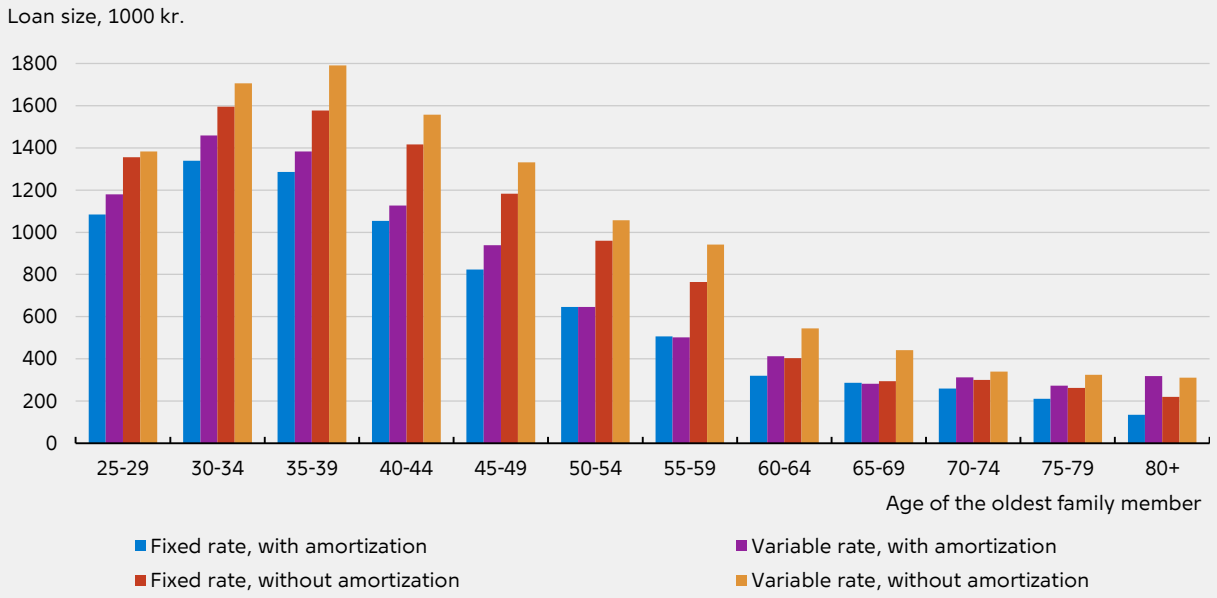
We start looking into the issue of loan types and loan size by considering the change in total outstanding debt during the year of loan uptake for families that did not have any outstanding mortgage debt at the beginning of the year (i.e. mostly first time buyers). This ensures that results are not driven by loan refinancing activity, which is common in Denmark. In all years in the period 2005-12, the median loan size for new mortgage borrowers who chose an IO-loan has been larger than the median loan size for families that took an amortising loan with the same interest profile, cf. chart 10.

The median loan sizes presented in chart 10 may in principle merely be a result of different borrowers choosing different loan types. Obviously, if life cycle effects impact both the type of loan chosen and the loan size, the pattern revealed by the charts may just be a result of a different age composition of the groups. However, we find that the same pattern is found within relatively narrow bands of age groups, cf. chart 11. We will return to this issue shortly in a more formal setting.

The higher median loan sizes for families with VR and IO-loans may also arise if families who choose these types of loans in general buy more expensive real estate (or real estate which may be expected to increase more in value) than families with other loan types. There is some evidence that families in the Capital region to a slightly larger extent than families in the other parts of the country use IO-loans, and at the same time, house prices are generally higher in this region. However, the same pattern as in chart 10 is found within regions, cf. chart 12.

Median loan size by loan type and age of the oldest family member, first time borrowers, 2012

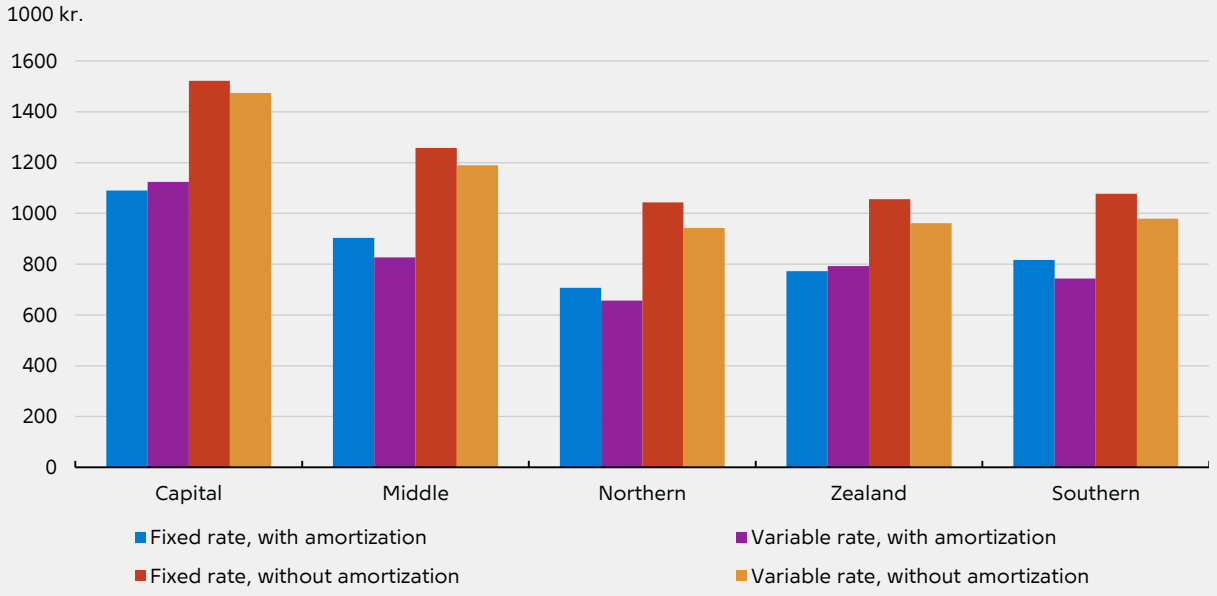
Chart 11



Note: Loan size is defined as the change in outstanding debt (including non-mortgage debt) during 2012. First time borrowers are defined as families, which did not have any mortgage debt outstanding at the end of 2011.
Source: Own calculations based on data from the mortgage banks and Statistics Denmark.

Median loan size by loan type and region, first time borrowers, 2012

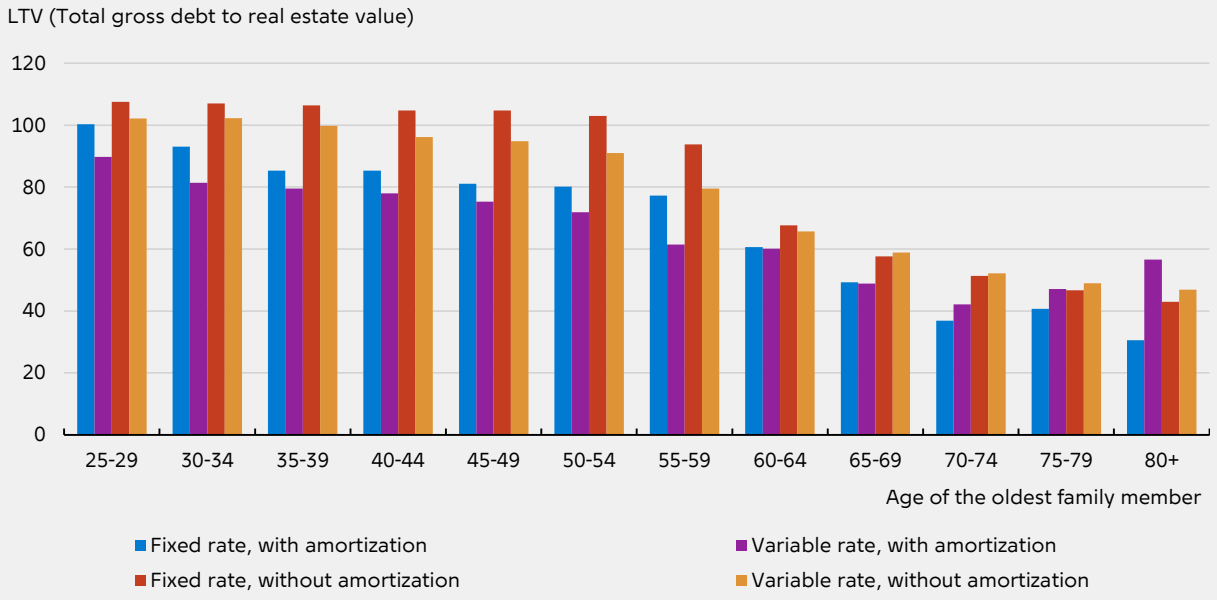
Chart 12



Note: Loan size is defined as the change in outstanding debt (including non-mortgage debt) during 2012. First time borrowers are defined as families, which did not have any mortgage debt outstanding at the end of 2011.
Source: Own calculations based on data from the mortgage banks and Statistics Denmark.

Median loan-to-value ratios, first time borrowers, 2012

Chart 13

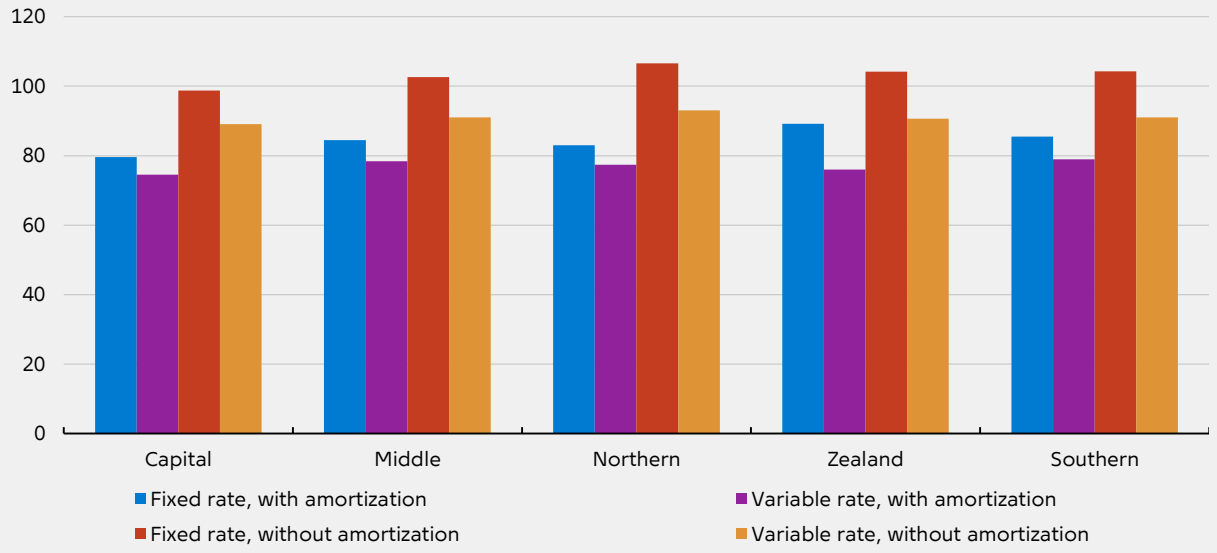


Note: For the calculation of the loan to value ratio (LTV), all debt, also debt which is not secured by real estate, is included in the nominator. Only value of real estate is included in the denominator. The value of real estate is estimated by the mortgage banks. First time borrowers are defined as families, which did not have any mortgage debt outstanding at the end of 2011.

Source: Own calculations based on data from the mortgage banks and Statistics Denmark.

Median loan-to-value ratios by region, first time borrowers, 2012

Chart 14



Note: For the calculation of the loan to value ratio (LTV), all debt, also debt which is not secured by real estate, is included in the nominator. Only value of real estate is included in the denominator. The value of real estate is estimated by the mortgage banks. First time borrowers are defined as families, which did not have any mortgage debt outstanding at the end of 2011.

Source: Own calculations based on data from the mortgage banks and Statistics Denmark.

Since there is large variation also within regions, a more convincing approach to assess this issue may be to consider the extent to which the LTV-ratio differs among families with various loan types. We focus here on the LTV-ratio at the end of the year for families who took a mortgage loan in 2012 (latest available data) and who did not have any outstanding mortgage debt at the end of 2011. We base the LTV-ratio on the property value estimate provided by the mortgage bank, which is likely to be quite reliable in the year of loan uptake, since in most cases, the property has been traded during the year of loan uptake and the actual sales price is available to the mortgage banks. Within age groups and regions, we find that families who choose IO-loans have larger total LTV ratios than families who choose to amortise their mortgage loans, cf. chart 13 and 14.

Also in the case of loan sizes and LTV's, the charts presented are bivariate relations and may hide heterogeneity within the defined groups. Therefore, we again complement the graphical presentation with a regression analysis of the extent to which loan sizes and LTV's vary with loan types, controlling for a wide range of family characteristics. We specify a regression model similar to equation (1), only now with the change in outstanding debt, and the LTV ratio at the end of the year, as dependent variables. We focus on loans taken up in 2012, which is the latest year with available data. We estimate the models separately for two groups of families, namely first time borrowers (i.e. families who did not have any outstanding mortgage debt at the end of 2011) and other families who took a new mortgage loan in 2012.

Results confirm that the patterns, which were revealed by the charts, are also present when controlling for differences within the groups used in the charts, cf. table 3. We begin by considering first time borrowers, defined as families who did not have any outstanding mortgage debt at the end of 2011 (panel A of table 3). For this group of families, those who have chosen an IO-loan have on average borrowed around 260,000 kr. more than families who have chosen a loan with amortisation. Controlling for borrower characteristics reduces this figure somewhat, but it is still the case that families with IO-loans have taken significantly larger loans than families with amortising loans. The estimated difference in loan sizes, controlling for a wide range of family characteristics, is around 240,000 kr. On the other hand, when controlling for family characteristics, families with VR-loans have increased their total debt by around 76,000 kr. less than families with fixed rate loans. The coefficient on the combination of VR and IO-loans is insignificant, meaning that a conservative estimate (setting the VR*IO-coefficient to 0) of the difference between families with a combination of VR and IO-loans and families with fixed rate loans with amortisation is 164,000 kr., where the latter have the smallest loans. The difference is more likely to be around 200,000 kr. taking into account the (insignificant) coefficient estimate of the VR*IO variable. Families who choose two or more of the four loan types also take out larger loans than families who only choose fixed rate amortising loans, the point estimate is around 180,000 kr.

Loan types, loan sizes and LTV: Regression estimates Tabel 3

Panel A: First time borrowers

Dependent variable	Change in outstanding debt		LTV	
	(1)	(2)	(3)	(4)
Variable Rate (VR)	-17,780	-76,206***	-6.557***	-2.329***
	(29,933)	(24,247)	(1.065)	(0.870)
Interest Only (IO)	256,079***	240,144***	10.798***	10.484***
	(20,417)	(16,726)	(0.709)	(0.586)
VR * IO	-61,473*	45,529	-4.614***	-0.664
	(36,269)	(29,298)	(1.278)	(1.041)
Combination of types	375,132***	179,718***	7.743***	4.885***
	(18,070)	(14,746)	(0.630)	(0.519)
Control variables	No	Yes	No	Yes
No. of. obs.	28,158	28,158	26,911	26,911
R squared	0.018	0.366	0.018	0.357

Panel B: Other families who took a new mortgage loan in 2012

Dependent variable	Change in outstanding debt		LTV	
	(1)	(2)	(3)	(4)
Variable Rate (VR)	53,351***	23,610***	-0.367	-0.134
	(7,826)	(7,636)	(0.352)	(0.278)
Interest Only (IO)	24,165***	13,494**	10.729***	11.969***
	(6,294)	(6,323)	(0.282)	(0.230)
VR * IO	6,826	6,014	-1.221***	-1.982***
	(10,331)	(10,053)	(0.464)	(0.366)
Combination of types	228,948***	179,195***	0.823***	2.731***
	(4,674)	(4,620)	(0.209)	(0.168)
Control variables	No	Yes	No	Yes
No. of. obs.	179,711	179,711	177,693	177,693
R squared	0.014	0.070	0.016	0.389

Note: First time borrowers are defined as families who did not have any outstanding mortgage debt at the end of 2011 and who took a mortgage loan in 2012. Other families are defined as families who had outstanding mortgage debt at the end of 2011 and who took a (new) mortgage loan in 2012.
Source: Own calculations based on data from the mortgage banks and Statistics Denmark.

As already noted, the higher loan sizes taken by families with particularly IO-loans may reflect that they buy more expensive real estate but do not have higher LTV's. However, this hypothesis is not confirmed by the results presented in columns 3 and 4 of panel A in table 3. While some parts of the differences revealed in chart 13 and 14 may be ascribed to differences in the composition of groups, families who took an IO-loan have significantly higher LTV-ratios at the end of the year than similar families who took an amortising loan – on average the difference is 10.5 percentage points. Families with VR-loans have on average LTV ratios which are 2.3 percentage points lower. Since the coefficient on the VR*IO variable is insignificant, first time borrowers who combined VR and IO-loans on average have LTV-ratios which are 8.2 percentage points higher than families with fixed rate amortising loans. Finally, families with more than one of the four loan types have LTV-ratios which are nearly 5 percentage points higher than families with fixed rate amortising loans.

Panel B of table 3 provides corresponding estimates for families who had outstanding mortgage debt at the end of 2011 and took a new loan in 2012. These families either refinanced or extended their mortgage or bought a new house in 2012. In spite of the much more diverse group of households and a less clear expectation to the relation between loan types and LTV, we find generally the same pattern as for first time borrowers.

These results indicate that some families use the lower initial instalments associated with IO-loans to take out larger loans than they would otherwise have done, had there been a legal limit on the maximum LTV for IO-loans. The widespread use of IO-loans is therefore likely to have implications for the volatility of house prices.

7. CONCLUDING REMARKS

This paper has presented a number of stylized facts regarding how savings behaviour and leverage varies across families with different mortgage loan types. We find that a larger share of the total IO-debt is held by families with fewer liquid assets and higher LTV. Furthermore, families with IO-debt have lower savings rates and higher initial LTV-ratios. The differences in savings propensity and leverage cannot be interpreted in a causal fashion. Rather, it is very likely that families with low savings propensities are more likely to choose the loan types which imply the least savings, and similarly that families who are more short-sighted than other choose the loan types which imply the least initial debt service payments – and perhaps also use such loans to buy more expensive property than they would otherwise have done. However, it is also widely accepted that the introduction of IO-loans has made it easier than it would otherwise have been for home-owner families to save less and increase their leverage. Therefore, even if no formal causal relation has been established at the individual borrower level, IO-loans are still likely to have facilitated lower savings and higher leverage for some households, as well as to have contributed to an increase in property prices.

Families may have different preferences for building up savings, and as long as it does not interfere with financial stability, there may be no need for regulating savings. However, it is essential to design the mortgage credit system in such a way that bonds remain secure and the system is still robust in periods when house prices fall. Danmarks Nationalbank (2014b) has therefore proposed that legislation should be introduced to reduce the LTV limit for IO-loans as a ratio of the value of the home at the time of mortgaging. In this way, borrowers will automatically build up a certain distance to the LTV limit over time, and therefore be more resilient to plummeting house prices.

LITERATURE

Andersen, Asger Lau, Anders Møller Christensen, Charlotte Duus and Ri Kaarup (2012), Danish Families' Financial Robustness, Variable Rates and Deferred Amortisation, *Danmarks Nationalbank Monetary Review*, 4th quarter, Part 2, pp. 1-52.

Andersen, Asger Lau and Charlotte Duus (2013), Danish Families in Mortgage Arrears, *Danmarks Nationalbank Monetary Review*, 3rd quarter, Part 2, pp. 61-118.

Association of Danish Mortgage Banks (2012), *The traditional Danish mortgage model*, available online on http://www.realkreditraadet.dk/Danish_Mortgage_Model.aspx.

Dam, Niels Arne, Tina Saaby Hvolbøl, Erik Haller Pedersen, Peter Birch Sørensen and Susanne Hougaard Thamsborg (2011), Developments in the Market for Owner-Occupied Housing in Recent Years – Can House Prices be Explained?, *Danmarks Nationalbank Monetary Review*, 1st Quarter, Part 2, pp. 1-81.

Danmarks Nationalbank (2014a), Current Economic and Monetary Trends, *Danmarks Nationalbank Monetary Review*, 4th Quarter, pp. 7-40.

Danmarks Nationalbank (2014b), *Financial Stability*, 2nd Half, December.

Gundersen, Poul, Stig Secher Hesselberg and Sean Hove (2011), Danish Mortgage Credit, *Danmarks Nationalbank Monetary Review*, 4th Quarter, Part 1, pp. 59-82.

Hull, Isaiah (2015), Indebtedness: An Application to Swedish-Style Mortgages, *Sveriges Riksbank Working Paper*, no. 298, April.

Isaksen, Jakob, Paul Lassenius Kramp, Louise Funch Sørensen and Søren Vester Sørensen (2011), Household Balance Sheets and Debt – an International Country Study, *Danmarks Nationalbank Monetary Review*, 4th Quarter, Part 2, pp. 39-81.

Kreiner, Claus Thustrup, David Dreyer Lassen and Søren Leth-Petersen (2015), Measuring the Accuracy of Survey Responses using Administrative Register Data: Evidence from Denmark, in Christopher Carroll, Thomas Crossley and John Sabelhaus (Eds.), *Improving the Measurement of Household Consumption Expenditures*, NBER Book Series Studies in Income and Wealth.