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Stricter lending requirements have made homeowners more robust

- The new rules on housing finance have made the housing market more robust by giving the most highly indebted homeowners an incentive to amortise. It is a sound principle to amortise when the debt is high.
- During the implementation period of the new rules, mortgage credit institutions have increased their flows of new loans to both first-time buyers and other buyers as well as to older borrowers' home equity withdrawal. New lending in 2018 to first-time buyers in Copenhagen and Aarhus remained relatively high.
- The most highly indebted homeowners have a higher risk of becoming technically insolvent and of defaulting on their mortgages. Mortgages granted in the boom years prior to the crisis had the greatest default risk.

Fewer risky loan types

held by the most highly indebted borrowers

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Higher savings

due to historically low interest rates on 30-year fixed rate mortgages

Read more

Robust housing market

and many first-time buyers

Read more

Danish homeowners are among the most highly indebted in the world. The high gross debt of Danish households is matched by corresponding assets such as real estate and pension schemes. Nevertheless, large debt makes the Danish economy and financial stability vulnerable to shocks to the housing market.

The combination of interest rates at record-low levels and mortgages with deferred amortisation implies that homeowners are able to leverage more aggressively than previously relative to their incomes. With low interest rates, high debt may seem easy to service now, especially if the first 10 years of the loan are interest-only. However, low interest rates and deferred amortisation increase the risk that borrowers become vulnerable to declining house prices, the expiry of the interest-only period and rising interest rates. So it is important that the credit policies of banks and mortgage credit institutions do not become too soft and that homeowners are able to service their mortgages and remain solvent if the current favourable conditions change. Against this background, Danish authorities have implemented a number of measures aimed at protecting homeowners and the financial sector against declining house prices and rising interest rates.

The new rules affect individuals' ability to buy or borrow against real estate. Accordingly, the effect of the rules on the housing market is often debated. The various measures all target the most risky borrowers and mortgages, see Chart 1. Banks and mortgage credit institutions can issue any type of mortgage to clients with a debt-to-income (DTI) ratio below 4 and a loan-to-value (LTV) ratio below 60 per cent, provided that the clients can service a 30-year fixed rate mortgage with principal repayments, and that they are deemed creditworthy according to the internal credit policy of the bank. On the other hand, the most highly indebted borrowers in Copenhagen and Aarhus must in general amortise. The rules allow

The mortgage product supply depends on DTI and LTV Chart 1

Note: Stylised example of the mortgage product supply for a creditworthy borrower with high job security and positive net wealth at loan origination. The LTV ratio is defined as total mortgage debt divided by the value of the house, while the DTI ratio is defined as total debt divided by pre-tax income. Borrowers should always be able to service a 30-year fixed rate mortgage with regular principal repayments regardless of the LTV and DTI ratios. The so-called growth area guidelines apply to Copenhagen and Aarhus only. The maximum LTV ratio at origination in mortgage credit institutions is 80 per cent but the product supply also depends on other debt. Borrowers in Copenhagen and Aarhus applying for variable rate mortgages must be able to service a mortgage with an interest rate of 4 per cent even if the LTV ratio is low.

banks and mortgage credit institutions to issue 30-year fixed rate mortgages with principal repayments to creditworthy clients even though both the DTI and LTV ratios are high. Of the various requirements, only the 5 per cent minimum down payment requirement should as a general rule be observed.

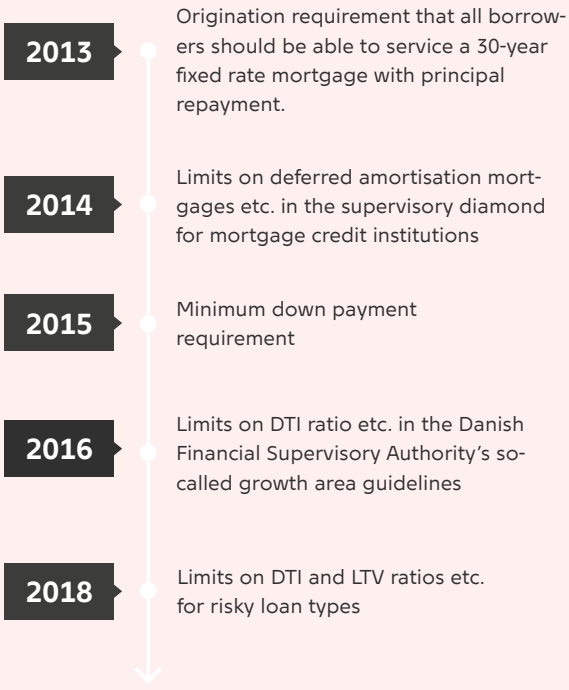
Historically low payments on mortgages with instalments

A 30-year fixed rate mortgage with regular instalments usually has higher monthly payments for the borrower than a variable rate interest-only mortgage would entail. The current interest rate on a 30-year fixed rate mortgage is, however, substantially lower than the historical average for variable rate mortgages. Regardless of whether the interest rate fixation period is fixed or floating, principal repayments constitute the largest share of the monthly mortgage payments. Accordingly, there is not much difference between the monthly mortgage payments facing a homebuyer choosing a 30-year fixed rate mortgage with regular principal repayments in 2019 and a homebuyer who chose a variable rate mortgage with deferred amortisation in 2006-08, when deferred amortisation mortgages came into widespread use, see Table 1. The cost of servicing a mortgage is therefore considerably lower today, as 72 per cent of the total payment consists of principal repayments, which represent savings, not costs.

The total debt service amount in kroner should be viewed against the background that current nominal house prices for Denmark as a whole are at roughly the same level as in the pre-crisis years, see Chart 2. In Copenhagen, prices of flats have increased significantly since the crisis, but remain below the pre-crisis peak, measured relative to disposable incomes.

Consequently, the average homebuyer with a 30-year fixed rate mortgage with principal payments needs an income more or less equivalent to an otherwise

Examples of measures targeting housing finance Box 1



Note: The years are the years in which the measures entered into force, except for the supervisory diamond, which was announced in 2014 and entered into force in 2018-20.

Monthly payment on current 30-year fixed rate mortgage with instalments vs. variable rate interest-only in 2006-08 Table 1

	Variable rate interest-only, average 2006-08	30-year fixed instalments, average 2nd half of 2019
Mortgage rate (bond)	4.22 per cent	0.90 per cent
Monthly payment (after tax)	2,965 kr.	3,350 kr.
Of which principal repayment (savings)	328 kr.	2,411 kr.

Note: Based on 95 per cent LTV on a kr. 1 million housing transaction, of which 80 per cent is financed by a mortgage credit institution and 15 per cent via a traditional bank loan amortised over 20 years. The remaining 5 per cent stem from own savings. Mortgage deductibility is assumed to be 33 per cent in both examples. Underwriting fees and taxes are not included in the calculations.
Source: Danmarks Nationalbank, Statistics Denmark and mortgage credit institutions' price sheets.

identical homeowner choosing a variable rate interest-only mortgage in 2006-08. Nevertheless, the high house prices in Copenhagen imply that potential homebuyers and mortgage credit institutions should always be prudent.

The amortisation requirement for the most highly indebted borrowers should also be seen in light of the fact that homeowners today generally amortise less than previously. The introduction of deferred amortisation mortgages in 2003 caused total mortgage repayments in per cent of the total mortgage stock to almost halve by 2009, see Chart 3. Since 2009, repayments have increased again as more borrowers have chosen mortgages with instalments. In addition, the low interest rates mean that instalments account for a relatively larger share of the total mortgage payment for those who do amortise. However, declining consumer price inflation implies that homeowners cannot anticipate that general inflation will erode the relative value of the mortgage debt as has been the case previously. Thus, mortgage repayments in real terms are currently relatively low despite the increase in nominal repayments. In a low-inflation society, homeowners are to a larger extent required to amortise to bring down their debts.

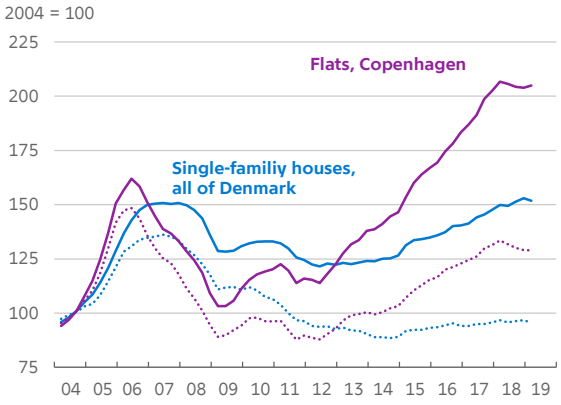
Smoothly increasing lending activity across all groups of borrowers

Tighter lending regulations can affect groups of borrowers differently. The rules tend to be relatively more binding for young first-time buyers in the larger cities as house prices are high relative to incomes. Therefore, a mortgage with principal repayment and a 30-year fixed interest rate may be the only choice for many young first-time buyers. Similarly, the new rules could potentially affect older borrowers' ability to remortgage their house above an LTV ratio of 60 per cent if their retirement income is relatively low.

Chart 4 shows that mortgage credit institutions have increased the flow of new lending to all groups of borrowers during the period in which the rules have been implemented. New lending for house purchases has been increasing continuously since 2010, totalling kr. 73 billion for Denmark as a whole. The increase in new lending applies to both first-time buyers and second-time and subsequent homebuyers.

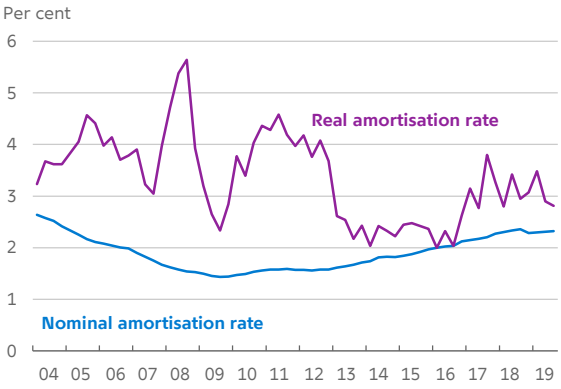
Similarly, the flow of home equity withdrawals was quite high in 2018, totalling kr. 94 billion, of which kr. 34 billion was granted to homeowners above

House price development: Nominally and deflated by disposable incomes Chart 2



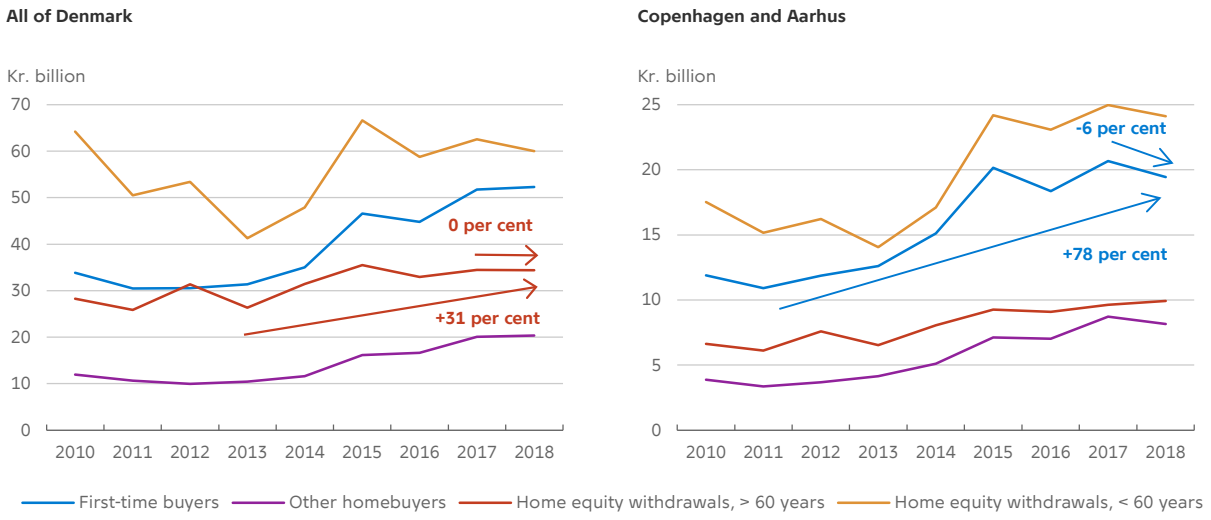
Note: Seasonally adjusted. Solid lines indicate nominal house prices while dashed lines indicate house prices deflated by disposable incomes.
Source: Statistics Denmark.

Principal repayments in real terms remain low despite an increase in nominal terms Chart 3



Note: The chart shows nominal ordinary principal repayments on mortgage loans in per cent of the total mortgage stock. The real repayment percentage is calculated as the nominal rate plus annual consumer price inflation.
Source: Danmarks Nationalbank and Statistics Denmark.

Flows of new mortgage lending for different groups of borrowers Chart 4



Note: The chart shows mortgage credit institutions' flow of new lending to different groups of borrowers. See Box 2 for definitions etc.
Source: Own calculations based on micro data from Statistics Denmark.

the age of 60. This was 31 per cent more than the amount granted in 2013. Home equity withdrawals fluctuate significantly over time, notably in response to changing interest rates, where borrowers' refinancing of fixed rate mortgages to lower coupons often goes hand in hand with an increase in total loan amount, see Danmarks Nationalbank (2019a). The total flow of home equity withdrawals was somewhat lower in 2018 than in 2015, when declining long-term interest rates fuelled a massive wave of mortgage refinancing. In 2019, refinancing activity was even stronger than in 2015, suggesting an increase in home equity withdrawals, but sufficient data is not yet available to extend Chart 4 further ahead in time.

In Copenhagen and Aarhus, the picture is broadly the same. The flow of new lending to first-time buyers was kr. 19 billion in 2018 and thus 78 per cent higher than in 2011. However, it was 6 per cent lower than in 2017.

Fewer of the most risky loan types

The stricter lending requirements in combination with declining long-term interest rates and higher margins on the most risky loan types have increased the incentive for borrowers to choose 30-year fixed rate mortgages with principal repayments.

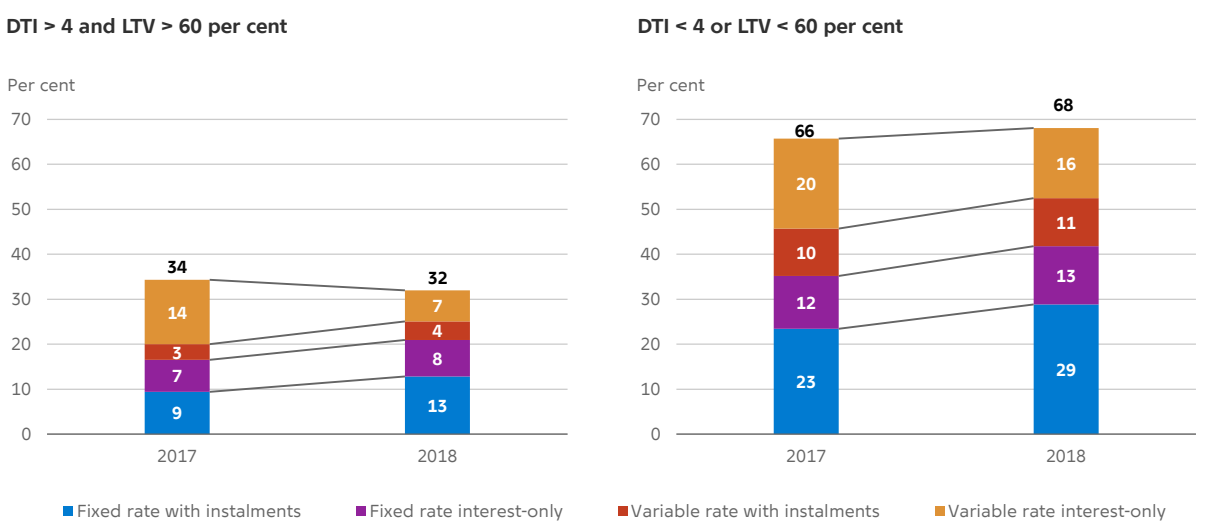
Measured as a share of total new lending to first-time buyers in Copenhagen and Aarhus, new mortgages to borrowers with high DTI and LTV ratios declined marginally in 2018, see Chart 5 (left). The mortgage credit institutions thus continued to grant many loans to first-time buyers with high DTI and LTV ratios after the new rules in the Executive Order on good practice for mortgage lending entered into force on 1 January 2018. On the other hand, there were significantly fewer variable rate interest-only loans, while the share of 30-year fixed rate loans with principal repayments was substantially higher in 2018 compared with 2017.

The shift towards longer interest rate fixation periods and principal repayments was not restricted to first-time buyers directly affected by the new rules, see Chart 5 (right). 68 per cent of new lending in Copenhagen and Aarhus was granted to borrowers with a DTI ratio below 4 or an LTV ratio below 60 per cent. These borrowers were also more likely to choose fixed interest rate and principal repayment mortgages in 2018.

The same applies to the flow of new lending to borrowers older than 60 years, though to a lesser extent, see Chart 6. Relatively fewer mortgages were granted with an LTV ratio above 60 per cent in 2018 compared with 2017. However, the total amount in

Fewer of the most risky loan types in the flow of new lending to first-time buyers in Copenhagen and Aarhus

Chart 5



Note: The chart shows the distribution of the flow of new lending to first-time buyers in Copenhagen and Aarhus. Each year sums to 100.
Source: Own calculations based on micro data from Statistics Denmark.

kroner to borrowers older than 60 years was the same in 2018, see Chart 4.

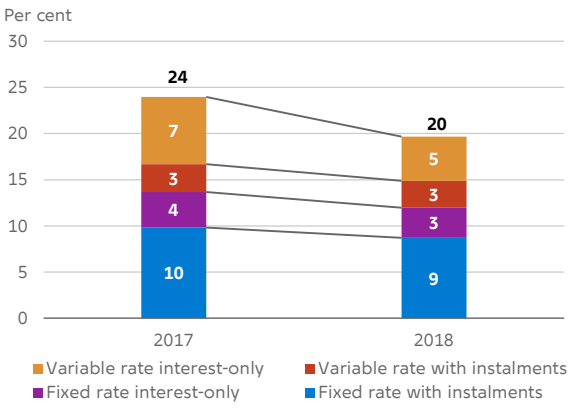
Highly indebted first-time buyers have higher incomes than before

The most highly indebted first-time buyers now have more robust incomes than before, see Chart 7. This is not the case for the less-indebted first-time buyers. The incomes of first-time buyers with a DTI ratio above 4 and an LTV ratio greater than 60 per cent have thus increased steadily since 2010 – both in Copenhagen and Aarhus and for Denmark as a whole. The median first-time buyer in Copenhagen and Aarhus with high debt ratios in 2018 had an income that was 35 per cent higher than the median income for Denmark as a whole. In 2010, the income of the highly indebted first-time buyers in these areas was only 13 per cent higher.

For all first-time buyers, the average income in 2018 is only slightly higher in Copenhagen and Aarhus than in 2016. For Denmark as a whole, incomes have remained more or less flat. The median age for first-time buyers, both in Copenhagen and Aarhus and in Denmark as a whole, has been fairly stable at 33-34 years over the entire period.

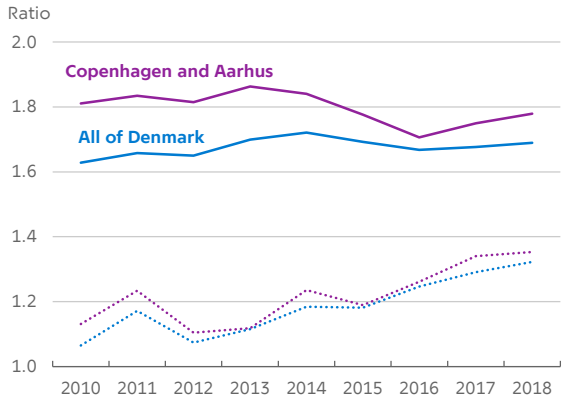
Flow of new lending to borrowers older than 60 years with an LTV ratio above 60 per cent

Chart 6



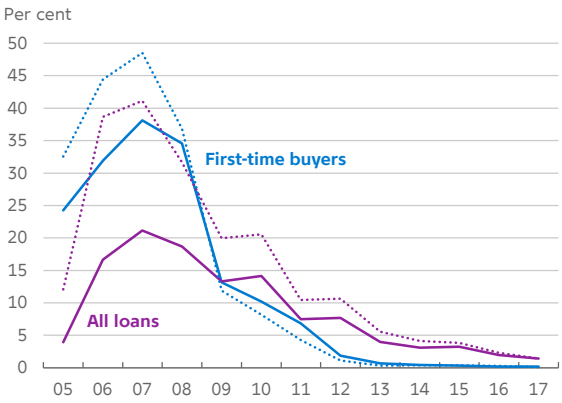
Note: The chart shows the flow of new lending to households where the oldest member is older than 60 years and where the LTV ratio exceeds 60 per cent as a share of the total flow of new lending to borrowers older than 60 years.
Source: Own calculations based on micro data from Statistics Denmark.

First-time buyers' income relative to other households Chart 7



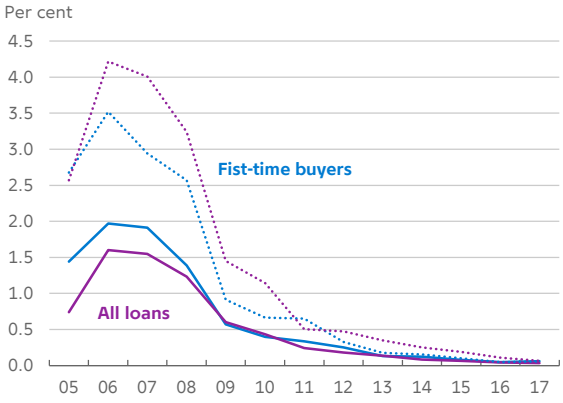
Note: The dashed lines refer to first-time buyers with a DTI ratio greater than 4 and an LTV ratio above 60 per cent, while the solid lines refer to all first-time buyers. The Y axis is the ratio of the median income of first-time buyers to the median of the entire population in Denmark and Copenhagen and Aarhus, respectively.
Source: Own calculations based on micro data from Statistics Denmark.

The risk of becoming technically insolvent was highest for the most highly indebted borrowers... Chart 8



Note: Dashed lines indicate borrowers with a DTI ratio above 4 and an LTV ratio above 60 per cent at origination. The chart shows the share of homeowners becoming technically insolvent at some point. Technical insolvency is defined as a situation where the mortgage debt exceeds the estimated value of the house pledged as collateral. The years refer to origination of the mortgage. The data points for 2007 refer, for example, to borrowers taking out a mortgage in 2007 that were at some point afterwards technically insolvent for at least one year. See Box 2 for more details.
Source: Own calculations based on micro data from Statistics Denmark.

...and so was the risk of defaulting on the mortgage Chart 9



Note: The chart shows the share of borrowers who at some point defaulted on their mortgage payments. Default is defined as being 105 days or more in arrears.
Source: Own calculations based on micro data from Statistics Denmark.

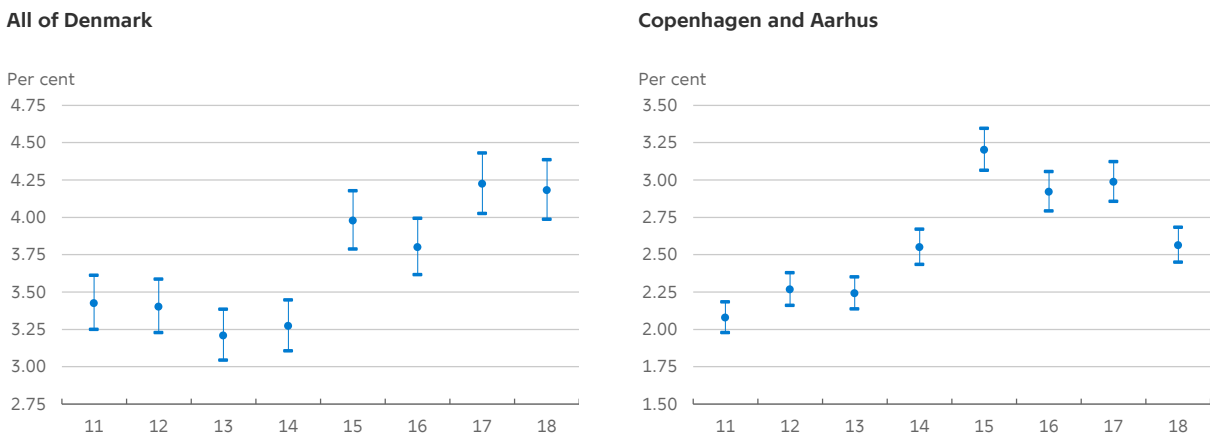
Borrowers with high DTI and LTV ratios were more vulnerable when the crisis hit

Other things equal, borrowers with a high LTV ratio at origination are more vulnerable to declining house prices and adverse economic developments, see Chart 8. This applies to borrowers in general and to first-time buyers, who often need to borrow relatively more as they have no capital gains from a previous sale. Among all borrowers that were granted a new mortgage in 2007, 21 per cent ended up being technically insolvent at some point afterwards. For first-time buyers, the share was 38 per cent. Among first-time buyers who had a DTI ratio above 4 and an LTV ratio above 60 per cent at origination, 49 per cent subsequently became technically insolvent.

In general, mortgages granted in the years just before the crisis, when optimism was high, were more likely to default at some point, see Chart 9. This applied to first-time buyers and other groups of borrowers in all parts of Denmark. Default probabilities were higher for first-time buyers than for other groups of borrowers. Thus, 1.6 per cent of all loans granted in 2006 defaulted at some point, while this was true for 2.0 per cent of loans granted to first-time buyers in 2006. Default rates were substantially higher for borrowers with high DTI and LTV ratios at origination.

Unchanged probability that a household purchases a home for the first time for all of Denmark, despite a drop in Copenhagen and Aarhus

Chart 10



Note: The chart shows predicted probabilities and 95 per cent confidence bands in a logistic regression for the probability that a household purchases a home for the first time (evaluated at the median aged 26-30 years). See Box 2 for more information.
Source: Own calculations based on micro data from Statistics Denmark.

The stricter lending requirements contribute to reducing the risk that a development similar to that seen in the pre-crisis years will take place again. Partly by giving more borrowers an incentive to amortise and partly by reducing house price growth.

Statistical models:
Unchanged probability of first-time purchase

The graphical analysis above describes developments in the housing market from different angels. Statistical models can supplement this partial picture by controlling for how different variables affect the housing market simultaneously.

As a supplement to Chart 4 that depicts how the flow of new lending to first-time buyers evolves over time, we have constructed a logistic regression model that estimates the conditional likelihood that a household purchases a house for the first time. Explanatory variables include household income and debt, age, geography as well as socio-economic variables such as dummies for students, pensioners or unemployed people, etc. within the household. The model also contains year dummies. These dummies will capture some of the time variation that cannot be explained by the other variables of the model. They will, among other things, capture changes in macro variables such as house prices, interest rates and regulation that cannot be estimated separately in the model because there is no variation at the individual level. The model cannot isolate what is due to changes in house prices or regulation but only give a general indication of how these macro variables correlate with the probability of purchasing a home for the first time. In addition, the model includes interaction terms between the year dummies and income that can capture whether a given income yields different probabilities of buying a home over time. The model generally shows that the probability increases with income and that households in the age interval 26-30 years are more likely to buy a home for the first time, other things equal.

Chart 10 shows the probability of buying a home for the first time, evaluated at the median household in the age interval 26-30 years. The model for all of Denmark shows that developments over time can be divided into two periods – 2010-14 and 2015-18 – as the estimates are statistically significantly different between the two periods but not within, see Chart 10 (left). Most of the new regulatory measures were implemented from 2015 onwards so the probability of becoming a first-time buyer has increased simultaneously. The increased probability since 2015 should presumably mainly be attributed to the further decline in long-term interest rates as well as the Danish economy entering into a relatively long economic boom.

Chart 10 (right) shows that the probability of buying a home for the first time is generally lower in Copenhagen and Aarhus compared with the rest of Denmark. This can be attributed to the fact that there are relatively more rental units and cooperative housing units in the larger cities. Apart from this, the picture is more or less the same: There was a significant increase in the probability in 2015 relative to 2011-14. In 2018, however, the probability declined somewhat relative to 2017 and was on a par with 2014. Whether this decrease was due to changing regulation, developments in house prices or other changing conditions, the model cannot say.

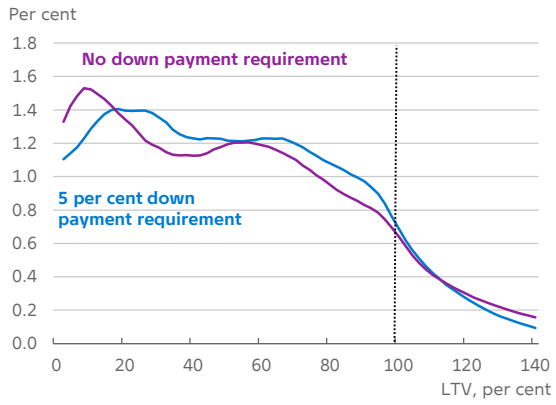
Theoretical perspective: Measures imply a more robust housing market and costs are small

It is generally difficult in a data-driven analysis as the one above to isolate the effects from the individual variables. This is partly because changes in regulation will affect variables such as the number of first-time buyers and lending growth through several channels. As a first channel, a higher down payment requirement may reduce demand for owner-occupied housing units, thereby reducing the number of potential first-time buyers. Lower housing demand means lower house price growth in the short term. Conversely, lower house price growth will increase the number of potential first-time buyers as mortgage credit institutions and banks can approve more households with a given income and creditworthiness. Relatively more robust homeowners will in the longer term imply fewer housing market-induced crises and smaller fluctuations in house prices. Other things equal, a more stable housing market will make it easier for young people to enter the housing market as the credit risk for mortgage credit institutions and banks will be lower.

One way of describing the expected effect of changes in economic variables is by using theoretical economic models that can take into account how changes in variables can affect other variables simultaneously and over time. As a supplement to the empirical analysis above, we analyse the effects of tighter lending requirements in two separate theoretical models: An agent-based model as described in Cokayne (2019) and a DSGE-model following Gerba and Zochowski (2017)[1]. The two models are calibrated to fit the

Agent-based model: Fewer technically insolvent homeowners with a down payment requirement

Chart 11



Note: The X axis denotes model-based LTV, while the Y axis denotes the probability that a household has that particular LTV ratio (across a full economic cycle). The dashed line is located at an LTV ratio of 100 per cent, above which a household is technically insolvent.
Source: Danmarks Nationalbank.

Danish economy and housing market. Changing the level of the down payment requirement in the models provides an indication of how the economic agents in the model will be affected. The models are stylised versions of the real world, and the estimates should be interpreted as upper estimates as some of the model assumptions are relatively harsh.

In the agent-based model it is possible to evaluate the effects of changing the level of the minimum down payment requirement as well as the DTI ratio at origination. Chart 11 shows the effects on the LTV distribution in a scenario where a minimum down payment of 5 per cent is introduced vis-à-vis a situation with no minimum down payment requirement. The effects should be interpreted as averages over the business cycle. The chart shows that there are relatively fewer households with LTV ratios above 100 per cent. The share of technically insolvent homeowners thus falls by 21 per cent in the scenario. In addition, the introduction of the minimum down payment requirement implies lower house price volatility.

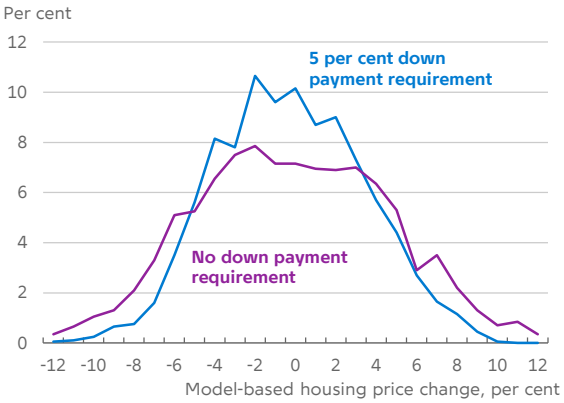
1 DSGE model: Dynamic Stochastic General Equilibrium model.

It is also possible to simulate the introduction of a 5 per cent down payment requirement in the DSGE model. DSGE models are particularly well-suited for studying the overall effect of policy changes as they take account of both direct and indirect effects from different channels.[2]

The effects of introducing a down payment requirement of 5 per cent are in line with those seen in the agent-based model. For example, house price volatility falls and extreme house price developments will occur less frequently, see Chart 12. The model also indicates that in a more robust housing market fewer households will default on their mortgages and the likelihood of financial crises decreases.

The costs of introducing a down payment requirement in the model are related to the fact that lower house price volatility during booms may imply that homeowners who bought their houses at a very favourable point in time will see a lower return on their investments. At the macro level, however, the benefits of a more stable housing market exceed the costs.

DSGE model: Lower probability of extreme house price fluctuations Chart 12



Note: The X axis denotes model-based house price fluctuations while the Y axis denotes the probability that a given price fluctuation will materialise.
Source: Danmarks Nationalbank.

2 For more details see Bentzen et al. (2020).

How we have proceeded

Box 2

The analysis is based on a working paper which is expected to be published during the first half of 2020. In the following, data, definitions and models are briefly outlined.

Data and definitions
The data used in the analysis is based on register data from Statistics Denmark, where information on e.g. incomes, wealth, mortgage debt and housing conditions is linked through individuals' civil registration (CPR) numbers. The relevant unit is typically *the household*. However, Charts 8 and 9 are constructed using *the individual* as the base unit to ensure that the relevant shares are not underestimated as a result of household IDs disappearing over time (e.g. due to divorce). New lending is defined as the change in total mortgage debt relative to the previous year, with only positive changes included. Thus, refinancing from a high-coupon mortgage to a lower coupon while keeping the total loan balance unchanged will not be included in the data set as a new loan. Similarly, families moving from one dwelling to another while at the same time reducing their mortgage debt will not be included. This definition differs from the term "gross lending", which is often used to describe the activity of mortgage credit institutions. Housing equity withdrawal is defined as new lending to households living in the same housing unit as in the previous year. A first-time buyer is defined as a household purchasing a house or flat a given year which did not own a house or flat the previous year.

Charts 8 and 9: The time series are constructed by considering the most recent mortgage over time. If a borrower obtains a new loan at a later stage, this new loan then becomes the only loan to be considered. For instance, if a loan is granted in 2006 and a new one in 2009, after which the borrower becomes technically insolvent in 2011, only the 2009 loan will be marked as technically insolvent. This is also the case for the default rate time series, except if the 2006 loan is still active. Both curves tend to be declining over time as a loan taken in, for example, 2016 is measured for fewer years than a loan taken in 2007.

Regression models
The probability p that a household buys a house for the first time is estimated in a logistic regression model on the functional form, $\log\left(\frac{p}{1-p}\right) = X'\beta$, where X is a matrix of explanatory variables including household income relative to median income (both linearly and squared), age, total debt the previous year and socio-economic factors such as whether the household contains students, pensioners or unemployed people. In addition, geographical controls, time dummies as well as interaction terms are included.

Agent-based model
In the agent-based model, microeconomic interactions between households in the housing market are modelled. Households make decisions about their housing situation, i.e. whether to rent or own their home. These interactions can be aggregated to create variables at the macro level, such as house price indices. By employing macroprudential tools, the central bank in the model can limit how much households can borrow to buy housing. Such restrictions affect other areas of the housing market, such as house price growth and the volume of technically insolvent homeowners in recessions.

DSGE model
The DSGE (Dynamic Stochastic General Equilibrium) model is a macro model that takes into account feedback mechanisms across sectors and time. The model contains a number of sectors and can link financial conditions and the housing market to households' consumption decisions. The model can be used to analyse the effect of introducing macroprudential regulation such as a down payment requirement, which in the model will affect households through several channels. A down payment requirement makes households relatively more solvent, but at the same time restricts house price growth and thus households' consumption possibilities, as the LTV ratio of the household is always at the highest possible value given by regulation. At the same time, policy measures that result in more solvent households reduce the risk on banks' balance sheets, leading to a lower probability and cost of systemic crises.

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ABOUT ANALYSIS

As a consequence of Danmarks Nationalbank's role in society we conduct analyses of economic and financial conditions.

Analyses are published continuously and include e.g. assessments of the current cyclical position and the financial stability.

The analysis consists of a Danish and an English version. In case of doubt regarding the correctness of the translation the Danish version is considered to be binding.

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