FI Analysis

Mortgage cap slowed growth of household debt

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Summary

Finansinspektionen (FI) introduced a mortgage cap on 1 October 2010. According to the mortgage cap, new loans collateralised by a home should not exceed 85 per cent of the value of the home. Several other countries have also implemented a similar regulation, but there are relatively few studies of the effects of a mortgage cap. This is largely due to lack of data, but assessments are also hampered by the fact that additional measures were often taken at approximately the same time or there were other economic events that occurred in connection with the implementation of the mortgage cap.

This FI Analysis presents an evaluation of the Swedish mortgage cap. The quality of the data that FI gathered prior to and immediately following the implementation of the mortgage cap is not as high as the quality of the data gathered today. Thus the results should be interpreted with a certain degree of caution. That said, the analysis indicates that the mortgage cap has changed household behaviour. The evaluation shows that the households limited by the mortgage cap borrowed approximately 13 per cent less and purchased homes that were approximately 10 per cent less expensive than what they would have otherwise done.

The effect was smaller for the entire sample of new mortgagors since many households borrow less than 85 per cent of the value of the home. As a whole, the mortgage cap resulted in new mortgagors buying homes that on average were 1.6 per cent less expensive. At the same time, the regulation also resulted in households that bought a home in 2011 on average borrowing 2.1 per cent less than what they would have done if FI had not introduced the mortgage cap.

The mortgage cap has had the greatest effect outside the metropolitan regions. Households that borrowed less and purchased less expensive homes are primarily those with high debt-to-value ratios. The analysis furthermore shows that the youngest households (below the age of 30) and the oldest households (above the age of 65) reduced their debt the most, but older households were more likely to also purchase less expensive homes. This means that primarily young households finance the purchase of a home through methods other than a mortgage.

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Swedish mortgage cap

Finansinspektionen (FI) has taken several measures to reduce the vulnerabilities associated with high household debt and to strengthen the resilience of consumers. FI introduced a mortgage cap on 1 October 2010 (Finansinspektionen, 2010a).[1] According to this cap, new loans collateralised by a home should not exceed 85 per cent of the value of the home.

The objective of the guideline was to counteract unhealthy lending practices and strengthen consumer protection. The background behind the guideline was that household debt and debt-to-value (DTV) ratios had been gradually increasing since the mid-1990s. Despite the economic recession during the global financial crisis, lending to households increased more than before the crisis. There was a concern that banks and other credit institutions were using higher DTV ratios as a means of competition. Excessively high debt and DTV ratios make borrowers vulnerable to a fall in house prices, introducing a risk that the borrower will not be able to sell the home for a price that will cover the loan. The guideline increases incentives for households to borrow less and thus creates a buffer against a fall in prices.

FI expected the guideline to have a limited, one-time effect on house prices (Finansinspektionen, 2010a). The mortgage cap only applies to loans where the home is used as collateral, but it is also possible to finance such a purchase through an unsecured loan. There was therefore a concern that mortgagors would take out unsecured loans to finance the 15 per cent of the purchase price that should not be included in the mortgage. This would result in a higher interest rate expense than before. The interest rate on unsecured loans was on average three percentage points higher than the interest rate on the top loan[2]. The banks also required unsecured loans to be amortised faster. This could reduce households' possibilities for qualifying for a loan since the larger payment commitment would affect the credit assessment.

The purpose of this FI analysis is to describe and estimate the effects of the mortgage cap on household debt as well as on the prices of the homes the households are purchasing. This evaluation improves the understanding of the effects of FI's macroprudential measures.

We primarily use aggregate information from FI's mortgage survey and public statistics to *describe* the developments since FI introduced the mortgage cap. In order to *estimate* the effects of the mortgage cap on household debt and house prices, we use FI's household data from 2009 and 2011. This data includes the periods before and after FI implemented the mortgage cap. We are thus able to evaluate how the mortgage cap has affected household behaviour.

1 FI introduced the mortgage cap via general guidelines. This means that it is not legally binding in the same way as a regulation. General guidelines allow for other methods as long as the objective of the guideline is met. The mortgage cap is largely followed by the affected lenders. In practice, therefore, the guideline means that households should not be granted mortgages that exceed 85 per cent of the value of the home. Finansinspektionen's general guidelines (FFFS 2010:2) regarding limitations to the size of loans collateralised by residential properties were replaced on 1 January 2017 by FFFS 2016:33.

2 A "top loan" was the portion of the mortgage that exceeded a certain percentage of the value of the home and had a higher interest rate than the rest of the mortgage (called the "bottom loan"). This percentage could vary by bank, but was normally around 70-75 per cent. The use of top and bottom loans is no longer common in Sweden.

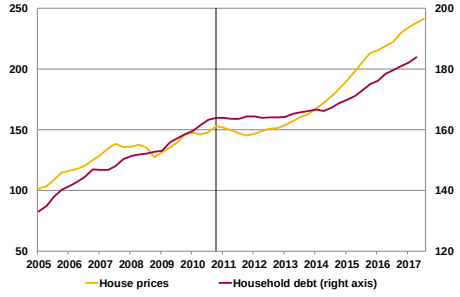
Table 1. Some mortgage caps in other European countries

Country	Year	Level	Applies to
Denmark	2015	95%	New loans
Estonia	2015	90%	First-time home buyers
		85%	Other, new loans
Finland	2016	95%	First-time home buyers
		90%	Other, new loans
Latvia	2007*	95%	Loans guaranteed by the state
		90%	Other, new loans
Lithuania	2011	85%	New loans
Norway	2015	60%	Oslo (second home)
		85%	Other, new loans
The Netherlands	2012	106%	New loans
	2018	100%	New loans
Ireland	2015	90%	First-time home buyers
		80%	Other, new loans
Poland	2014	85% to 90%	New loans, cap is dependent on collateral
Sweden	2010	85%	New loans

Source: FI.
Note: * Indicates that the differentiation occurred in 2014.

Diagram 1. House prices and household debt

(Index 100 = 2005 and per cent of disposable income)



Source: Statistics Sweden and Valueguard.
Note: Total household debt as a percentage of their disposable income. Sum from the past four quarters. The vertical line refers to Q4 2010 when the mortgage cap was introduced.

In order to measure the effect of the mortgage cap, we estimate what the development would have been if FI had not implemented the cap. To do this, we break the households into groups - those affected by the regulation and those that were not. We then compare the development between these two groups.

In this analysis, we first present some of the international experiences from other countries with a mortgage cap. We then describe the development in Sweden before and after FI implemented the mortgage cap, and we estimate the effects of the mortgage cap on the debt and house prices of Swedish households. Finally, we complete the analysis with our conclusions.

Mortgage cap - a common macroprudential measure

There are quite a few countries that have a mortgage cap in some shape or form (Table 1). Most of these caps are relatively new, have often been combined with other measures[3], and at times been introduced in several steps. Because of this, and due to the fact that there is little relevant data, it is difficult to assess their effects. It is therefore unusual to find analyses of these measures.

The articles that analyse the mortgage cap are primarily panel studies (several countries) of how the regulations affect debt and the housing market (see the table in Appendix 1). Most of the studies indicate that the mortgage cap has restrained debt and house prices. However, there is no consensus regarding the size of the effects. Kuttner and Shim (2013) shows that the estimated effect of a mortgage cap on debt and house prices is of less importance when also considering other regulations. Reichenbachas (2017) also finds small effects in a study on how the mortgage cap in Lithuania affected debt, house prices and the GDP in the short term. Reichenbachas's results – that the mortgage cap only has a limited effect – can be explained by the fact that the regulation in Lithuania only affected a small number of households.

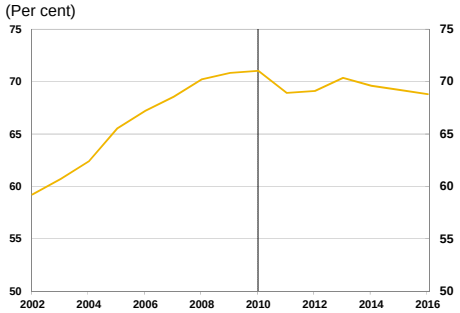
Duca et al. (2011) finds, however, that the mortgage cap can have greater effects: a reduction in the cap by 1 per cent for first-time home buyers in the USA holds house prices down by an equal magnitude in the long run. Crowe et al. (2011) shows that the mortgage cap is an effective measure for reducing the growth rate of house prices. Using a sample of 21 countries, the authors calculate that a reduction in a mortgage cap by one percentage point results in fall in nominal house prices of 1.3 per cent.

Many studies indicate that mortgage caps affect lending more than house prices (see, for example, Avouyi and Lecat, 2014 and Jácome and Mitra, 2015). On the other hand, Kelly et al. (2017) takes the position that these results are due to the studies using aggregate data and finds it difficult to identify the effects of the regulation. Using household data from Irish mortgagors, the authors show that the effect on house prices can be large. The results are supported by Igan and Kang (2011), which uses data from households in South Korea. South Korea has used its mortgage cap actively, both raising and lowering it. The authors also show that the turnover of homes decreases when the

3 Example of other such measures include financial policy reforms or limitations on loans or debt servicing in relation to household income.

Diagram 2. Volume-weighted debt-to-value ratios, new loans

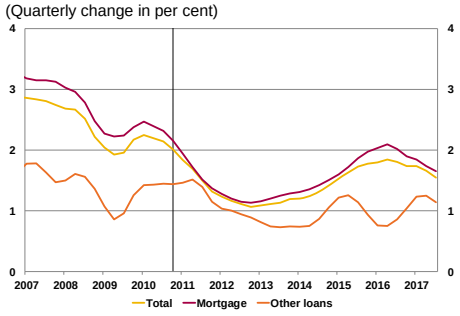
(Per cent)



Source: FI.
Note: The vertical line refers to the point in time at which FI introduced the mortgage cap.

Diagram 3. Household debt

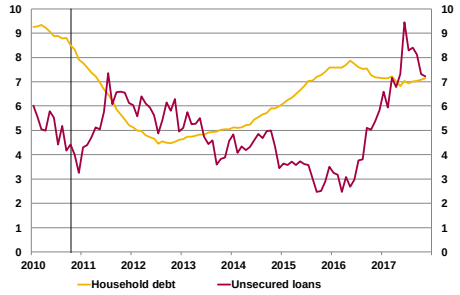
(Quarterly change in per cent)



Source: Statistics Sweden.
Note: Other loans refer to unsecured loans and loans secured by non-real estate collateral. The vertical line refers to the point in time at which FI introduced the mortgage cap.

Diagram 4. Growth in households' total debt and unsecured loans

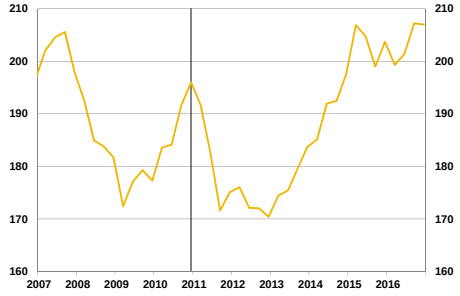
(Annual percentage change)



Source: Statistics Sweden.
Note: Growth in unsecured loans refers to consumption loans adjusted for reclassifications and bought and sold loans. The vertical line refers to the point in time at which FI introduced the mortgage cap.

Diagram 5. Households' financial assets

(Per cent of disposable income)



Source: Statistics Sweden.
Note: The vertical line refers to the point in time at which FI introduced the mortgage cap.

mortgage cap is lowered. The effect on the turnover is larger than the effects on house prices. Therefore, they find no strong influence on mortgages and household debt.

Sweden introduced a mortgage cap relatively early compared to other countries, and it affected almost one out of every five new mortgagors when it was introduced. This FI Analysis contributes to the literature by studying how the regulation affected behaviour of Swedish households. Utilising a unique data set at the household level, we evaluate the mortgage cap's effect on debt and house prices.

Sharply rising debt and debt-to-value ratios preceded the mortgage cap

This section describes the developments before and after FI implemented the mortgage cap. We study variables that are expected to have been influenced by the cap: debt (broken down by debt-to-value (DTV) ratio), house prices and turnover of homes. The cap has most likely also influenced demand for not only mortgages but also other loans (such as unsecured loans) as well as household savings and wealth. Furthermore, the mortgage cap may also have resulted in many households needing more time to save for the downpayment since more cash would be needed if the household could not finance 15 per cent of the purchase price in some other way.

Before FI introduced the mortgage cap, house prices and household debt had been rising sharply for several years (Diagram 1). House prices did fall slightly during the global financial crisis in 2008, but they quickly recovered. In Sweden, household debt consists predominantly of mortgages, and households' DTV ratios rose during the same period.

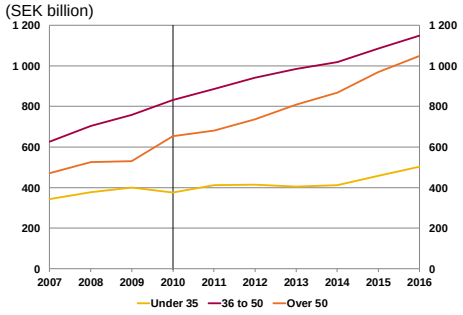
The mortgage cap coincided with the reversal of the rising trend for DTV ratios for new loans, which had been observed since 2002 (Diagram 2). House prices also fell temporarily in 2011 (Diagram 1). Since house prices were at a higher level than in previous years, debt continued to rise, albeit at a slightly slower rate (Diagram 3). At the same time, there was not a significant change in the growth rate of other loans.

Since the mortgage cap limits a household's possibilities for obtaining a large mortgage in relation to the market value of the home, the household needs to finance at least 15 per cent of the value of the home in some other way. It is therefore not surprising that unsecured loans rose at the end of 2010 (Diagram 4).

The mortgage cap can also affect financial savings, but different households are affected differently. Some borrowers need to use their own savings as a deposit, which reduces their financial savings. Other future home-buyers need to save more for their downpayment, which increases their financial savings. Data shows that households' financial savings decreased immediately after FI introduced the mortgage cap (Diagram 5). The initial decrease may be because home-buyers used their own savings to a larger extent than they did before. However, after an initial downturn, savings increased again. This may be a sign that households are saving for a future downpayment to a greater degree than before the guideline was introduced.

Diagram 6. Total mortgages by age

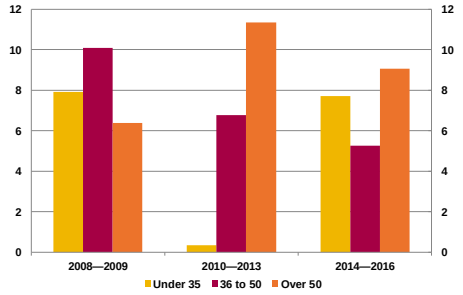
(SEK billion)



Source: FI.
Note: The volume refers to the total mortgage stock at the eight largest Swedish banks. The vertical line refers to the point in time at which FI introduced the mortgage cap.

Diagram 7. Growth in total mortgages by age

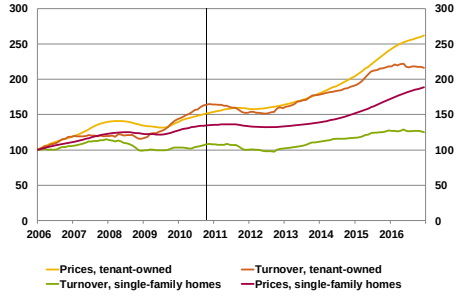
(Per cent)



Source: FI.
Note: The diagram shows the average growth rates for each period.

Diagram 8. House prices and turnover

(Index, December 2005 = 100)



Source: Valueguard.
Note: Each index is calculated using a 12-month moving average with December 2015 set at 100. The black vertical line shows the point in time at which the mortgage cap entered into force - 1 October 2010.

As a result of the mortgage cap, households must finance a larger portion of the purchase of their home through means other than a mortgage. Households may need to save for a longer period of time or increase their savings for a shorter period of time.[4] Calculations show that a household that is planning to buy a home and wants to keep the same savings horizon as before the mortgage needs to save almost as three times as much per month to buy the same home after the mortgage cap. If the household cannot increase its monthly savings, it must save for a period five times as long.[5]

LENDING TO YOUNG ADULTS HAS SLOWED SINCE THE MORTGAGE CAP

FI's annual mortgage survey contains data about the mortgage stock broken down by age and DTV ratio. The mortgage volume has almost quadrupled in the past ten years; in 2016, it was just over SEK 2,700 billion at the eight largest Swedish banks (Diagram 6). Households with mortgagors over the age of 35 are largely responsible for this increase. Lending to households with mortgagors under the age of 35 has been relatively stable until 2014.

Up until 2009, the rate at which lending was increasing was more or less the same in all age categories (Diagram 7). After 2009, growth in lending to young households (under the age of 35) stopped at the same time as lending to households with mortgagors above the age of 50 increased more rapidly. This could be an indication that the mortgage cap primarily affected young households. Young adults normally have smaller savings and can thus be limited more than older adults. It may also be more difficult for young adults, who often have low income, to get a loan when house prices are increasing rapidly. However, between 2009 and 2013, house prices increased at approximately the same rate as disposable income. The slow-down in lending to young households can also be due to other factors. For example, unemployment increased sharply after the global financial crisis in 2008–2009, particularly for young adults.

The rapid increase in lending to older households may be an indication that it has become more common for young adults to be helped by their parents when financing the purchase of a home. After 2014, lending increased rapidly in all age categories. The large increase in lending was one of the reasons why FI later implemented an amortisation requirement in June 2016.[6]

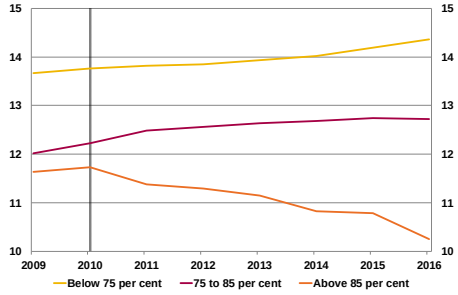
4 Alternatively, a household can take out an unsecured loan if the credit assessment allows for this or receive (or borrow) money from parents (or another family member).

5 The calculations are based on a household being able to get a loan for 95 per cent of the value of the home before the mortgage cap and 85 per cent after. In the example, house prices increase by 5 per cent a year, savings give an annual return of 3 per cent and capital gains tax is 30 per cent. Since house prices are rising, the size of the required cash deposit will also increase over time. We estimated that the price level would fall by just over 2 per cent after the mortgage cap was implemented.

6 The objective of the amortisation requirement is to counteract macroeconomic and financial stability risks associated with high household debt. The requirement entails that the households with a mortgage in excess of 50 per cent of the value of the home must amortise at least one per cent of the loan every year. If the loan exceeds 70 per cent of the value, the household must amortise at least 2 per cent a year.

Diagram 9. Market values by DTV ratio

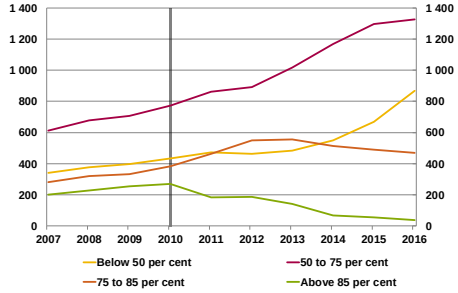
(Logarithmic values)



Source: FI.
Note: Market value refers to the total value of the homes serving as collateral for the outstanding mortgages in each DTV ratio interval. This breakdown in the data is only available for four of the eight major Swedish banks for the entire time period. The vertical line refers to the point in time at which FI introduced the mortgage cap.

Diagram 10. Total lending by DTV ratio

(SEK billion)



Source: FI.
Note: The volume refers to the total mortgage stock at the eight largest Swedish banks. The data contains total volumes for all banks for all available years, but the breakdown into DTV ratios is missing for some banks during certain years. We have created the missing data by assuming that the missing values are the same percentage of the total as the first year of the data for each bank. The vertical line refers to the point in time at which FI introduced the mortgage cap.

THE MORTGAGE CAP AFFECTS THE HOUSING MARKET

Even though the rate at house prices were rising slows slightly, house prices still rose after the mortgage cap (Diagram 8). At the same time, turnover noticeably slowed, in particular for tenant-owned apartments.

FI's mortgage surveys have aggregate data on market values, i.e. the total value of the homes that serve as collateral for the outstanding mortgages. The aggregate information is divided into DTV intervals for the households. This means that we can follow the development of the market value in each interval before and after the mortgage cap. The breakdown shows that the total market value for households with DTV ratios below 75 per cent followed approximately the same trend before the mortgage cap as it has after (Diagram 9). However, the market value for households limited by the cap (those with the highest DTV ratios) has decreased since 2010.[7] The market value for households with a DTV ratio between 75 and 85 per cent increased to the same extent.

The change in the total market values per DTV ratio interval is due in part to the upward adjustment of the values as house prices rise.[8] Amortisation payments also lower the DTV ratios. Furthermore, households that previously could have a mortgage for more than 85 per cent of the value of the home are limited by the cap. They end up in an interval with a lower DTV ratio.

PERCENTAGE OF HOUSEHOLDS WITH HIGH DEBT-TO-VALUE RATIOS DECREASED SINCE FI IMPLEMENTED THE MORTGAGE CAP

Loans to buy a home are closely linked to house prices. After the introduction of the mortgage cap, house prices stabilised until they began to climb upward again in 2013. Up until 2010, the lending trends in each DTV ratio interval were relatively similar, even if the levels varied (Diagram 10).

Since FI introduced the mortgage cap, lending to households with DTV ratios greater than 85 per cent has gradually decreased, and in 2016 this figure was more or less zero. The delayed effect is due to the fact that it took time for the mortgage cap to encompass the entire loan stock.[9] Lending to households with a DTV ratio of 75–85 per cent increased to a corresponding extent when the number of households that previously borrowed more than 85 per cent was restricted. Households with a DTV ratio of less than 75 per cent do not appear to have been affected by the mortgage cap – growth in these loans was approximately the same prior to 2010 as it was after.

The development immediately following 2010 can be linked to the mortgage cap. Other factors then enter the picture that affect the development, for example the discussion regarding an amortisation requirement. However, a comparison of the period 2009–2011 does not

7 The decrease in the market value for households with high DTV ratios is probably due to both the mortgage cap and the fact that upwards adjustment of values on homes that are not recently purchased lowers the DTV ratios for loans in the stock.

8 At the time of purchase, the market value is the same as the price. The market values are then recalculated by the banks every year.

9 The shrinking number of households with a DTV ratio greater than 85 per cent in the loan stock is in part due to the fact that new loans with high DTV ratios are not issued any more and in part that part of the loan stock is sold every year and the upward adjustment of house values lowers the DTV ratio.

necessarily show the development of mortgages due to the mortgage cap, either, since the economy was reacting to many events during this period. In order to measure the effect of the mortgage cap in particular, we must estimate what the development would have been if FI had not implemented the cap. We do this using a model based on detailed data about households. The model can thus separate the effect of the mortgage cap from other factors.[10]

Estimated effects of the mortgage cap

Up to this point, we have described the development of certain macroeconomic variables prior to and following the implementation of the mortgage cap. In order to estimate the mortgage cap's effect on household debt and house prices, we study households that were restricted by the regulation and compare these households to those that were not affected by the regulation.

FI conducts a mortgage survey every year that includes new mortgagors. However, FI's regulations affect not only households that are granted a new mortgage but also households that were denied a mortgage or do not even apply for a loan due to the mortgage cap. These households are not captured by the survey.

FI's mortgage reports present the results of the surveys since 2011, see for example Finansinspektionen (2017b). There is also an early compilation of data from 2009, but it is not included in FI's normal reporting due to quality deficiencies (Finansinspektionen, 2010b). We have reviewed variables from 2009 and 2011 and conclude that they can be used to measure and evaluate how the mortgage cap has affected households. It is not clear what the banks reported as total debt in 2009. This hinders comparisons between both banks and years. In the analysis, however, we have assumed that the figures the banks reported are actually total debt. The figures reported for other variables included in the analysis also appear to be reliable. Given this, we are able to compare household behaviour from the survey immediately prior to the implementation of the mortgage cap (2009) with the survey immediately following the implementation (2011). The results should be interpreted with some caution, though, given the quality deficiencies in the dataset.

We focus on how the mortgage affected household debt and the prices of the homes purchased by the households. Because we have access to detailed information at the household level, we can also consider other factors that could vary over the years (such as type of family, region and age).

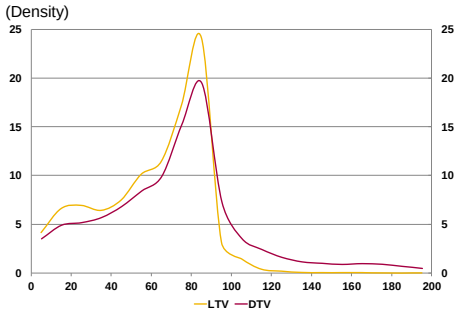
ADJUSTED DEBT-TO-VALUE RATIO

The loan-to-value (LTV[11]) ratio is a key variable in this analysis. It is used to break the households down into groups based on whether or not they were affected by the mortgage cap. A limitation in the 2009 mortgage survey is that we only have access to the household's total debt – not its total mortgage. Because total debt is larger than the mortgage, we are not able to directly calculate the LTV ratios. In order

10 A similar method is used in Finansinspektionen (2017a) to evaluate the amortisation requirement's effects on household behaviour.

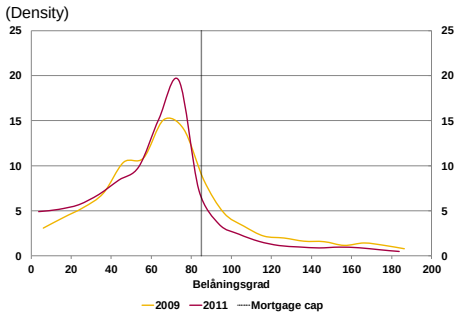
11 LTV is computed as mortgage to value.

Diagram 11. Distribution of total debt and mortgages in relation to house prices, 2011



Source: FI.
Note: The diagram shows how the LTV and DTV ratios can be broken down by household in the 2011 mortgage survey.

Diagram 12. Distribution of adjusted debt-to-value ratios, 2009 and 2011



Source: FI.
Note: The vertical line marks a ratio of 85 per cent.

Table 2. The mortgage cap's effect on total debt and house prices, new mortgagors

(Per cent)

LTV ratio	Liabilities	House prices
More than 85%	-13.0*** (3.8)	-10.0*** (3.5)
Degree of explanation	46.4	53.4
Number of obs.	16,981	16,964

Source: FI.
Note: Robust standard of error in parentheses. *** indicates that the estimate is statistically different than zero at a one-percent level. The table shows only the difference-in-difference estimates, which indicate the effect of the mortgage cap on households with LTV ratios above 85 per cent. The model that serves as the basis for these estimates is described in Appendix 3.

to compare the LTV ratios prior to and following the mortgage cap, we must construct a comparable measure.

The 2011 survey contains the households' mortgages as well as their total debt. Using these variables, we can create DTV_i, household i:s total debt in relation to the price of the home, and LTV_i, the household's mortgage in relation to the price of the home (Diagram 11). The 2011 DTV ratio is not adjusted but rather specified by each household's LTV_i. On average, DTV is 11.5 percentage points higher than LTV in 2011. We therefore construct households' LTV ratios in 2009 by adjusting downwards each household's DTV ratio by 11.5 percentage points. This adjustment is necessary in order to be able to compare the figures by year, but it also increases uncertainty related to the estimates.[12]

With the adjustments, we can use the 2009 and 2011 surveys to estimate the effects of the mortgage cap. To do this, we split the households into two groups using their adjusted DTV ratios:

1. Households with an adjusted DTV ratio below 85 per cent of the market value are not affected by the mortgage cap and serve as a *reference group* in our analysis.
2. Households with an adjusted DTV ratio of more than 85 per cent are restricted by the mortgage cap.

The percentage of households with an adjusted DTV ratio of more than 85 per cent fell after the implementation of the cap (Diagram 12). At the same time, the concentration of households just under 85 per cent increased in 2011. This was expected since the regulation specifies that households may not have a mortgage that results in a DTV ratio of more than 85 per cent.[13] The distribution thus shifts to the left, and households that want to take a large loan are concentrated around the cap.

SIMILAR DEVELOPMENT IN DEBT AND MARKET VALUES PRIOR TO 2010

A basic assumption when estimating the effects of the mortgage cap is that the groups being studied showed similar trends prior to the implementation of the cap. Another assumption is that households in the reference group were not affected by the mortgage cap and borrowed as much and bought as expensive homes after the mortgage cap as they did before. Given these assumptions, we can estimate how households subject to the mortgage cap would have behaved if FI had not introduced the cap.

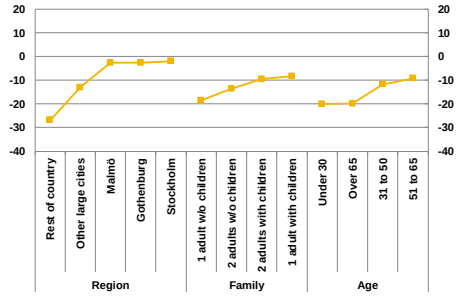
We cannot test for common trends at the household level since we do not have such data at the household level prior to 2009. However, we can look for common trends using aggregate data from FI's mortgage surveys. The results from this data indicate that debt and market values for households with DTV ratios both above and below 85 per cent showed the same trends prior to the implementation of the mortgage cap. The assumption that the groups showed the same trends prior to

12 In Appendix 2, we present alternative estimates in which we conducted sensitivity analyses for the fundamental assumptions. The results from these estimates do not vary significantly from the data we present in the main analysis.

13 Households may choose to take on a loan that exceeds the 85-per cent limit by using alternative financing, e.g. unsecured loans. However, the financing cost of such alternatives is high, which introduces weaker incentive to use them.

Diagram 13. Effects of the mortgage cap on total debt for different types of households

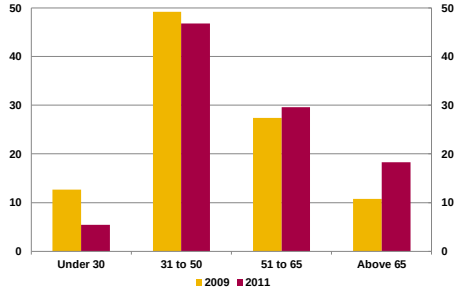
(Per cent)



Source FI.
Note: The diagram shows how groups of new mortgagors are affected by the mortgage cap. The interval for each estimate shows the estimated 95-per cent confidence interval for each household category.

Diagram 14. New mortgagors by age in 2009 and 2011.

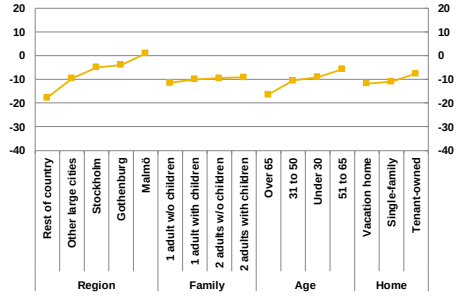
(Per cent)



Source: FI.
Note: The percentages show the breakdown of households in the mortgage surveys in 2009 and 2011.

Diagram 15. Effects of the mortgage cap on the house price for different types of households

(Per cent)



Source FI.
Note: The diagram shows how groups of new mortgagors are affected by the mortgage cap. The interval for each estimate shows the estimated 95-per cent confidence interval for each household category.

the implementation of the regulation is therefore not rejected. This means we can continue in our analysis and estimate the difference-in-difference equations to quantify the effects of the mortgage cap.[14] Using these equations, we can also study any differences in how the mortgage cap affected different types of households.[15]

HOUSEHOLDS WITH HIGH DTV RATIOS BORROW LESS AND PURCHASE MORE INEXPENSIVE HOMES

The estimates show that, as a result of the mortgage cap, households (with new mortgages), whose total debt exceeds the cap, borrow less than what they would have done if FI had not introduced the cap (Table 2). The decrease is estimated to be 13 per cent.

For some households, total debt consists of more than just their mortgage. Therefore, the interpretation of the results would have been different if we had been able to study only mortgages. The results still indicate, though, that households with high DTV ratios with a new mortgage in 2011 borrowed less as a result of the mortgage cap. The cap probably has meant that many households that already had a high level of total debt opted to borrow less or not borrow more at all.

If FI had not introduced the mortgage cap, these households would most likely have borrowed more. Households affected by the mortgage cap also opted to purchase less expensive homes a result of the cap (Table 2). Restricted households purchased homes that were approximately 10 per cent less expensive.

HOUSEHOLDS OUTSIDE THE LARGE CITIES AFFECTED THE MOST

The effect of the mortgage cap is greatest for households outside the metropolitan regions (Diagram 13). It is primarily there that households with high DTV ratios borrowed less and purchased less expensive homes as a result of the mortgage cap. DTV ratios on average are highest in the areas where house prices are lower. One conceivable explanation for this is that many households in the metropolitan areas – where house prices increased sharply – built up capital by selling previous homes, thus creating a relatively large downpayment. They therefore do not need to borrow with as high DTV ratios when purchasing a home.

The results show that it is primarily families without children who borrow less as a result of the cap. However, the difference between these families and families with children is not statistically significant (Diagram 13). We find that the youngest and the oldest mortgagors reduce their debt by approximately 20 per cent. The reduction in other age groups is around 10 per cent. In addition, the percentage of young borrowers in 2011 decreased compared to in 2009 (Diagram 14). Because the economy was stronger in 2011 compared to 2009, and unemployment among younger age groups was lower, the mortgage cap may have made it more difficult for some young households to enter

14 Difference-in-difference is a statistical method used to compare the effect of a reform for those affected (the groups subject to the requirement) to a comparable control group. It is important for the selected groups to show similar growth before the reform. This method adjusts for factors that affect both the groups, and the results can then be interpreted as a causal effect of the reform. A normal application of difference-in-difference is the evaluation of political reforms (see, for example, Card and Krueger,1994 and Imbens and Wooldridge, 2009).

15 The model is described in Appendix 3.

Diagram 16. Mortgage cap's impact on mortgages and house prices

Source: FI.
Note: The diagram shows the change in per cent of total debt and the price of homes as a result of the mortgage cap. The estimation of the effects for each group (including the reference group) was based on the estimated effects presented in Table 2.

the housing market. However, the banks may have also strengthened their credit assessments during this period.

Households that purchase less expensive households also borrow less as a result of the mortgage cap, but the effect on house prices as a whole is smaller. This may be a sign that alternative financing (for example, savings) has become more important for households with high DTV ratios. Approximately the same percentage of families with and without children chose to purchase less expensive homes (Diagram 15). In other words, they were equally affected by the regulation.

It is the oldest mortgagors affected by the mortgage cap who adapted their behaviour the most. They borrow approximately 20 per cent less and purchase homes that are almost 20 per cent less expensive. Older households often have more options. They can purchase less expensive homes by choosing a smaller home or a less attractive area. They often also have savings that they can use for the downpayment.

Younger households subject to the mortgage cap also borrow 20 per cent less. However, they purchase homes that are only 10 per cent less expensive. This could be because young households already are buying small homes and therefore primarily can purchase a less expensive home by choosing a less attractive location. They often also do not have savings that they can use for the downpayment. Young households are therefore forced to finance the purchase through unsecured loans, help from parents or by borrowing together with a partner.

MORTGAGE CAP APPEARS TO HAVE REDUCED HOUSEHOLD DEBT AND SLOWED THE GROWTH IN HOUSE PRICES

The analysis shows that the mortgage cap has affected the behaviour of the households restricted by the regulation, i.e. those that want to borrow a lot in relation to the value of the home. These households purchased less expensive homes and borrowed less than what they would have down without the regulation.

In order to calculate how the regulation affected the entire mortgage market, we weigh together all households in the mortgage survey with the estimated effects of the mortgage cap. This shows that households with new mortgages purchase homes that on average are 1.6 per cent less expensive as a result of the mortgage cap (Diagram 16). The cap also slowed the growth rate of household debt by on average almost 2.1 per cent. These effects are less than the estimated effects of the amortisation requirement from 2016 (Finansinspektionen 2017a)[16], but the mortgage cap affected far fewer households than the amortisation requirement.[17]

Conclusions

This FI Analysis evaluates the Swedish mortgage cap FI implemented in 2010. The quality of the data that FI gathered prior to and immediately following the implementation of the mortgage cap is not as high as the quality of the data gathered today, but the analysis indicates that

16 In contrast to this study, Finansinspektionen (2017a) estimated the amortisation requirement's effect on households' mortgages and not on households' total debt.

17 The mortgage cap affected 18 per cent of the new mortgagors and the amortisation requirement 60 per cent.

the mortgage cap has changed household behaviour. Households with new mortgages are borrowing less than what they would have done if FI had not implemented the mortgage cap. They are also buying less expensive homes.

Prior to the implementation of the mortgage cap, FI expected there to be a limited effect on house prices. Our analysis indicates that households restricted by the mortgage cap borrow approximately 13 per cent less and purchase homes that are approximately 10 per cent less expensive. For the mortgage market as a whole, this means that the mortgage cap has slowed the growth in house prices by on average 1.6 per cent. This is in line with FI's expectation. At the same time, households taking a mortgage to buy a home on average borrowed 2.1 per cent less as a result of the cap.

The effect of the mortgage cap is greatest for households outside the metropolitan regions. Households that borrowed less and purchased less expensive homes are primarily those with high DTV ratios. The youngest and the oldest households also appear to have reduced their debt the most, although young households purchased homes that were just as expensive. This can be a sign that young households are more likely than older households to use other types of financing than mortgages when purchasing a home.

Like in several other studies, we show that the mortgage cap had more of an impact on lending than on house prices (for example, Avouyi and Lecat, 2014 and Jácome and Mitra, 2015). This applies in particular to young new mortgagors. However, the effect on house prices can still be large for households that are affected. This is supported by Kelly et. al. (2017), which with detailed data of Irish borrowers shows that a mortgage cap plays an important role in cooling rapidly rising house prices. The fact that our study shows a limited effect for the mortgage market as a whole is due to the relatively small number of households affected by FI's implementation of the mortgage cap.

Since FI introduced the mortgage cap in 2010, additional regulations have been introduced on the mortgage market (higher risk weights and amortisation requirements). The banks have also gradually tightened their credit assessment process. Even if this evaluation was conducted more than seven years after the implementation of the cap, it is important to understand the effects of the regulation. The evaluation can also contribute to a better general understanding for the effects of macroprudential measures.

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APPENDIX 1. Selection of previous studies

Literature (Cross-sectional studies)	Regulations analysed	Method	Main results.
Arregui et al. 2013	DTV, DSTI, cash requirements and provision requirements for credit losses.	Dynamic panel regression of 38 countries, data (2000–2011).	DTV, DSTI and cash requirements slow the growth of loans and house prices.
Ahuja and Nabar 2011	DTV, DSTI, cash requirements and provision requirements for credit losses.	Dynamic panel regression of IMF's survey data from 2010 (2000–2010).	A DTV cap slows the growth of house prices. DTV and DSTI slow the growth of mortgages.
Almedia et al. 2006	DTV, DSTI, risk weights, cash requirements and provision requirements for credit losses.	Panel regression of growth in house prices and mortgages, based on 26 countries (1970–1999).	In countries with high DTV, shocks to income have a larger effect on growth in new mortgages and house prices.
Nier et al. 2012	DTV, DSTI, risk weights, cash requirements and provision requirements for credit losses.	Dynamic panel regression of 38 countries, data (2000–2011).	DTV, DSTI and cash requirements slow the growth of loans and house prices.
Kuttner and Shim 2012	DTV, DSTI and risk weights on mortgages.	Panel regression of growth in house prices and mortgages, based on 57 countries (1980-2010).	DTV and DSTI slow the growth of mortgages and house prices.
Lim et al. 2011	DTV, DSTI, credit growth cap, cash requirements, capital requirements and provision requirements for credit losses.	Dynamic panel regression based on IMF's survey data from 2010 (2000–2010).	All regulations contribute to a reduction in the co-variation between the business cycle and credit growth.
Wong et al. 2011	DTV	Panel regression, based on data from 13 countries.	A DTV regulation reduces the risk of credit losses on mortgages given a shock to the real estate market.

Source: IMF 2014 "Selected issues paper: Sweden", IMF Country Report No. 14/262.

Note: DTV is the debt-to-value ratio and DSTI is the debt servicing ratio (interest payments and amortisation payment divided by disposable income).

Table A1. The mortgage cap's effect on debt and house prices broken down into three groups, new mortgagors

(Per cent)

DTV ratio	Liabilities	House prices
75-85%	-2.8	-5.4
	(3.8)	(3.5)
More than 85%	-14.6***	-10.4***
	(2.8)	(2.5)
Degree of explanation	47.7	53.3
Number of obs.	16,973	16,957

Source: FI.
Note: Robust standard of error in parentheses. *** indicates that the estimate is statistically different than zero at a one-percent level. The table shows only the difference-in-difference estimates, which indicate the effect of the mortgage cap on households with DTV ratios of 75-85 per cent and above 85 per cent. The model that serves as the basis for these estimates is described in Appendix 3.

Table A2. Alternative estimate of the mortgage cap's effect on debt and house prices, new mortgagors

(Per cent)

DTV ratio	Liabilities	House prices
More than 85%	-18.2***	-13.4***
	(2.7)	(2.3)
Degree of explanation	45.8	53.4
Number of obs.	16,981	16,964

Source: FI.
Note: Robust standard of error in parentheses. *** indicates that the estimate is statistically different than zero at a one-percent level. The table shows only the difference-in-difference estimates, which indicate the effect of the mortgage cap on households with DTV ratios above 85 per cent. The model that serves as the basis for these estimates is described in Appendix 3.

Appendix 2. Alternative estimates

Sensitivity analysis: breakdown into groups

In the main text we show the results from an estimate where we split the households into two groups: one group with households that have a DTV ratio of less than 85 per cent and one group with households that have a DTV ratio of more than 85 per cent. The results of this analysis are based on the assumption that the reference group is not affected by the mortgage cap. However, the cap may have resulted in some households adapting their DTV ratio to fall just under the limit. This would mean that the reference group is not "unaffected" and the results may both overestimate and underestimate the effects. We have conducted a sensitivity analysis that takes into consideration that the cap may have affected households just under the limit. We then divide the households in to the following three groups:

1. Households with an adjusted DTV ratio of 75 per cent of the market value. This is the reference group in our sensitivity analysis.
2. Households with an adjusted DTV ratio of between 75 and 85 per cent. This group is considered in the analysis to study the behaviour of households that are just under the cap.
3. Households with an adjusted DTV ratio of more than 85 per cent.

We find, just like in the basic analysis, the households with a DTV ratio above 85 per cent purchased less expensive homes than they would have done without the cap and that their total debt is lower (Table A1). Households with DTV ratios just under the mortgage cap (75 to 85 per cent) did not change their behaviour as a result of the cap. The difference in the behaviour of this group compared to the behaviour of the reference group is not statistically significant. In other words, there is no difference compared to what was presented in the main analysis (compare Table A1 to Table 2).

Sensitivity analysis: DTV ratios

The 2009 mortgage survey does not contain data about the mortgage's size and, thus, LTV ratio. In the main analysis, we have chosen to calculate the average difference between the DTV ratios (total debt divided by market value) and LTV ratios (mortgages divided by market value) for 2011 (Diagram 11). We then used this difference to calculate LTV for 2009. Since mortgages constitute the total debt for half of the borrowers in 2011, we make an alternative estimate where we do not adjust DTV for 2009. In this calculation, we group together the 2009 households from DTV and the 2011 households from LTV.

The calculation can be interpreted as mortgages representing the entire debt for all households in the 2009 survey. We also applied two extreme assumptions to the calculation: All households have the same difference between LTV and DTV in 2009 (the calculations in the main analysis) and all households have the same LTV and DTV.

The results from these estimates are consistent with those in the main analysis, but the effects are slightly larger, which indicates that debt and market values could have been slowed more (compare Table A2 to Table 2 in the main analysis).

Appendix 3. A difference-in-difference model for effects of the mortgage cap

By specifying an econometric model, we are able to investigate how the mortgage cap affects debt and market values. We can also estimate how the mortgage cap affected different types of households. The approach that we use is based on the principle that the analysed debt and house prices, prior to the implementation of the regulation, grow at the same rate regardless of the DTV category of the household.

We estimate the following difference-in-difference model:

(A1) $$y_{it} = \beta_0 + \beta_1 P_{it} + \beta_2 B_{it} + \beta_3 P_{it} B_{it} + \delta X_{it} + \varepsilon_{it},$$

where *y* is the dependent variable of interest; *P* is a dummy variable for the period after the reform (2011 in our case); *B* indicates whether the household is included in the group that is affected by the reform (DTV ratio of more than 85 per cent). The coefficient β_3 in front of the interaction term $P_{it}B_{it}$ gives an estimate of the *DD* parameter and shows how the regulated households are affected by the mortgage cap. *X* is a vector of additional explanatory variables and ε is an error term.[18] The difference-in-difference method is described in more detail by Imbens and Wooldridge (2009).

18 The input explanatory variables in the model are: volume-weighted interest rate, age of the borrower, age squared of the borrower, if there are several adults in the household, if there are children i the household, type of home, bank-specific and region-specific effects.