

Recently, it has become increasingly common for Swedish households to opt for variable interest rates for their mortgages. In this economic commentary, households' choice of fixation periods, the banks' mortgage funding and the risks posed by households' choice of fixation periods are discussed.

The study shows that short fixation periods are common both in Sweden and in other countries, and it is probably household preferences that determines the fixation period for Swedish mortgages, rather than the banks. It appears that households take account of both the future interest rate level in the short term (one-year rate expectations) and present relative expenses (the spread between fixed and variable mortgage rates) when they choose between variable or fixed mortgage rates. The study also shows that the historical variation in inflation affects the share of new lending at short fixation periods.

In this study, we also analyse the choice of Swedish households of fixation period using microdata regarding new borrowers. The analysis shows that it is households with high income and low debts that are most inclined to choose variable rates for their mortgages. This confirms the results from previous theoretical studies that have shown that households with a high, stable income ought to be more inclined to opt for variable-rate mortgages.

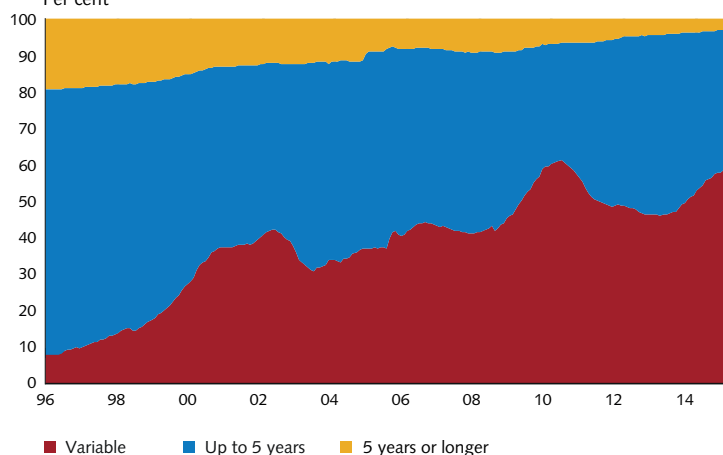
## An analysis of the fixation period for Swedish mortgages

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### 1. Introduction

Since the end of the 1990s, it has become increasingly common for Swedish households to opt for mortgages with a short fixation period. Currently, around 76 per cent of all new mortgages are granted at the variable rate, while only around 6 per cent of all new mortgages have a fixation period of five years or more.<sup>1</sup> Because of this, the share of variable rate mortgages in the Swedish mortgage stock has risen from around 8 per cent to around 60 per cent over a 20 year period. At the same time, the share of mortgages with a fixed rate of five years or more has decreased from almost 20 per cent to just over 3 per cent in the same period (see Chart 1).

Chart 1. Share of variable and fixed rate mortgages in Sweden  
Per cent



Note. Based on the lending of mortgage institutions. The breakdown between fixed rate mortgages up to 5 years and above 5 years is an estimation calculated based on statistics regarding the household lending of monetary financial institutions.  
Sources: Statistics Sweden and the Riksbank

On an international front too, a growing share of variable rate mortgages has become increasingly common, and in most countries the share of new lending at the variable rate has been high at times.<sup>2</sup> In a comparison of the historical averages of the share of new mortgages at a variable rate in a selection of countries, we see that many countries have had a higher share of variable rate lending than Sweden (see Chart 2).

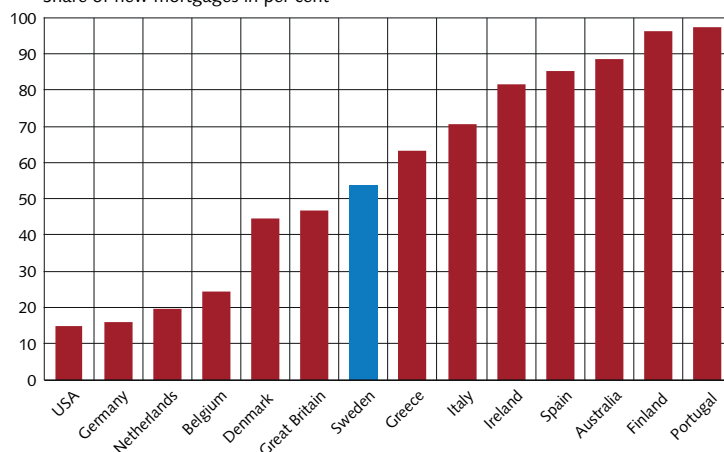
However, there is considerable variation between countries. In e.g. Portugal and Finland, it is not uncommon for more than 90 per cent of new mortgages to have

1. "Variable rate" is defined herein as a mortgage with a fixation period of 3 months or less.

2. In the international comparison, "variable rate" is defined as loans with a fixation period of less than a year.

a variable rate, while mortgage borrowers in Germany and the US prefer fixed rate mortgages (see Chart 2). In many countries, the choice between variable or fixed rates has also varied over time. For example, in the 1980s around 60 per cent of new mortgages in the US were granted at a variable rate, which is in contrast with today, with fewer than 20 per cent of US mortgages being granted at the variable rate.<sup>3</sup>

**Chart 2. Historical average of the share of variable rate mortgages in a selection of countries**  
Share of new mortgages in per cent



Note. The chart is based on historical averages of all new mortgages with a fixation period of less than 1 year. Note that historical averages are based on time periods of different lengths (for details, see Badarinza et al. (2014)).

Sources: Badarinza et al. (2014) and the Riksbank

There are also great differences in the length of the average fixation period from country to country. In Sweden, the historical average fixation period for new lending is around 2.2 years<sup>4</sup> while the average fixation period in the US is around 20 years (see Chart 3).

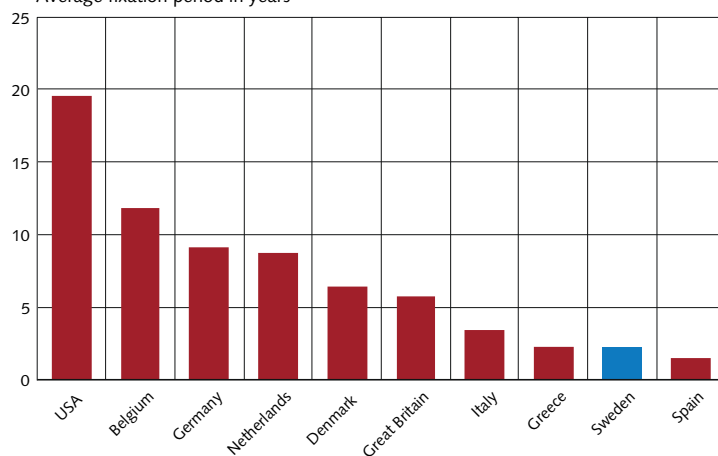
This difference is largely due to the fixation periods offered. In the US and France, mortgages with a fixation period of up to 30 years are commonly offered. In Canada, Germany, Switzerland and the Netherlands, the most common fixation periods are between 5 and 10 years. In countries such as Sweden, Australia, Spain and the UK, mortgages with a fixation period exceeding five years are instead uncommon.<sup>5</sup>

3. See Figure 1 in Badarinza et al. (2014).

4. Calculated as a weighted mean of the averages in the interval presented in Chart 1.

5. See Lea (2010).

**Chart 3. Average fixation period in a selection of countries**  
Average fixation period in years



Note. The average fixation period for Sweden is calculated with the variable rate defined as 3 months, and two further intervals (3 months to 5 years, and over 5 years), while for other countries the variable rate is defined as 1 year and the average is calculated based on 3 fixed-period intervals (1 to 5 years, 5 to 10 years and over 10 years), see Badarinza et al. (2014).  
Sources: Badarinza et al. (2014), Statistics Sweden and the Riksbank

In summary, it is therefore common to have a share of variable rate new mortgages that is high at times in many countries, and the share of variable rate mortgages in Sweden is around the international average. However, in an international comparison Sweden stands out as one of the countries with the shortest average fixation period for fixed-rate mortgages.

## 2. Risks in households' choice of fixation period

Households' choice of fixation periods poses risks – to individual households, macroeconomic stability and financial stability alike.

### *The individual household*

For a household with a high proportion of its mortgage at the variable rate, nominal interest payments will increase if the interest rate rises. However, households can hedge themselves against this risk by opting for a fixed rate mortgage. At the same time, a household with a variable rate mortgage can be expected to have lower nominal interest payments in a poorer economic climate when inflation and interest rates decline. Opting for the variable rate on a mortgage can therefore be seen as insurance against a poorer economic climate. It can thus be expected to a certain extent that the fixation period chosen by households might be affected by households' interest rate and inflation expectations.

The degree of vulnerability of a household with a substantial part of its mortgage at the variable rate depends on the extent of that household's debts in relation to disposable income. A household with a loan-to-income ratio (i.e. debts divided by annual income) of 100 per cent would need to reduce its total saving plus consumption by 1 per cent if the interest rate were to rise by 1 percentage point. A household with a loan-to-income ratio of 500 per cent would need to reduce its consumption and saving by 5 per cent for the same rate increase. In other words, heavily indebted households are most sensitive to changes in interest rates. However, we do not know by how much households would cut back on their consumption and reduce their savings. It might be perceivable that households with variable rates also save more than those with fixed rates. In this case, changes to interest rates would not affect household consumption to a great extent because they can offset the higher cost by saving less.

However, sharp increases in the interest rate are unlikely to be offset with a mere reduction in saving, especially so for households that are already heavily mortgaged. So, although it is difficult to specify the extent to which consumption is affected by increased interest expense, there is reason to believe that there is a correlation

between fixation periods and the sensitivity of households' consumption to rate changes. Also, this correlation intensifies in line with the leverage ratio, and hence overly indebted groups with slender margins are those for whom the risks associated with variable rates are greatest.

### *The macroeconomy*

Besides the risks to which individual households are exposed, a high share of variable rate mortgages may pose stability risks. This is because a high share of variable rate mortgages, combined with high indebtedness, could bring about heightened sensitivity to interest rates in the household sector. Great sensitivity to interest rates could lead households to cut back on their consumption if the interest rate rises faster than they planned for. In turn, this risks generating repercussions on aggregate demand and on the profitability of companies, causing higher credit losses and a higher funding cost for the banks, which poses a risk to financial stability.

Household sensitivity to interest rates also has implications for the monetary policy transmission mechanism. If households are more sensitive to interest rates, their scope for consumption is affected more by a change in monetary policy. This means that monetary policy operates more through the household sector than other transmission channels, such as through company investments or the exchange rate. However, it can also mean that household consumption, and potentially also house prices, fluctuate more over the business cycle.

If instead households have a high share of fixed rate loans, a given change to the interest rate will have less of an impact on household consumption. This would then lead to the household sector being a less important component in the monetary policy transmission mechanism, which could have a stabilising effect on the housing market.

However, the extent to which private consumption is affected by which fixation periods households choose is unclear. Forward-looking consumers can counteract fluctuations in interest expense by changing their saving and keeping consumption more or less unchanged. In the classic macroeconomic analysis, households' choice of fixation period entirely lacks significance to total consumption because household debt is financed by other households' saving. In turn, this assumption means that households' choice of fixation period would not affect households at the aggregate level in the event of an unexpected change in the interest rate. Instead, it would only bring about a redistribution of resources between indebted households and saving households.<sup>6</sup> However, these results are based on a series of strong assumptions, the most important being that savers and borrowers react in exactly the same way to income fluctuations. That assumption can only be met in a world in which all individuals behave in the same way and meet the same criteria.

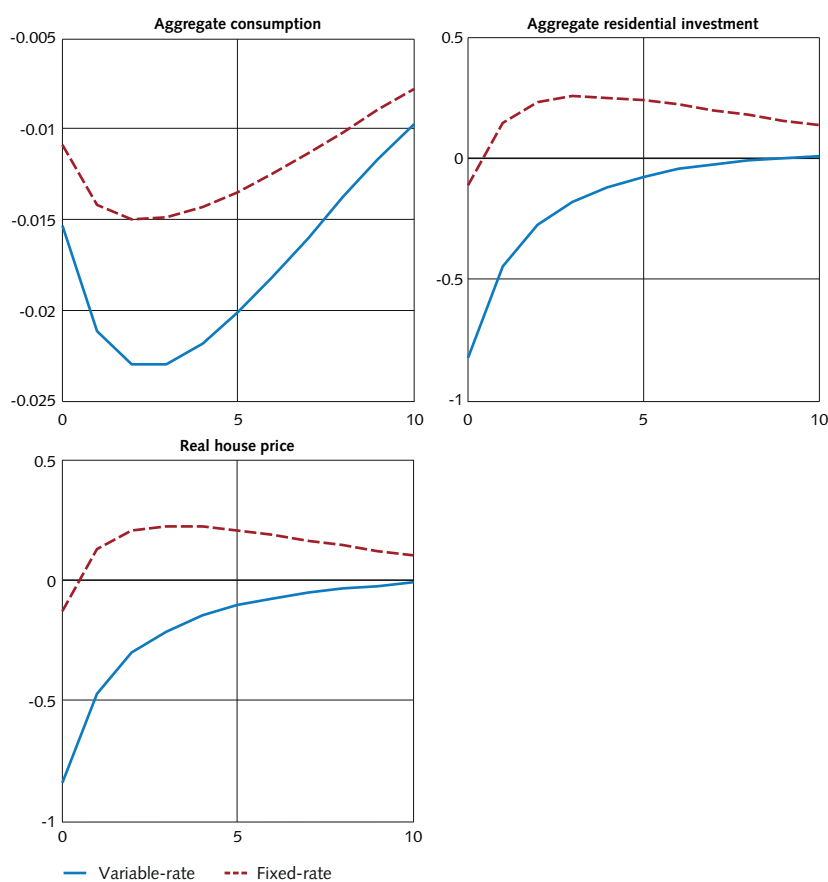
A model that does not rest on the assumption of identical consumers, and which can therefore be used to analyse households with mortgages, was formulated by Iacoviello (2005). In that model, households exist with two different levels of patience.<sup>7</sup> The impatient households attach great importance to their current consumption, and are thus inclined to borrow money to a greater extent than the more patient households, which consist of savers in the model. The impatient households must borrow against some sort of collateral, however. This means that the model is based on there being some sort of mortgage cap that poses an upper limit to the size of the loan. In the model, the upper limit is binding, and the impatient households thus wish to increase their leverage in order to boost their current consumption. This assumption thus entails that households with loans (impatient) and saving households (patient) have a different marginal inclination to consume. If the borrowers obtain greater resources, they will therefore wish to use them for consumption to a greater extent than their patient counterparts. Hence, changes in resource distribution, unlike in the classic model, will also have an effect on aggregate consumption and demand.

6. The rationale is based on the assumption that total household saving, i.e. saving adjusted for debt, is zero.

7. The model's fundamental assumptions regarding financial friction come from the general equilibrium model presented by Kiyotaki and Moore (1997). Iacoviello (2005) takes the mechanisms from Kiyotaki and Moore (1997) and places them in a new Keynesian framework.

Rubio (2011), Calza, Monacelli and Stracca (2013) and Brzoza-Brezina, Gelain and Kolasa (2014) analyse the effects of different fixation periods on borrowing rates in the type of model formulated by Iacoviello (2005). All find that monetary policy has a greater impact through household consumption if a greater share of loans is granted at the variable rate. This is because the effect of interest rate changes is borne by the borrower, whose consumption is more income-sensitive due to the binding credit limitation. An important insight from all three studies is that house prices react more to a change in monetary policy if mortgages are granted at the variable rate. Figure 4 shows the effects calculated by Calza, Monacelli and Stracca (2013), which is the study that finds the strongest effects of different fixation periods.<sup>8</sup>

**Chart 4. Reaction to a tightening monetary policy shock in Calza, Monacelli and Stracca (2013)**  
Percentage deviations from equilibrium (steady state)



Note. The impulse-response functions in the figure are based on a monetary policy shock of 0.25 percentage points. For details, see Calza, Monacelli and Stracca (2013).  
Source: Calza, A., Monacelli, T. and Stracca, L. (2013) "Housing finance and monetary policy", *Journal of the European Economic Association* vol. 11(1)

Besides analysing interest rate fixing in a calibrated model, Calza, Monacelli and Stracca (2013) also estimate a vector autoregressive model for 19 countries between 1970 and 2008. The analysis shows that, in the countries that have a high share of variable rate loans, changes in interest rates also have a stronger effect on private consumption. The result is in line with the theoretical results from that analysis, although the results should not be interpreted as proof of direct causal effects from fixation periods on interest rate sensitivity.

Brzoza-Brezina, Gelain and Kolasa (2014) also analyse the effects of changes to the maximum permitted leverage ratio for the borrowing households. They find that such a change would not have any appreciable direct effect. However, it would increase the importance of the share of variable rates to monetary policy efficiency. It would

8. Rubio (2011) and Brzoza-Brezina, Gelain and Kolasa (2014) find lesser effects from different fixation periods, but which resemble, in qualitative terms, those presented in Figure 1.

therefore also amplify expected fluctuations on the housing market in the event of changes to the nominal interest rate.

An important conclusion that we can draw from studying modern macro literature is that there is support for fixation periods having a bearing on the aggregate effect of a change to the interest rate. The larger the share of households with variable rate loans, the stronger the reaction to monetary policy of private consumption, house prices and GDP. Also, the higher the loan-to-value ratio of households, the greater this effect. However, the models do not say anything about why certain households choose loans at the variable rate and others not, or why the variable rate is more common in some countries than others.

### 3. What drives households' choice of fixation periods?

The choice of fixation period and the difference between countries are due to several factors. The fact that households in certain countries choose variable rate mortgages to a greater extent is partly due to borrowing culture and the institutional conditions of each country, such as the cost of early mortgage redemption. In many countries (such as the Netherlands, Switzerland, Spain, Sweden, etc.) the cost of early mortgage redemption is devised as an interest rate differential charge. Other countries have a low or non-existent charge for early mortgage redemption (such as Japan and the US).<sup>9</sup> Also, some countries have opted to regulate the share of new lending at the variable rate with a view to reducing the interest rate sensitivity of households.<sup>10</sup>

Besides these country-specific conditions, theoretical studies have shown that risk-averse and highly leveraged households, which have an uncertain and variable income and substantial risk to net worth, might prefer fixed rate mortgages. Households with smaller loans, more stable income and a greater inclination to move might, at the same time, prefer variable rate loans.<sup>11</sup> The same study also shows that a high share of variable rate mortgages is more advantageous in countries where it is relatively easy to default on a mortgage. However, the study assumes that households are rational, and disregards the fact that households may make decisions based solely on their immediate situation. Also, experimental studies have shown that people who are usually risk-averse tend to be more amenable to risk when they choose between fixed rate and variable rate mortgages.<sup>12</sup>

Empirical studies have also shown that households take into account both the future interest rate level in the short term (one-year rate expectations) and present relative expenses (the spread between fixed and variable mortgage rates) in their decision between variable and fixed mortgage rates (see Chart 5).<sup>13</sup> Households' interest rate expectations have a bearing because households take account of the expected cost of the mortgage throughout whole or parts of the term of the loan, in relation to the risk to which the household is exposed. There are also studies showing that households in countries with historically volatile inflation tend to prefer variable rate mortgages to a greater extent (see Chart 6).<sup>14</sup>

If the relative risks between fixed and variable rates are constant over time, it is also probable that one of the most significant factors in which fixation period households choose is the spread between the fixed and variable mortgage rates. This is because households of limited financial means care about the present cost of the loan, and they hence tend to opt for variable rate mortgages if this results in lower housing costs in the short term.<sup>15</sup>

9. For a discussion on the institutional conditions of different countries, see Lea (2010).

10. Belgium and Israel, for example, have regulations in place that are intended to reduce the share of new lending at the variable rate with a view to reducing the interest rate sensitivity of households. For details, see the Financial Stability Review 2014, National Bank of Belgium.

11. See Campbell and Cocco (2003).

12. This behaviour can be explained based on Prospect theory, see Mori, Diaz and Ziobrowski (2009).

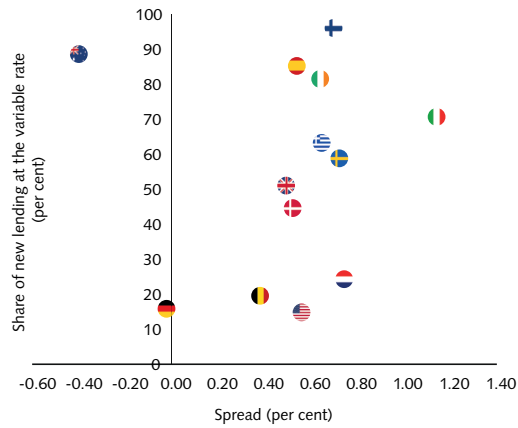
13. Campbell and Cocco (2003) also discuss the importance of future interest rate expectations and the spread between fixed and variable mortgages to households' choice of fixation periods.

14. See Campbell (2013).

15. Another reason for households focusing on the present costs could be that creditors take account of some sort of debt service ratio in their calculations, giving households the incentive to choose variable-rate rather than fixed-rate mortgages if the spread between these two alternatives is wide, see e.g. Johnson and Li (2015).

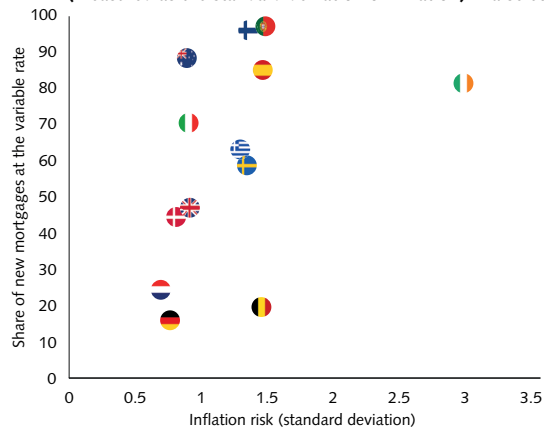


**Chart 5. Share of new mortgages at the variable rate and the spread between fixed and variable interest rates in a selection of countries**



Note. The chart is based on historical averages (2003-2013) of all new mortgages with a fixation period of less than 1 year. Note that historical averages are based on time periods of different lengths (for details, see Badarinza et al. (2014)).  
Sources: Badarinza et al. (2014) and the Riksbank

**Chart 6. Share of new mortgages at the variable rate and the inflation risk (measured as the standard deviation of inflation) in a selection of countries**



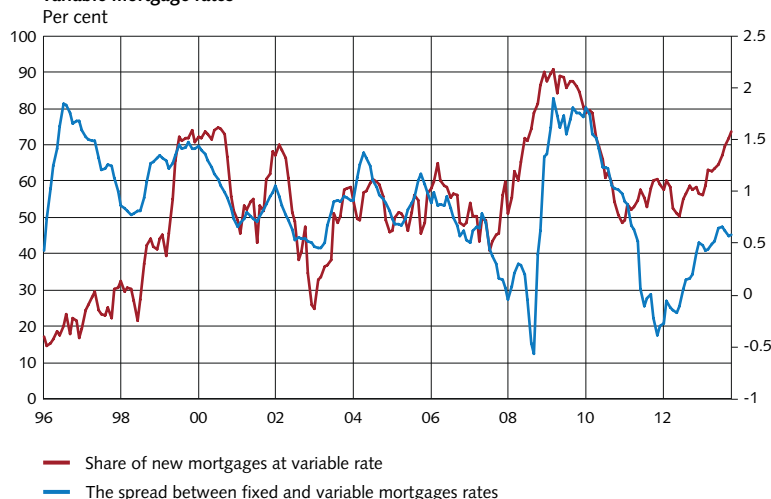
Note. The chart is based on historical averages (2003-2013) of all new mortgages with a fixation period of less than 1 year.  
Sources: Badarinza et al. (2014) and the Riksbank

A partial reason for why it has become increasingly common for Swedish households to choose variable rate mortgages could thus be that there has been a wide spread between fixed and variable mortgage rates for a long time. At the same time, the institutional conditions have meant that it can be expensive to redeem a mortgage prematurely.<sup>16</sup>

16. See the Riksbank's consultation response to the Ministerial memorandum on Interest rate differential charges, etc. for mortgages (Ds 2013:38), August 2013.



**Chart 7. Share of new mortgages at the variable rate and spread between fixed and variable mortgage rates**



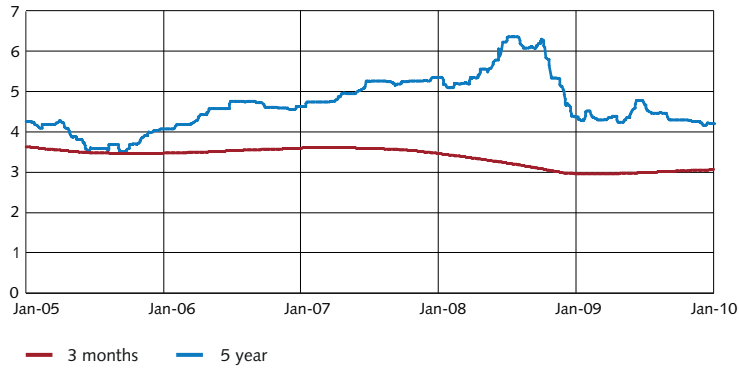
Note. Variable rate loans are defined as loans with a fixation period of less than 1 year. The spread between fixed- and variable rate mortgages is based on calculated volume-weighted mortgage rates.  
Sources: Badarınza et al. (2014) and the Riksbank

Another potential reason is that in Sweden, choosing the variable rate ahead of slightly longer fixation periods for a mortgage has proved beneficial in the past. In Chart 8 below, we compare the interest rate for a fixed loan of 2 and 5 years, respectively, with the interest the customer would have paid for a loan with an interest rate that had been fixed for 3 months in the same period. The result shows that at no time during the period January 2005 to January 2010 would it have been beneficial to fix the interest rate at 5 years compared with 3 months. Instead, a customer who chose to fix the interest rate at 5 years would on average have paid 1.3 percentage points more interest. For a loan of SEK 1 million, this equates to SEK 13,000 higher interest expense annually, or SEK 65,000 over 5 years.

However, there are also periods when it has been more beneficial to fix the rate at 2 years, as shown in the chart, where the blue line (3 months) is above the red one (2 years) during certain periods.



**Chart 8. Interest on a fixed rate loan compared with total interest for a loan with a 3-month fixation period during the same period**  
Per cent



Note. On each given date, the fixed rate is compared with what the interest would have been if a 3-month fixation period had been chosen in the same period, i.e. for 5 or 2 years. The interest rates are an average of the published list rates of Swedish mortgage institutions.  
Source: The Riksbank

In other countries too, it has paid off historically to opt for variable rate rather than fixed rate mortgages – in the US, for instance (see Chart 9). This has been the case despite the authorities in the US long having urged mortgage borrowers to choose fixed rate mortgages.<sup>17</sup>

**Chart 9. Interest in the US for a 15-year fixed rate loan compared with total interest for a loan with a 1-year fixation period during the same period**  
Per cent



Note. On each given date, the fixed 15-year rate in the US is compared with what the interest would have been if a one-year mortgage rate had been chosen for the same period. The rates are an average from Freddie Macs Primary Mortgage Market Survey (PMMS).  
Sources: Macrobond and the Riksbank

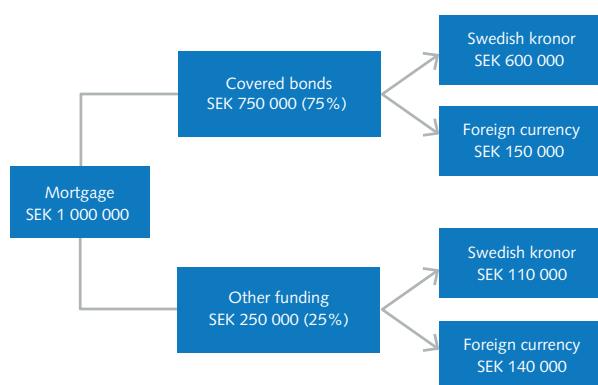
17. In the depression in the US in the 1930s, many banks failed because they could not refinance their mortgages. In turn, this led to the authorities starting to advocate mortgages with longer fixation periods by means of various regulations that still partly live on today. For details, see Ligon and Michel (2014).

It is also possible that households have low<sup>18</sup> and overly optimistic expectations about the future interest rate trend following the latest low-rate period. If this is the case, this could affect the length of time households choose to fix their rates.<sup>19</sup> Another potential reason could be that the banks, for some reason, steer customers' choice of fixation periods in their advice. According to the banks, however, there is not usually any such steering; rather, they offer tailored advice and it is ultimately customer and their preferences that determine the length of their chosen fixation period (see the next chapter).

#### 4. What is the banks' view of households' fixation periods?

It is also of interest to study whether households' choice of fixation periods affects how the banks fund their mortgages. Swedish banks fund mortgages mainly by issuing covered bonds in both SEK and foreign currency (see Chart 10). Because the majority of all mortgages today have fixation periods of less than 5 years, the banks usually assume that the customers in their mortgage stock keep their mortgages for more or less the same length of time, irrespective of their fixation period. The duration of the banks' covered bonds is therefore typically the same today, irrespective of the fixation period selected by customers.<sup>20</sup>

Chart 10. Examples of how a Swedish bank funds a mortgage



Sources: Statistics Sweden and the Riksbank

The duration of the banks' newly issued covered bonds is currently around 4 years (see Chart 11). This is much shorter than the contractual duration of a mortgage, which is between 30 and 50 years.<sup>21</sup>

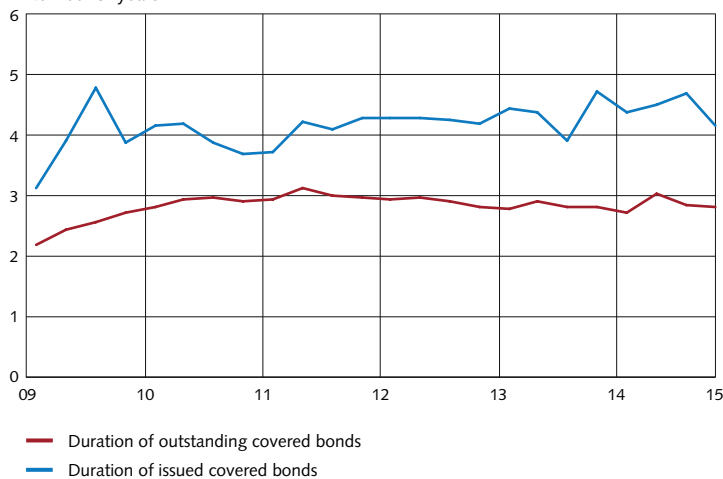
18. See Economic report by SKOP on households' interest rate expectations, 17 March 2015.

19. See Kahneman, Slovic and Tversky (1982) and Case et al. (2012).

20. However, the banks use interest rate swaps to match the incoming interest payments that they receive from customers, with their outgoing interest payments to investors. They do so in order to neutralise the interest rate risk that would otherwise arise.

21. The Swedish Mortgage Market 2013. Finansinspektionen. The fixation period of the loan can however vary from 3 months to 5 years.

**Chart 11. Duration of outstanding and issued covered bonds**  
Number of years



Note. The chart covers seven of the eight issuers active on the Swedish covered bond market. They are Handelsbanken/Stadshypotek, Landshypotek, Länsförsäkringar Hypotek, Nordea/Nordea Hypotek, SBAB, SEB, Swedbank/Swedbank Hypotek. Skandiabanken has also been issuing on the Swedish market since May 2014.  
Source: Association of Swedish Covered Bond issuers

All banks state that the main reason for so many mortgages having a three-month fixation period is that customers seek the lowest interest rate. When customers have compared interest rates, the lowest rate has most commonly been the variable rate (3-month fixation period). Another factor that can affect customers' preference for a variable rate mortgage is the benefit of not having to pay an interest rate differential compensation to the bank when selling their home or switching banks. Irrespective of for how long customers choose to fix their rate, the banks point out that customers today have much better insight into mortgage affairs than before. This is because, for instance, the media has urged customers to negotiate mortgage rates, and it has become easier for customers to compare interest rates between banks.

According to the major banks, usually the banks do not steer customers in their advice in a way that affects their choice of fixation period, either through internal pricing or other active steering. The advice given is based on weighing in a great number of individual factors pertaining to the customer such as loan-to-value ratio, income and savings.

However, the banks too see risks in the majority of all customers choosing short fixation periods, because this makes them much more sensitive if interest rates were to change than if they had borrowed at a fixed rate. In order to diversify the risks, the banks therefore often advise customers to split up the loan and have part of it at a fixed rate. Another popular measure to reduce interest rate sensitivity is to offer the customer the option of supplementing the variable rate with a rate cap that is fixed for e.g. 5 years. In this way, the customer benefits from the short fixation period while at the same time being protected against a sharp rise in interest rates.

According to the banks, it would be difficult to offer loans with fixation periods of up to 20 to 30 years, like in other countries, because there is no demand from banking customers to sign up for such long fixation periods. The banks have previously offered loans with a fixation period of 10 to 16 years, but demand from customers proved very low, one reason being potentially high interest rate differential charges if the loan were redeemed before the end of the fixation period. The banks therefore ceased to offer such loans.

If, however, customers start to demand mortgages with longer fixation periods than currently, and the banks can thus assume that customers keep their mortgages longer with the bank, there may be incentives for the bank to extend the duration of their funding. This could in turn reduce the banks' refinancing risks, which is positive in terms of financial stability. Hence, there would also be a link between long fixation periods and covered bonds with a long duration.

## 5. Microdata analysis

The Riksbank has analysed microdata from Finansinspektionen's mortgage survey (MS) to see which households are inclined to select variable rate mortgages. The MS data is based on submitted data from the largest banks<sup>22</sup> and covers all new loans during the period of submission.

MS data contains detailed data regarding the content of the contracts of new mortgage borrowers, as well as data about the household's characteristics and about the home purchased with the loan. The data includes size, interest rate and fixation period for up to four bottom loans, and potentially top and/or an unsecured loan.<sup>23</sup>

Table 1 below shows the variables used in the analysis as well as their medians and means.

**Table 1. Variables at household level and their medians and means**

VARIABLE	MEDIAN	MEAN
Disposable income (SEK/month)	35,808	39,506
Discretionary income (SEK/month)	13,726	19,596
Age	43	44
No. applicants	2	1.63
Transaction price (SEK)	1,810,000	2,396,151
Bottom loan (SEK)	650,000	990,494
Top loan (SEK)	122,500	179,905
Unsecured loan (SEK)	115,194	159,604
Total debt (SEK)	1,329,557	1,710,233
Interest rate, bottom (per cent)	2.66	2.71
Interest rate, top (per cent)	3.75	3.51
Interest rate, unsecured loan (per cent)	5.25	4.98
Interest payments, bottom (SEK/month)	1,453	2,167
Interest payments, top (SEK/month)	361	516
Interest payments, unsecured loan (SEK/month)	483	643
Total monthly interest payments as a share of disposable income (per cent)	9.23	10.50
Loan-to-value ratio (per cent)	73	65
Loan-to-income ratio (per cent)	327	360
Probability of default (per cent)	0.11	0.44
Share of bottom loan at the variable rate (per cent)	100	66
Share of top loan at the variable rate (per cent)	100	95
Share of unsecured loan at the variable rate (per cent)	100	92

Note. Based on MS data from 2009, 2011, 2012, 2013 and 2014. The total number of observations is 89,017.  
Sources: Finansinspektionen and the Riksbank

As seen in Table 1, the median household is one consisting of two people with combined disposable income of SEK 35,808. The main applicant of the median household is 43 years old and takes out a bottom loan of SEK 650,000. The loan-to-value ratio of the household is 73 per cent and the loan-to-income ratio is around 327 per cent.

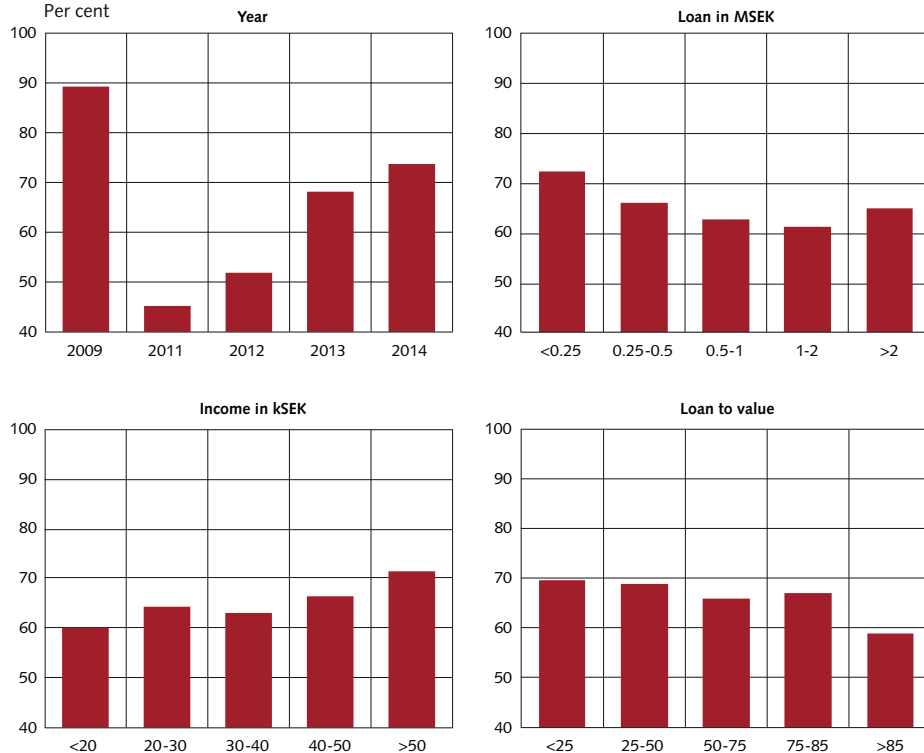
### *Descriptive analysis of fixation periods*

Because households can take out more than one loan (such as two bottom loans or one bottom loan and one top loan), we can calculate the share of loans at the variable rate at the household level. This can then be used to analyse the choice of fixation period. Hereafter, "variable rate" shall be defined as an interest rate with a 3-month fixation period.

22. One of the banks did not participate in the 2009 survey.

23. A bottom loan is defined as the part of a mortgage that is considered to have low risk by the bank, while a top loan is defined as considered to have high risk.

Chart 12. Share of mortgages at the variable rate  
Per cent



Sources: Finansinspektionen and the Riksbank

Chart 12 shows the (unconditional) average share of loans at the variable rate by year, monthly income (in thousands of SEK), loan size (in millions of SEK) and loan-to-value ratio (in per cent). It can be seen that the share of variable rate loans increases with income, and declines with both the borrowed amount and loan-to-value ratio. Also, there is considerable variation over time, probably because of the spread between variable and fixed rates, and because of expectations about the future direction of interest rates. In 2009, when interest rates dropped rapidly in response to the financial crisis, almost all new loans had the variable rate. In 2011 when interest rates started to rise again, fewer than half instead opted for the variable rate (see also Chart 7).

Below, we have studied in more detail how the interest rate level and market expectations affect households' choice of fixation period. It should be noted that lower income and greater loans increase the inclination to fix the interest rate in the model of Campbell and Cocco (2003), in which rate expectations and present spread are important factors.

### *A regression model for choice of fixation period*

The descriptive analysis shows a clear pattern in households' choice between variable and fixed rates. However, in order to further analyse the patterns we find, we deepen the analysis using regression methods. As already mentioned, it is probable that both the current interest rate level and expectations about future rates have implications for how inclined households are to take out fixed rate mortgages. We test these hypotheses by including both the level of the short interest rate and the slope of the yield curve in the regression. For each period, we use the yield on a government bond with a 3-month duration as the level of the short interest rate. The spread in yield between 5-year and 3-month government bonds is used as the slope of the yield curve. Besides the level and slope of the yield curve, we also include a curvature measure, which we define as the spread in yield between government bonds with a 3-month duration and those with a 3-year duration. Because we include all of these variables in the regression, it is important to note that the effect of the level should be interpreted as a parallel shift in the yield curve, with unchanged slope and curvature. The effect of the slope should be interpreted in the same way, i.e. as a change to the long-term interest rate level while shorter rates are kept constant. Finally, we interpret effects of yield curve curvature as how quickly the short rate adapts to the long-term level.

The slope of the yield curve reflects households' expectations about how the interest rate will develop. The advantage of using government bond yields is that they are observable by households as well as determined exogenously. If we were to use the actual interest rates paid by each household, we would encounter an endogeneity problem, because loan terms depend on the characteristics of the household, such as credit risk. Also, we can only observe the interest rates for the loan taken out by the borrower, and not for alternative contracts that banks may have offered the borrower.<sup>24</sup> An important assumption in the analysis is thus that mortgage rates at different fixation periods are determined by the yield curve for government bonds, for which we find clear evidence in our dataset.<sup>25</sup>

Besides this, we control for household disposable income, discretionary income, age, probability of default (PD), loan-to-income ratio (LTI), loan-to-value ratio (LTV), borrowed amount, whether the borrower lives in a major city region (Stockholm, Gothenburg, Malmö), whether there is more than 1 bottom loan and whether there is a top and/or an unsecured loan.<sup>26</sup> The dependent variable is households' share of loans at the variable rate. The results are shown in Table 2.

All values are significant at the one per cent level, apart from PD, which has a p-value of 0.126. The estimated effects of the yield curve components are intuitive and as expected. A shift in the yield curve has a negative effect on the share of variable loans. A higher slope with a given level and curvature reduces the incentives to fix the interest rate and hence increases the share of variable loans, while this share decreases with a higher curvature of the yield curve.

**Table 2. Choice of fixation period**

DEPENDENT VARIABLE: SHARE OF LOANS AT THE VARIABLE RATE		EST	SE
Level (3-month duration)		-0.155	0.003
Slope (5-year minus 3-month spread)		0.205	0.017
Curvature (3-year minus 3-month spread)		-0.152	0.021
Log disposable income		0.097	0.005
Log discretionary income		0.003	0.001
Log loan amount		-0.009	0.002
Log LTV		-0.012	0.003
Log PD		-0.001	0.001
Lives in Stockholm, Gothenburg or Malmö		0.039	0.003
Age of main applicant	Level	0.028	0.002
	Square/100	-0.053	0.005
	Cube/1000	0.003	0.000
No. applicants	1		Benchmark
	2	-0.070	0.004
	3 or more	-0.093	0.017
More than 1 bottom		-0.107	0.004
Has a top loan		-0.032	0.004
Has an unsecured loan		-0.057	0.005
Constant		-0.507	0.056
Observations			89.017
R <sup>2</sup>			0.147

Note. The regression also includes dummy variables for banks. The standard error in column 3 is robust to heteroskedasticity.

The regression confirms the results of the descriptive analysis. Higher income gives a greater share of loans at the variable rate, while higher loan amounts or higher LTV gives a higher share of fixed rate loans. Age has a non-linear effect. The share of variable loans increases up to 42 years of age, but decreases after 42 years of age.

24. Imputing absent values could be a way forward, see e.g. Bacon and Moffatt (2012). However, imputed interest rates too are probably endogenous in the choice of fixation period.

25. To be more precise, 66 per cent of the variation in the observed interest rate in the contract data is explained by the yield curve of government bonds as explanatory variables.

26. Due to limitations in the data, we cannot include risk aversion or portfolio selection motives.

In order to study whether the choice of fixation period is due to indebtedness, we used the estimated regression model to simulate the share of loans at the variable rate for several different types of household. We define four different types of household with four different loan-to-income ratios:

1. Low (around the 15th percentile)
2. Medium (around the 50th percentile)
3. High (around the 85th percentile)
4. Very high (LTI of between 10 and 15)

We set the interest rate effect to equal the 2014 numbers in order to focus on the differences in covariates between different types. Table 3 shows the numbers and simulated proportions for each type of household.

**Table 3. Choice of fixation period for four types of household**

	LOW LTI	MEDIUM LTI	HIGH LTI	VERY HIGH LTI
LTI (interval, %)	110-171	301-354	515-630	1000-1500
Income (SEK/month)	35,558	38,911	40,871	37,004
DI <sup>27</sup> (SEK/month)	22,511	19,547	17,981	10,224
Loan volume (SEK)	436,034	942,522	1,659,713	2,218,752
Loan-to-value ratio (%)	56.5	69.2	72.7	76.1
Probability of default (%)	0.4	0.4	0.53	0.48
Age of main applicant	48	43	42	46
No. applicants	1.64	1.67	1.57	1.49
Major city (%)	21.5	41.0	63.7	62.7
No. bottom loans	1.20	1.58	1.81	1.77
Top loan (%)	10.8	15.1	15.2	19.5
Unsecured loan (%)	7.3	9.0	7.2	4.8
Predicted share of mortgages at the variable rate (%)	77	76	76	75
Number of households	8,903	8,903	8,903	1,266

Table 3 shows that there is almost no difference in the inclination of the four different types to sign up for variable rate loans, despite there being considerable differences between their loan amounts and income. For example, households with a high LTI borrow more than those with a low LTI, both at the level and as a proportion of the value of the home, which the regression model predicts will give a lower share of variable rate loans. At the same time, households with a high LTI are characterised by higher income and the fact that they often live in a major city region. This increases their inclination to take out loans at the variable rate and counteract the effect of the high indebtedness. It is therefore important to take account of the correlations between the covariates in this type of analysis.

### *Price elasticity for fixation periods*

In order to further analyse how the interest rate affects the choice of fixation period, we use our regression model once again. This time, we use the model to simulate price elasticity for choice of fixation period. Own price elasticity on demand for variable loans gives us the percentage change in the quantity of loans at the variable rate for a given percentage change in the interest rate on short loans. Because our regression models the share of loans with the variable rate, we can simply calculate this elasticity.<sup>28</sup>

The own price elasticity for variable rate loans is estimated at -0.67 with a standard error of 0.01. This means that if the variable rate increases by 1 percentage point while the fixed rate is held constant, the quantity of variable loans decreases by 0.67 per cent. The own price elasticity for fixed rate loans is estimated at -1.18 with a standard

27. DI stands for "discretionary income".

28. Note that we can write our regression as  $y = \frac{Q_s}{Q_s + Q_l} = \alpha P_s + \beta (P_l - P_s)$ , where  $Q$  is quantity,  $P$  is price, and  $s$  and  $l$  index short and long rates. Based on this, we can show that own price elasticity for short rates is  $\epsilon_s = \frac{\partial Q_s}{\partial P_s} \frac{P_s}{Q_s} = \frac{(\alpha - \beta) P_s}{y(I - y)}$ , and for long rates:  $\epsilon_l = \frac{\partial Q_l}{\partial P_l} \frac{P_l}{Q_l} = -\frac{\beta P_l}{y(I - y)}$ .



error of 0.10. The price elasticity of fixed rate loans is greater than 1, implying elastic demand for loans at the fixed rate. On the contrary, the demand for variable rate mortgages is inelastic, and therefore will respond much less to price changes.

In summary, households' choice of fixation period depends on current interest rates and their expectations about future interest rate levels. The choice of fixation period also depends on household characteristics, such as income, age and indebtedness, but to a lesser extent than interest rate effects. Because the choice of fixation period is chiefly due to the price of short loans in relation to long ones, demand for fixed rate loans could be stimulated by narrowing the spread between fixed and variable interest rates.

## 6. Stress test

In order to study the extent of vulnerability of heavily indebted households with a high proportion of variable rate loans, we break down the households based on the share of loans at the variable rate and loan-to-income ratio.<sup>29</sup> (see Table 4). For each group of mortgage borrowers, the median borrower's interest-to-income ratio is then calculated. The interest-to-income ratio is then used to colour-code the table. The higher the interest-to-income ratio, the deeper the shade of red. A low interest-to-income ratio instead has a green shade. Table 4 thus illustrates both the share of households (figure) and median borrower's interest-to-income ratio (colour) for new mortgage borrowers, sorted by the proportion of loans at the variable rate and loan-to-income ratio.

Table 4 shows that around 23 per cent of all households in the sample have a loan-to-income ratio above 500 per cent. 80 per cent of households have over 60 per cent of their loans at a fixation period of less than 1 year. In turn, this means that around 19 per cent of households have a loan-to-income ratio of over 500 per cent, and also a fixation period of less than 1 year for over 60 per cent of the loans. At the same time, we see that only a small proportion of the households have an interest-to-income ratio above 30 per cent at the time the loan was granted, and that households that only have mortgages at a fixation period of less than 1 year (100 per cent) have a low interest-to-income ratio as a rule.

**Table 4. Share of households in per cent based on the proportion of loans at the variable rate and loan-to-income ratio**

Colour coding based on the interest-to-income ratio of the median household

		SHARE OF LOANS AT THE VARIABLE RATE IN PER CENT							
		0-10	10-20	20-40	40-60	60-80	80-99	100	TOTAL
LOAN-TO-INCOME RATIO IN PER CENT	0-100	0.7	0.2	0.2	0.2	0.2	0.1	4.0	5.5
	100-200	1.4	0.7	0.6	0.9	0.9	0.9	10.4	15.8
	200-300	1.1	0.8	0.9	1.5	1.2	1.6	12.9	20.0
	300-400	1.1	0.8	0.9	1.4	1.1	1.8	12.7	19.8
	400-500	0.7	0.6	0.7	1.2	0.9	1.5	10.7	16.3
	500-600	0.5	0.4	0.5	0.7	0.6	0.8	7.3	10.6
	600-700	0.2	0.2	0.2	0.4	0.3	0.5	3.8	5.7
	700-800	0.1	0.1	0.1	0.1	0.2	0.2	1.8	2.5
	800-900	0.0	0.0	0.1	0.1	0.1	0.1	1.0	1.3
	900-1 000	0.0	0.0	0.0	0.0	0.1	0.1	0.5	0.7
	> 1 000	0.0	0.0	0.0	0.1	0.2	0.2	1.2	1.7
Total		5.8	3.7	4.3	6.6	5.8	7.7	66.2	100

COLOUR CODE FOR HOUSEHOLDS' INTEREST-TO-INCOME RATIO (PER CENT)								
0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40<

Note. The calculations are based on households' total debt based on sample data for new loans taken during the periods 27 August-3 September 2014 and 25 September-2 October 2014. For details, see Finansinspektionen's report "The Swedish mortgage market 2015".

Sources: Finansinspektionen and the Riksbank

29. This is based on sample data for new loans taken during the periods 27 August-3 September 2014 and 25 September-2 October 2014. For details, see Finansinspektionen's report "The Swedish mortgage market 2014".

We then study the debt servicing ability of households with short fixation periods by performing a stress test. In the stress test, the mortgage rate with a fixation period of less than 1 year increases from around 2.7 per cent to 8 per cent in a 1-year period, during which time income is assumed to be constant.<sup>30</sup> The interest rate stress is intended to simulate a temporary interest rate shock of around one year.

The stress test shows that the majority of the new mortgage borrowers in the sample would still have an interest-to-income ratio below 30 per cent (see Table 5). At the same time, the test shows that highly leveraged households with a high proportion of loans at the variable rate would have a sharply increased interest-to-income ratio. For the approximate 19 per cent of the new mortgage borrowers that have over 60 per cent of loans at the variable rate and a loan-to-income ratio of over 500 per cent, the interest-to-income ratio increases by 22 percentage points on average. Around 5 per cent of the households in the sample gain an interest-to-income ratio of over 40 per cent (dark red shade in Table 5). Without a stressed interest rate, only 0.4 per cent had an interest-to-income ratio above 40 per cent.

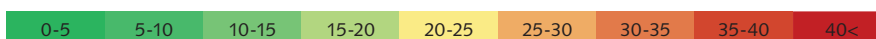
If borrowing rates were to increase to 8 per cent, our calculations further show that the mortgage borrowers in the sample might reduce their consumption by up to 11.5 percentage points<sup>31</sup> in relation to their disposable income if they were to adapt to the higher interest payments solely by cutting back on their consumption.<sup>32</sup>

**Table 5. Share of households in per cent based on the proportion of loans at the variable rate and loan-to-income ratio**

Colour coding based on the interest-to-income ratio of the median household if the interest rate on loans with a fixation period of less than a year rises to 8 per cent

		SHARE OF LOANS AT THE VARIABLE RATE IN PER CENT							
		0-10	10-20	20-40	40-60	60-80	80-99	100	TOTAL
LOAN-TO-INCOME RATIO IN PER CENT	0-100	0.7	0.2	0.2	0.2	0.2	0.1	4.0	5.5
	100-200	1.4	0.7	0.6	0.9	0.9	0.9	10.4	15.8
	200-300	1.1	0.8	0.9	1.5	1.2	1.6	12.9	20.0
	300-400	1.1	0.8	0.9	1.4	1.1	1.8	12.7	19.8
	400-500	0.7	0.6	0.7	1.2	0.9	1.5	10.7	16.3
	500-600	0.5	0.4	0.5	0.7	0.6	0.8	7.3	10.6
	600-700	0.2	0.2	0.2	0.4	0.3	0.5	3.8	5.7
	700-800	0.1	0.1	0.1	0.1	0.2	0.2	1.8	2.5
	800-900	0.0	0.0	0.1	0.1	0.1	0.1	1.0	1.3
	900-1 000	0.0	0.0	0.0	0.0	0.1	0.1	0.5	0.7
	> 1 000	0.0	0.0	0.0	0.1	0.2	0.2	1.2	1.7
Total		5.8	3.7	4.3	6.6	5.8	7.7	66.2	100

COLOUR CODE FOR HOUSEHOLDS' INTEREST-TO-INCOME RATIO (PER CENT)



Note. The calculations are based on households' total debt based on sample data for new loans taken during the periods 27 August-3 September 2014 and 25 September-2 October 2014. For details, see Finansinspektionen's report "The Swedish mortgage market 2015". The stressed interest-to-income ratio is calculated based on a borrowing rate of 8 per cent for the share of mortgages at the variable rate.

Sources: Finansinspektionen and the Riksbank

## 7. Conclusion

Our analysis shows that the share of variable rate mortgages continues to rise in Sweden. At the same time, the high share of variable rate mortgages is not unique in an international perspective. The high proportion of variable rate mortgages could pose a stability risk, both to the macroeconomy and to financial stability, if households were to cut back sharply on their consumption in the event of unexpected interest rate

30. With the assumption of the interest rate rising to 8 per cent during one year, households with a fixation period of less than a year are not covered by the interest rate stress. Because not all loans in the sample carry the variable rate, this means that the average interest rate for new mortgage borrowers will be around 7 per cent.

31. Based on the share-weighted average increase to the interest-to-income ratio for households in Finansinspektionen's 2014 mortgage survey.

32. Hence, the calculations are based on households not using saved funds to cope with a sharp increase to borrowing rates.

hikes. By analysing microdata, we see however that it is households with high income and low debts that are most inclined to choose variable rates for their mortgages. We also see that expectations about a higher future interest rates make households more inclined to fix their interest rates. The analysis shows that it is primarily the households that are highly resilient to higher interest expense that take out variable rate mortgages to the greatest extent.

A stress test shows that the majority of the new mortgage borrowers in the sample still, in the event of a sharp increase in the interest rate to 8 per cent, have an interest-to-income ratio below 30 per cent. At the same time, the test shows that highly leveraged households with a high proportion of loans at the variable rate would have a sharply increased interest-to-income ratio. For the approximate 20 per cent of the new mortgage borrowers that have over 60 per cent of loans at the variable rate and a loan-to-income ratio of over 500 per cent, the interest-to-income ratio increases by 22 percentage points on average.

## References:

- Bacon, P.M. and P.G. Moffatt (2012). "Mortgage Choice as a Natural Field Experiment on Choice under Risk", *Journal of Money, Credit and Banking*, vol. 44 (7).
- Badarinza, C., Campbell, J.Y. and Ramadorai, T (2014), "What Calls to ARMs? International Evidence on Interest Rates and the Choice of Adjustable-Rate Mortgages", Working Paper.
- Brzoza-Brzezina, M. Gelain, P. and Kolasa, M. (2014), "Monetary and macroprudential policy with multi-period loans," *Norges Bank Working Paper 16/2014*.
- Calza, A., Monacelli, T. and Stracca, L. (2013) "Housing finance and monetary policy", *Journal of the European Economic Association* vol. 11 (1).
- Campbell, J.Y. (2013), "Mortgage Market Design", *Review of Finance*, vol. 17 (1).
- Campbell, J.Y. and Cocco, J. (2003), "Household Risk Management and Optimal Mortgage Choice", *The Quarterly Journal of Economics*, vol. 118 (4).
- Case, K. Shiller, R. and Thompson, A. (2012). "What Have They Been Thinking? Home Buyer Behavior in Hot and Cold Markets", *NBER Working Paper No. 18400*.
- The Swedish mortgage market 2013, *Finansinspektionen report*, April 2014.
- The Swedish mortgage market 2014, *Finansinspektionen report*, April 2015.
- Financial Stability Review 2014, *National Bank of Belgium*, May 2014.
- Iacoviello, M. (2005), "House Prices, Borrowing Constraints and Monetary Policy in the Business Cycle", *American Economic Review*, vol. 95 (3).
- Johnson, K.W. and Li, G. (2015) "Are adjustable-rate mortgage borrowers borrowing constrained?", *Real Estate Economics*, forthcoming.
- Kahneman, Slovic and Tversky (1982). "Judgment under Uncertainty: Heuristics and Biases", *New York and Cambridge: Cambridge University Press*.
- Kiyotaki, N. and Moore, J. (1997). "Credit Cycles". *Journal of Political Economy*, vol. 105 (2).
- Lea, M. (2010), "International Comparison of Mortgage Product Offerings", *Research Institute for Housing America*, September 2010.
- Ligon, J. and Michel, N. (2014), "Why Is Federal Housing Policy Fixated on 30-Year Fixed-Rate Mortgages?", *The Heritage Foundation, Background No. 2917*, June 2014.
- Mori, M, Diaz, J. and Ziobrowski, A. (2009). "Why Do Borrowers Choose Adjustable-Rate Mortgages over Fixed-Rate Mortgages? A Behavioral Investigation". *International Real Estate Review*, vol. 12 (2).

 The Riksbank's consultation response to the Ministerial memorandum on Interest rate differential charge, etc. for mortgages (Ds 2013:38), August 2013.

Rubio, M. (2011), "Fixed- and variable-rate mortgages, business cycles, and monetary policy", *Journal of Money, Credit, and Banking*, vol. 43 (4).

SKOP (2015), "Households' interest rate expectations", *Economic report by SKOP*, March 2015.