# FI Analysis

# Interest rate adjustment periods – an economic vulnerability?

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## Summary

In Sweden, both the percentage of mortgages that have a variable interest rate and household debt have risen sharply. This combination has made households sensitive to rising interest rates. High interest rate sensitivity helps stabilise consumption since interest rates and income normally shadow one another. It also makes it possible for monetary policy to stabilise the economy. However, high interest rate sensitivity could also mean that, if interest rates rose without a parallel increase in income, households would be forced to lower their consumption and, in a worst-case scenario, find it difficult to repay their debt.

Our analysis shows that the margins of new mortgage holders have increased over the past few years. Despite longer interest rate adjustment periods, the ability of households to repay their debt does not appear to be impaired by short-term upswings in interest rates. However, the large volume of liabilities subject to variable rates is still cause for concern. If interest rates rise while income growth is low, households may be forced to reduce their consumption. It can be noted, though, that an analysis of historical outcomes in several countries shows that the probability that this scenario will occur is low.

Regardless of the effects on the macro economy, high sensitivity to interest rates could introduce risks from a consumer protection perspective. Households facing low margins, high debt-to-income ratios or a risk that they will lose their income are particularly vulnerable to higher interest rates. By fixing their interest rates, these households could protect themselves from interest rate risk and take advantage of the interest rate adjustment period to build resistance before their interest rate rises. The analysis shows that both vulnerable and resilient mortgage holders have chosen to have a high percentage of their loans at a variable rate. Instead of fixing the interest rate as a preventive measure, households have increasingly borrowed more at variable rates as the interest rates have fallen. As a result, households have become vulnerable to unexpected increases in the interest rate.

There are several reasons why individual households should be cautious and fix the interest rate for a large part of their mortgages in the future. *First,* the Swedish economy is currently experiencing a unique situation in that interest rates are very low at the same time as economic growth is strong. It is more likely that interest rates will rise in the future than fall. *Second,* high debt in relation to income (i.e. a high debt-to-income ratio) means that a long interest rate adjustment period makes it possible to build up resilience before the interest rate is re-set. *Third,* an individual household's income can decrease or increase slowly even if the aggregate increase in income is high. The point in time that interest rates rise may also occur before individual households experience a rise in income.

It is important for households to be able to effectively manage their interest rate risk. This means understanding the consequences of fixing the interest rate, and banks play an important role in helping households understand the advantages of fixed rates. It is also important for households to be able to choose between variable and fixed interest rates without frictions that distort their options, but the analysis shows that the current regulations for early repayment of mortgages can contribute to such frictions.

Diagram 1. Percentage of mortgages with different original interest rate adjustment periods

(Per cent)
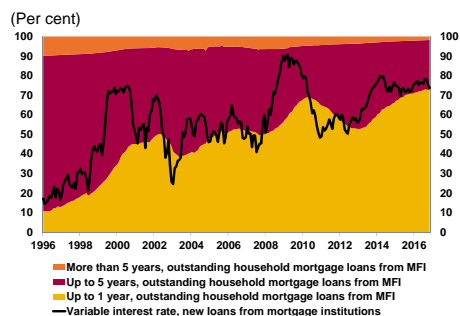


Note: MFI is short for monetary financial institutions. The distribution of interest rate adjustment periods in the lending from MFIs prior to 2003 corresponds to the distribution in loans from mortgage institutions with constant shares of fixed loans with up to 5 years' and over 5 years' interest rate adjustment periods.

Source: Statistics Sweden and the Riksbank.

Diagram 2. Average share of loans at variable rates by country
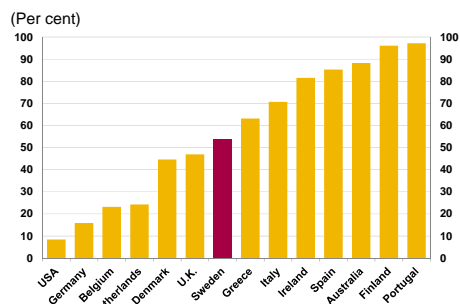
(Per cent)



Note: The average refers to the period 2003–2013 for the majority of the countries. Internationally, loans with up to a one-year interest rate adjustment period are often referred to as "at variable rates". In Sweden, a variable rate most often refers to loans with a three-month interest rate adjustment period. To compare loans between the countries, we have included all loans with up to a one-year interest rate adjustment period as loans at variable rates.

Source: Badarinza, et al (2014).

Diagram 3. Average interest rate adjustment period by country
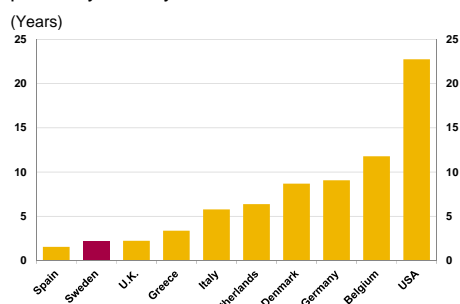
(Years)



Note: The average refers to the period 2003–2013 for the majority of the countries. Internationally, loans with up to a one-year interest rate adjustment period are often referred to as "at variable rates". In Sweden, a variable rate most often refers to loans with a three-month interest rate adjustment period. To compare the rates between the countries, we have set the interest rate adjustment period to 1 year for all loans at variable rates. The countries represented in Diagram 3 do not fully match the countries represented in Diagram 2 due to incomplete data.

Source: Badarinza, et al (2014) and SCB

# Introduction

In Sweden, the percentage of mortgages with short interest rate adjustment periods has increased sharply over the past 20 years (see Diagram 1). In January 2017, loans with interest rate adjustment periods of up to one year comprised 73 per cent of the total loans to households for residential purposes held by MFIs. The average interest rate adjustment period in the mortgage stock was approximately one year. The percentage of loans at variable rates in the flow of new loans from mortgage institutions was 74 per cent.[1]

From an international perspective, the percentage of mortgages at variable rates has not been extreme in Sweden (see diagram 2).[2] However, the Swedish households' average interest rate adjustment periods have been the shortest in the western world (see Diagram 3). This is in part due to the fact that countries apply different practices when it comes to the interest rate adjustment periods that the banks offer. For example, borrowers in the USA can fix their interest rates for up to 30 years. The term "variable interest rate" also refers to an interest rate adjustment period of one year in many countries, compared to three months in Sweden.[3]

Short interest rate adjustment periods make households sensitive to changes in the interest rate. In a worst-case scenario, higher interest rates could weaken households' ability to manage their debt, which could result in credit losses and instability in the financial system. Even if large credit losses from the household sector are improbable, there is still a risk that higher interest rate expenses would reduce consumption, since a high level of interest rate sensitivity would give households less room for consumption and savings. The risk of this occurring is particularly high if borrowers have chosen borrowing terms based on unreasonable expectations of low mortgage rates or low variation in these rates in the future.

Several factors indicate that the short interest rate adjustment periods of households are beneficial for the macro economy. One is that the variable interest rate, in most cases, has historically followed income growth through the business cycle. Variable interest rates have therefore constituted a type of insurance by stabilising households' margins for consumption and savings over a business cycle.

Furthermore, it is not necessarily in line with the goal of monetary policy to increase the policy rate in a way that drastically slows private consumption through smaller margins for households. After all, the Riksbank uses the policy rate to stabilise prices and the economy as a whole. It is also important to note that the Riksbank does not have full control over the interest rates in the Swedish economy. Mortgage rates, for example, are also affected by variations in global real interest rates as well as credit and liquidity premiums for the banks' borrowing, all of which lie outside of the Riksbank's control.

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1 The three-month mortgage rate is hereafter referred to as the "variable rate". "Loans at variable rates", however, will refer to loans with up to a one-year original interest rate adjustment period in this FI Analysis.

2 See also ESRB (2016), which compares the percentage of loans at variable rates between EU countries.

3 See, for example, Holmberg (2015), Lea (2010) and Badarinza, et al (2015), which discuss the different practices related to interest rate adjustment periods in different countries.

This analysis aims to analyse households' interest rate adjustment periods based on FI's assignment and areas of responsibility. The first aim of the analysis is to investigate whether the higher percentage of loans at variable rates has increased the credit risks in the household sector. This would mean a greater risk for credit losses in the financial system, which by extension could conceivably affect financial stability.

The second aim of this analysis is to assess whether households' short interest rate adjustment periods introduce a financial imbalance, which could in turn threaten the stability of the credit market and macroeconomic growth. To make this assessment, we analyse the risk of a reduction in consumption in scenarios where interest rates rise and how this risk relates to the benefits of a major change in interest rates on aggregate demand in the economy. We also compare such a scenario with an alternative scenario in which households' mortgages instead have significantly longer interest rate adjustment periods.

Regardless of the effects on financial or macroeconomic developments, the appropriateness of a short interest rate adjustment period depends on each individual household. For example, different households can face different risks of variations in or loss of income and thus different needs for securing future interest rate expenses. Based on a consumer protection perspective, it is therefore important for individual consumers to be able to understand the importance of the interest rate adjustment period and managing their own interest rate risk. This analysis therefore discusses this issue from a consumer protection perspective as well.

## Interest rate adjustment periods affect the macroeconomy in several ways

Traditional economic analyses assume efficient markets and rational behaviour from households based on their expectations. This means that the interest rate adjustment period does not affect households' consumption since the households expect the same costs, regardless of the length of the adjustment period. It is also often assumed that borrowing households are financed by saving households, and that these households react in the same way despite variations in income. This means that variations in household disposable income[4] (for example due to interest rate fluctuations) only result in a re-distribution of resources between borrowing and saving households. Therefore, the interest rate adjustment period does not play a role in the economy as a whole.[5]

But there are also a number of studies that assume that borrowing and saving households react differently to income variation. In these studies, households' interest rate adjustment periods play a role in how large of an effect the change in interest rates has on aggregate demand. These studies find also that the shorter the interest rate adjustment period, the larger the effect of the changes in interest rates. This analysis primarily focuses on how the interest rate adjustment period

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4 "Disposable income" refers to earned income and capital income (net) after tax and interest expenses.

5 See Holmberg, et al (2015) for a discussion on this type of assumption.

affects borrowers' consumption due to reduced cash flow margins and via effects on housing prices.[6]

## CASH FLOW CHANNEL

The most direct effects from having a high percentage of loans at variable rates arise via the cash flow channel. The higher the percentage of the loans that households choose to have at variable rates, the greater and more rapid the impact on their interest rate expenses when interest rates change. A change in variable rates also rapidly impacts how much households have left for consumption and saving. This channel can thus be said to be part of what is called the "interest rate channel", through which interest rate changes lead to redistributions between consumption and savings.

Calza, et al (2009) and Rubio (2011) assume that the consumption propensity of households varies. As a result, the borrowing household's reduction in consumption is not completely offset by the saving household's increase in consumption. Both studies show that the effect of a tighter monetary policy on aggregate consumption, utilisation of resources and inflation is greater when a large number of mortgage holders hold loans at variable rates.[7] This is due in part to the fact that raising the policy rate leads to higher nominal variable mortgage rates while the nominal fixed mortgage rates are unaffected. The greater the effect of the change in interest rates on inflation also means there is a greater impact on the real interest rate expenses in an economy with a high percentage of mortgages at variable rates.

Several studies discuss how variable lending rates stabilize households' disposable income over the business cycle. For example, Lind (2009) highlights the positive effect of falling variable rates on Swedish households' disposable income in 2009 when Sweden's GDP fell. Along the same lines, Official Norwegian Reports (2011) shows that the high percentage of mortgages at variable rates had similarly positive effects in Norway due to the major impact of changes in the policy rate. Aron, et al (2016) also points out that the high share of mortgages at variable rates in the United Kingdom weakened the effects of the financial crisis in 2008−2009 on the fall in house prices and the payment capacity in the household sector.

However, some studies show that a high percentage of highly indebted households with loans at variable rates may result in changes to the policy rate having too much of an impact. Flodén, et al (2016) uses Swedish data to analyse how increases in interest rates affect households with limited credit (that are not able to borrow as much as they would like). This paper also analyses if there are differences between households with different debt-to-income ratios (debt as a percentage of disposable income) and different interest rate adjustment periods on their mortgages. The conclusion is that an interest rate increase leads to a twice as large reduction in consumption among households with high debt-to-income ratios and loans at variable rates than among households with low debt-to-income ratios and fixed-rate loans.

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6 See Swedish Ministry of Finance (2014), which discusses the channels through which financial instability affect the real economy. See also Mishkin (2007), which discusses more specifically the channels through which interest rate changes have an effect via the housing market.

7 See also Brzoza-Brzezina, et al (2014), which shows that the effect of monetary policy on GDP is larger in an economy where mortgages are issued at variable rates instead of fixed rates.

## BALANCE SHEET CHANNEL

Interest rate changes can also affect house prices, which in turn affect consumption since this determines how much households can borrow when using their home as collateral. A fall in house prices limits the possibilities for additional loans, which reduces a household's consumption capacity. This consumption effect arises through the balance sheet channel.

Rubio (2011) assumes that the value of the borrower's collateral (i.e. the home) is determined in part by demand for such collateral in the economy. The paper also assumes that an increase in interest rates affects the demand for housing for households with loans at variable rates more than households with loans at fixed rates. As a whole, this means that an increase in the interest rate will have a greater effect on house prices in economies with a high percentage of loans at variable rates. Calza, et al (2013) also shows that a lower binding debt-to-value ratio ceiling for mortgages enhances this effect since it further limits the households' possibility to use the value of its collateral for borrowing.

## UNCERTAINTY CHANNEL

The Swedish Ministry of Finance (2014) has also identified an "uncertainty channel", which means that households react to a higher risk of becoming unemployed and higher uncertainty on the financial markets by increasing their precautionary savings and reducing their consumption. It is conceivable that a borrower with a loan at a variable rate experiences greater uncertainty in a stressed scenario than a borrower with a fixed rate. It is thus also conceivable that a high percentage of loans at variable rates in stressed scenarios could result in enhanced negative side-effects for consumption and house prices.

## EMPIRICAL COMPARISONS

A number of empirical studies compare similar economic outcomes in economies with both high and low percentages of loans at variable rates. Cloyne, et al (2016) compares the effects of lowered policy rates in the UK and the USA. While the UK has a high percentage of mortgages at variable rates, the USA mortgage market consists primarily of mortgages at fixed rates.

The study shows that the mortgages' interest rate adjustment period is not the deciding factor for the aggregate effect on consumption. In both countries, an expansive monetary policy results in a considerable difference in consumption of consumables and durables between mortgagors and outright home-owners. Given the relatively high percentage of loans at variable rates in the UK, the expectation could have been to see a greater effect from the interest rate reduction there compared to in the USA. However, the results surprisingly show that mortgagors' consumption over time is almost identical in both countries, even though the average mortgage rates fell more for British mortgagors than those in the US. The results are interpreted such that other macroeconomic effects from the reduction in interest rates resulted in higher income, and that this outweighs the effects of reduced interest rate expenses via the cash flow channel.

Di Maggio, et al (2016) and Keys, et al (2014) investigate the effect of lower mortgage rates on US household consumption. The study shows that households raise their expenses for durables significantly, which supports the results from theoretical models that assume mortgagors have a relatively high propensity to consume. Both studies also com-

Diagram 4. Percentage of fixed rates in new loans from mortgage institutions and three-month mortgage rate

(Per cent)



— Percentage of new loans from mortgage institutions at fixed rate
— 3-month mortgage rate (right-hand axis)
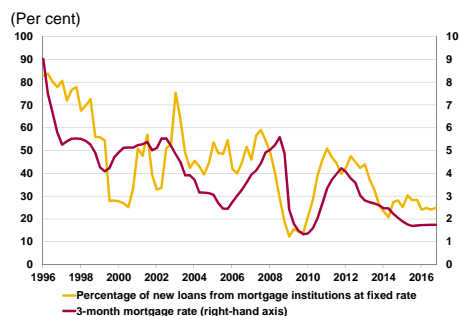
Source: Statistics Sweden and Thomson Reuters.

Diagram 5. Difference between fixed mortgage rates and the average of the variable mortgage rates

(Percentage points)



— 1 year — 2 years — 3 years — 5 years
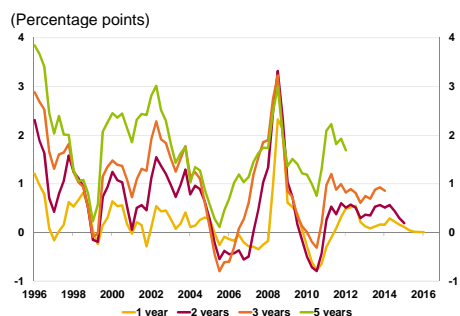
Note: The interest rate difference is calculated *ex post*, i.e. as the fixed mortgage rate for each interest rate adjustment period minus the average of the realised future quarterly observations of the variable mortgage rates for each respective interest rate adjustment period. When each respective line is above zero, it has been cheaper to choose variable rates than fixed rates, and vice versa.

Source: Thomson Reuters and FI.

pare the consumption effects in different counties and find that interest rate reductions have a greater impact in counties with a higher percentage of loans at variable rates.[8] Di Maggio, et al (2016) shows that consumption of durables increases significantly more in counties with a high percentage of loans at variable rates than those in counties with a high percentage of loans at fixed rates.

The remainder of this FI Analysis primarily discusses the cash flow channel, but the literature shows that the balance sheet and uncertainty channels are also important since a high percentage of mortgages at variable rates can amplify the impact of interest rate changes.

# Several factors affect the choice of the interest rate adjustment period

When households choose their interest rate adjustment period, they need to weigh costs against risks. Fixed rates in general are higher than variable rates. By fixing the interest rate, households pay a maturity premium that in part compensates for the risk that interest rates and thus interest rate expenses will not develop as expected. At the same time, the variable rate stabilises real interest rate expenses if inflation varies over time. The trade-off also includes several other factors, such as households' income risk and preferences. Campbell, et al (2003) shows that households with large loans, high income risk, high risk aversion, high potential bankruptcy costs and low willingness to move would benefit from fixed interest rates.

In practice, however, a household's decision is more of a balancing act, and the decision is also influenced by factors more psychological in nature. For example, Andre (2016) discusses how low interest rates can get households to take on large amounts of loans at variable rates without considering that the mortgage rates could rise in the future. This can be a sign of what is sometimes called *present bias* within behavioural economics. This means that, when making decisions, individuals can give relatively larger importance to yields in the near future compared to the yields further out in time. Households can also be inconsistent depending on which decision is being made. Mori, et al (2009) shows, for example, that individuals tend to be less willing to take risk when investing than when taking a mortgage.

## LONG PERIOD OF FALLING INTEREST RATES – BUT THIS TREND CAN BE BROKEN

Interest rates have demonstrated a slow, downward trend since the mid-1990s (see Diagram 4).[9] Swedish households have chosen their interest rate adjustment periods during a time when the fixed rate ex ante has most often proven to be costly. The data show that it has only been profitable to fix the interest rate for up to three years during the

8 See also Badarinza, et al (2016), which discusses the advantages of the major impact of interest rate changes on economies with high percentages of loans at variable rates.

9 The mortgage rates in the diagrams in this FI Analysis correspond to the average listed rates for Handelsbanken, Nordea, SBAB, SEB and Swedbank after deducting an assumed discount of 20 basis points.

Diagram 6. Explanatory factors behind the variation in the percentage of variable rates in new lending

(Per cent)
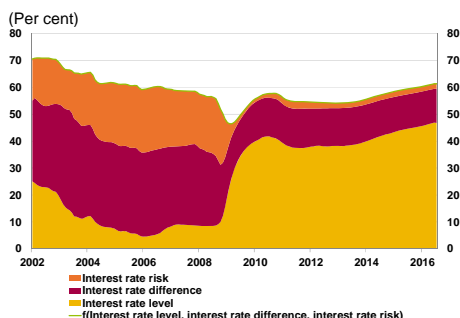


Note: The diagram shows a recursive estimated coefficient of determination and a breakdown of the contributions from each variable (partial coefficient of determination). The coefficient of determination states how much of the variation in the dependent variable (the percentage of variable rates in the mortgage institutions' new lending) that can be explained by variations in the independent variables, i.e. the estimated trend in three-month mortgages rates (interest rate level), the difference between the five-year and three-month mortgage rates (interest rate difference) and the historical rolling two-year standard deviation in annual changes of three-month mortgages rates (interest rate risk).

Source: FI and Statistics Sweden.

Diagram 7. Actual and expected mortgage rates

(Per cent)
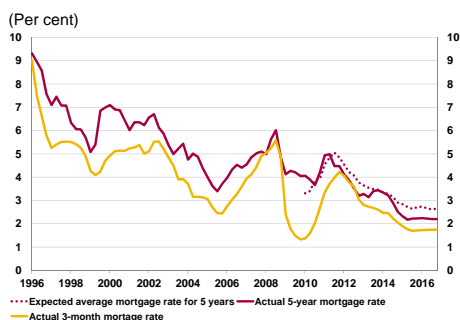


Note: The dashed line shows the households' average expected 3-month interest rate over the next five-year period. This line reflects the average interest rate households believe they will pay if they chose a variable rate five years from now. It is a linearly weighted average of the actual discount-adjusted three-month interest rate and expectations of the three-month mortgage rate in one, two and five years.

Source: NIER and Thomson Reuters

period leading up to the global financial crisis in 2008 and ahead of the weak economic development in 2012. Fixing a mortgage rate to the average five-year interest rate has not been profitable in the past 20 years (see Diagram 5).

This has strengthened the common argument that variable rates normally offer lower interest rate expenses than fixed rates. However, interest rates can change and a period of gradually rising interest rates in the future may mean that the fixed interest rate is the more profitable choice. Interest rates are currently exceptionally low, which means it is more likely that they will rise than fall in the future. This is because the interest rates in the Swedish economy are largely controlled by the policy rate and there is a limit for how low this rate can go.[10]

## SIGNS THAT HOUSEHOLDS ARE BEING PROCYCLICAL

The choice that households make when selecting their interest rate adjustment period is influenced by the interest rates that are offered by banks. The lower and more stable variable mortgage rates are and the higher the insurance premium (measured as the difference between the five-year mortgage rate and the variable mortgage rate), the larger the percentage of households that choose variable rates (see Diagram 6).

But households' choice of interest rate adjustment periods appears to have changed over time. Prior to the financial crisis in 2008, this choice was primarily affected by stability in the variable mortgage rate and the size of the insurance premium. In recent years, however, this choice has to a greater extent followed the level of the interest rate (see Diagram 6). Even though the insurance premiums have been very low (see the difference between the fixed and variable rate in Diagram 7), households have chosen not to insure themselves against interest rate risk.

Surveys also indicate that households expect variable rates to rise in the future. Households also expect it to become cheaper to fix their interest rate for five years than to consistently choose the variable rate during the same period (see Diagram 7), but they are not acting in accordance with these expectations. Instead, households are choosing a variable rate even though it appears to be more expensive.

One conceivable explanation for why households are choosing variable rates despite expectations of rising interest rates is that this choice offers flexibility. If interest rates rise slowly and a household needs to settle its loan within five years, for example to switch to a new bank or move to a new home, it may prove to have been cheaper to have a variable rate than a fixed rate. By choosing a fixed rate, the household will have insured itself against an expected future interest rate increase that will occur after it has settled its loan. It will have then unnecessarily paid for an insurance. If the household greatly values this flexibility, it may choose to have a variable rate.

As a whole, historical data show that households have given considerable weight to the current interest rates in their choice of interest rate adjustment period instead of forward-looking expectations about the variable rate. As a result, the impact of changes to the interest rate has grown as interest rates have fallen and has fallen as interest rates have risen. The interest rate adjustment period that households choose has therefore tended to be procyclical. Instead of choosing a constant per-

10 Alsterlind, et al (2015) discusses this lower limit for the Riksbank's policy rate.

centage of loans at a fixed rate, this percentage has shadowed the interest rate and in part the upswings and downswings of the economy.

### REGULATIONS CAN AFFECT THE CHOICE OF INTEREST RATE ADJUSTMENT PERIODS

Agreement terms and legislation also affect households' possibilities and incentives to fix their interest rates. Households today do not have a legal right to change their interest rate adjustment period. In practice, this does not prevent households from switching from a variable to a fixed rate since they can take on a new loan and settle the old loan. It is rather the consequences of having a fixed interest rate that can make households opt out of fixing their interest rates.

One rational argument not to choose a fixed interest rate is that this would mean in practice that households are locked in at their bank if interest rates were to rise. The rules for early repayment are such that switching banks or changing the interest rate adjustment period means that households need to give up their low fixed rate and take out a new loan at the current interest rate terms. Households that do not want to be locked in at their bank therefore face incentives to choose a variable rate since this offers the flexibility of changing the loan conditions at little cost. This type of flexibility can be desirable for many reasons. For example, a household that is likely to, and may need to, switch to a new home in the near future may benefit from a variable rate. Variable rates in this way become a kind of insurance against non-interest-dependent changes in the household's living conditions and strengthens their negotiation position in relation to the bank.

Another reason not to fix the interest rate is the pre-payment penalty. When a consumer changes the terms of their mortgage (for example by moving or changing the interest rate adjustment period), the bank may be entitled to charge an interest rate differential if interest rates have fallen since the loan agreement was signed. This differential is small for loans at variable rates, but can be large for loans at fixed rates. Households that do not want to pay the interest rate differential also face incentives not to choose a fixed interest rate.

Regulations affect both the bank's opportunities to manage risk and the incentives households are facing to fix their interest rates. The interest rate differential was introduced so banks would be able to manage the risk that households may switch banks or change their interest rate adjustment periods when interest rates fall. However, in a scenario with rising interest rates, it is instead the households that experience problems.

## Households' margins – a measure of resilience

A household's choice of interest rate adjustment period is very important for its financial situation, in particular its resilience to unexpected increases to the interest rate. We use the household's monthly cash flow margin as a measure of this resilience. The margin is defined as the household's discretionary income calculation, i.e. the household's income after tax minus interest rate expenses, amortisation and standardised costs (see Appendix 1).

Households' margins are affected by a number of different factors, such as income and monthly costs. There are also significant differ-

Diagram 8. Size of different groups of house-
holds with regard to margin
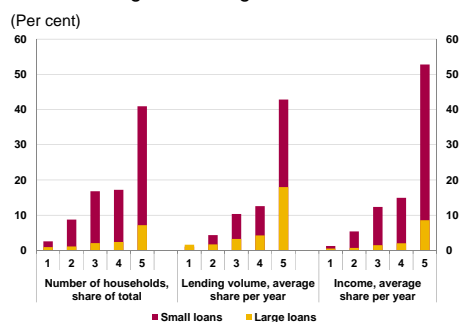
(Per cent)



Note: Category 1 is households with a negative margin.
Categories 2–5 are households with margins of 0–25, 25–50,
50–75, and 75 per cent, respectively, of the standardised cost.
"Large loans" refer to a liability ratio of at least 600 per cent of
the income after tax.

Source: FI.

ences in the financial conditions between the Swedish households that
can affect their resilience (see Table B2 in Appendix 2). In order to
take these differences between households into consideration, we
analyse their resilience to interest rate changes and choice of interest
rate adjustment periods based on FI's microdata material from the
mortgage surveys for 2011−2015. The data set is described in Appen-
dix 2.

## DIFFERENT MARGINS MEAN DIFFERENT RESILIENCE

For a household with a small margin, it is probable that every increase
in interest rate expenses decreases consumption since the household
has a small monthly surplus to rely on when interest expenses rise. In
a worst-case scenario, larger expenses could mean that the margin is
so small that the household would no longer be able to pay for interest
and amortisation.

Households whose margins amount to at the most 25 per cent of their
standardised costs can be considered to have a low margin.[11] These
households represent approximately 13 per cent of the total number of
lenders in 2011−2015 (see Groups 1 and 2 in Diagram 8).

The category of households with low margins contains a group of
households with negative margins (approximately 3.5 per cent of the
total number of borrowers) that should be interpreted with some cau-
tion. A significant percentage of these have been allowed to borrow
due to high savings or temporarily low income. Another normal case
is that the loan is a temporary bridge loan that falls due in the near
future. There is therefore cause to assume that some households with
negative margins actually have a higher payment capacity than what
their margins indicate.

Unlike households with low margins, households with high margins
should not represent a credit risk since they have the capacity to han-
dle higher interest rate expenses without any problems. Households
with high margins are also able to save, and they can draw upon these
savings to compensate for higher interest rate expenses should interest
rates rise.

However, it is also conceivable that households with large or mid-size
margins will reduce their consumption if interest rates rise. For exam-
ple, the household may choose to keep or even increase their buffer
savings due to financial uncertainty or to reinstate the size of their
savings following a reduction in the value of their assets (such as their
home). It is therefore probable that even households with high or me-
dium margins will reduce their consumption when interest rates rise
and thus contribute to lower consumption growth.

## SMALL DIFFERENCES IN THE PERCENTAGE OF LOANS AT
## VARIABLE RATES BETWEEN HOUSEHOLDS WITH SMALL
## MARGINS

The percentage of mortgages at variable rates is high among all
households, regardless of the margin, but there are some differences
between the households. Those with lower margins on average have a
lower percentage of their loan at variable rates than those with higher

11 For example, the standardised cost was SEK 28,404 for a household with two adults, two
children, a house and a holiday home for 2015. To be considered a low-margin household in
our analysis, the household would have at the most SEK 7,101 (25 per cent of the standard-
ised cost). See Appendix 2 for more information.

Diagram 9. Estimated average percentage at variable rates for different margins and sizes of debt
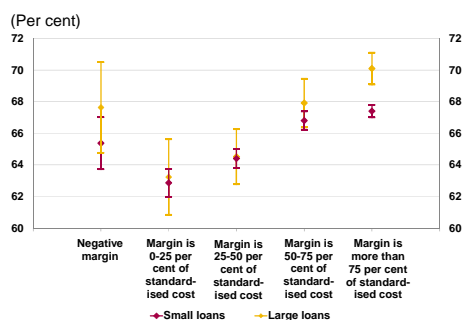
(Per cent)



Note: The diamonds show how large a percentage of households would choose variable rates if all households in the sample belonged to the respective categories but otherwise had unchanged characteristics. Around these points is also a 95-per cent confidence interval. "Large loans" refers to a debt-to-income of at least 600 per cent of income after tax. See the methodology description in Appendix 3.
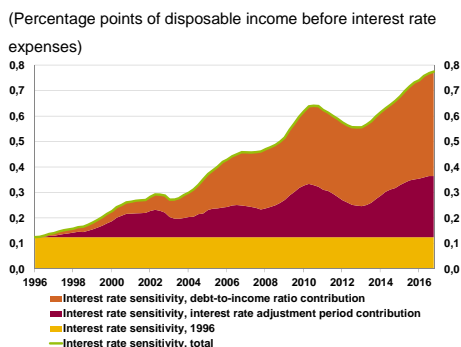
Source: FI.

margins (see Diagram 9).[12] This indicates that households with low margins to a greater extent, by their own choice or due to requirements from the bank, choose to ensure against interest rate risk by fixing the interest rate. Even if the differences between the households are small, the results show a relatively healthy approach to risk-taking. Households with low margins in some cases do not have buffers to handle an increase in interest rate expenses, and thus may face incentives to choose to borrow more at fixed rates.

The households that have negative margins tend to have a higher percentage of mortgages at variable rates than households with low but positive margins (see Diagram 9). This can be interpreted as a vulnerability since households with negative margins have the smallest buffer for handling interest rate fluctuations. But, as previously mentioned, many borrowers in this category are not as vulnerable as their margins imply. Many borrowers in this category of household with a negative margin are probably equally resilient to interest rate increases as household with medium or high margins, for example as a result of high savings. In addition, all bridge loans are borrowed at a variable interest rate.

The households' choice of interest rate adjustment period does not differ significantly given a household's debt-to-income ratio. Only in the group of households with the highest margins does the percentage of loans at a variable rate differ with regard to the debt-to-income ratio. The share of loans at variable rates is highest among households with a total debt of at least 600 per cent of income after tax. This indicates that there is a group of households with high debt-to-income margins and high margins that have particularly high sensitivity to interest rates compared to other categories of households in the sample.

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12 See Appendix 3 for the method description.

Diagram 10. Sensitivity in households' margins to an interest rate increase of one percentage point

(Percentage points of disposable income before interest rate expenses)



Note: The diagram shows how much the households' disposable income decreases during a year when lending rates rise by one percentage point and all other variables stay the same. See the methodology description in Appendix 3.

Source: Statistics Sweden and FI

Diagram 11. Percentage of households with low or negative margins in the original data and in the scenario
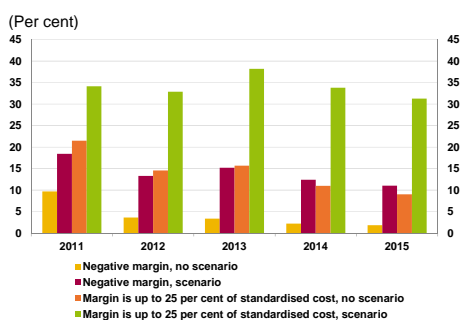
(Per cent)



Note: In the scenario, the interest rates on loans at variable rates increase by 7 percentage points in one year. See the methodology description in Appendix 3.

Source: FI.

Diagram 12. Households' average margins and contributions from various components

(SEK)
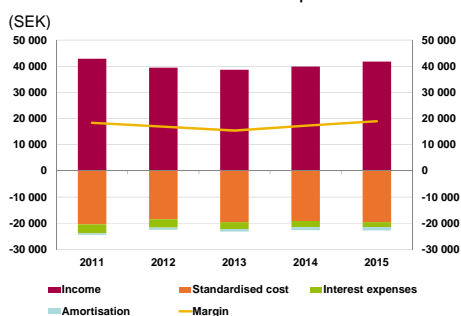


Note: Please note that the developments in the variables are influenced in part by aggregation effects in the samples of borrowers from the different years (see Appendix 2 for more information).

Source: FI's mortgage surveys.

# Have shorter interest rate adjustment periods increased the credit risks?

Sensitivity to interest rates is a product of interest rate adjustment periods and the debt-to-income ratio. With high debt, the household can have high interest rate expenses regardless of the interest rate adjustment period. If the interest rate adjustment period is long, this decreases the risk that the household's interest rate expenses would increase rapidly. In addition, a long interest rate adjustment period also acts as a time buffer; the household's income has time to rise and the household is able to amortise parts of its loans before the interest rate is fixed again at a potentially higher level. This also means that fixed interest rates with relatively short interest rate adjustment periods can result in insufficient time buffers. For example, a household often has time to increase its income and amortise more over a period of ten years than two years.

Given today's short interest rate adjustment periods, Swedish households have very small time buffers. The immediate effects of an interest rate increase on households' margins have increased in recent years as more loans go over to variable rates and the debt-to-income ratio increases (Diagram 10). However, this does not mean that the risk of financial instability as a result of the households not being able to pay their interest rate expenses has increased. As previously mentioned, the change in this risk is also dependent on the development in the households' resilience to increases to their interest rate expenses.
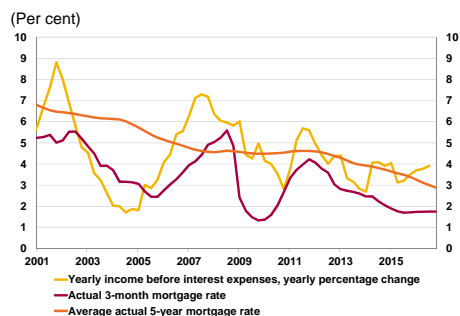
## HIGHER MARGINS STRENGTHENED RESILIENCE

The higher percentage of loans at variable rates has increased households' sensitivity to rapid changes in interest rates. An interest rate increase of 7 percentage points in one year in 2011 resulted in the number of households with small margins increasing from 22 to 34 per cent, i.e. by 13 percentage points. The corresponding increase in 2015 is 22 percentage points (from 9 to 31 per cent). In other words, more households go from having relatively good margins to low margins from an interest rate upswing in 2015 compared to the previous year (see the differences between the green and orange bars in Diagram 11).

At the same time, the mortgage survey shows that the percentage of households that have low or negative margins when the bank grants a mortgage has decreased since 2011 (see the orange and yellow bars, respectively, in Diagram 11). This reflects the development that has been illustrated in FI's reports, "The Swedish Mortgage Market". So even though there are now more households that go from having relatively good to relatively small margins when the interest rate goes up, the total percentage of borrowers with low margins in the stressed scenario decreased over time (see the green bars in Diagram 11).

The credit risk of households appears to have been offset by higher margins. Over the past two years, households' average margins have risen when being granted a mortgage by a bank. This means that households' payment ability in general has improved. An important driver behind this is that household income has increased relatively rapidly. Decreased interest rate expenses from lower interest rates also affected the margins (see Diagram 12). This development entails a deviation from the normal correlation between income growth and interest rates, which often has been positive.
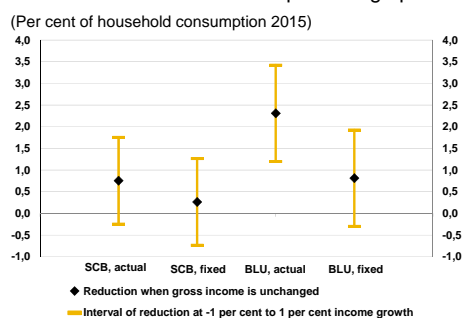
Diagram 13. Income growth, three-month and five-year mortgage rates

(Per cent)



**Yearly income before interest expenses, yearly percentage change**
**Actual 3-month mortgage rate**
**Average actual 5-year mortgage rate**

Note: Income refers to households' aggregate nominal disposable income after the aggregate interest expenses have been added. The average actual five-year mortgage rate is calculated as a moving average of five years' of quarterly observations of mortgage rates. This illustrates the mortgage rate that a loan with a five-year interest rate adjustment period has had historically on average.

Source: Statistics Sweden and Thomson Reuters.

Diagram 14. Consumption reduction following an interest rate increase of 1 percentage point

(Per cent of household consumption 2015)



◆ **Reduction when gross income is unchanged**
**Interval of reduction at -1 per cent to 1 per cent income growth**

Note: BLU refers to FI's mortgage surveys. See the methodology description in Appendix 3.

Source: Statistics Sweden and FI's mortgage surveys.

# How does the interest rate adjustment period affect household consumption?

It appears that the risk of credit losses at the banks due to high interest rates has been offset by the improvement in households' margins. However, the high sensitivity of households to interest rates means that changes in the interest rates can have a major impact on indebted households' margins and consumption. This entails both advantages and disadvantages.

On the one hand, a major impact should help stabilize households' disposable income over time since interest rates tend to follow the state of the economy (see Diagram 13). Interest rate sensitivity also means that changes to the policy rates also have a major impact on household consumption. For example, it is conceivable that the recovery in the Swedish economy after the financial crisis in 2008−2009 could have been inhibited by a higher percentage of mortgages at fixed rates since the interest rate deductions would not have had as fast of an impact.

On the other hand, high sensitivity to interest rates can lead to an excessive impact from interest rate changes or have negative effects on consumption growth in scenarios where interest rates increase at the same time as income growth is low. It is also worth noting that the percentage of mortgages at variable rates was approximately 20 percentage points lower in 2008 when the global financial crisis occurred (see Diagram 1). This implies that the impact of changes to the interest rate could be sufficient even if households were to borrow more at fixed rates than what they do today.

## MODERATE CONSUMPTION EFFECTS

Our calculations using SCB's data indicate that household consumption over a period of one year would be more than 0.8 percentage points lower if the interest rate increased by one percentage point. If all loans instead had a fixed interest rate with a 3.75-year[13] average interest rate adjustment period, consumption would decrease by 0.3 percentage points (see Diagram 14).[14]

Estimates using data from the mortgage survey show a corresponding consumption reduction for a period of one year to be significantly larger (see "BLU" in Diagram 14).[15] This is in part because the mortgage survey is not entirely representative of the population since all households are not indebted. This is also because the debt-to-income ratios of new mortgage holders are significantly higher than in the total mortgage stock.

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13 The average interest rate adjustment period corresponds to the average of loans with more than a one-year interest rate adjustment period in 2015, which is described in Appendix 3.

14 The estimate corresponds to the consumption reduction that would occur under the assumption that all other variable are unchanged. See the methodology description in Appendix 3 for more details about the calculation.

15 Appendix 3 describes that the calculation is based on the assumption that the total stock of mortgages has the same features as the loans in the mortgage survey from 2015.

The results above are based on the assumption that all households reduce their consumption by one krona for every krona that interest expenses increase, which means that there are no distribution effects in the consumption reduction. However, it is also conceivable that households with high or low margins will reduce their consumption to varying extents. Households with low margins can be considered to compensate in full for the higher interest expenses by reducing consumption, while households with high margins can be considered to compensate in part for higher interest rate expenses by saving less. To capture such distribution effects, we also assume that households with low margins reduce their consumption by the entire increase in interest expenses, while households with a margin of 25−50 per cent of the standard cost compensate for half of the increase in the interest rate expense with less savings, and that household with margins exceeding 50 per cent of the standard cost do not reduce their consumption at all. The consumption reduction (calculated based on the mortgage survey) would then only be 0.2 percentage points.

These calculations estimate the consumption reduction resulting from a direct increase in interest expenses. An interest rate increase can also lead to a consumption reduction for households with loans at fixed rates that will not be re-set in the near future. This is because an increase in lending rates may mean that households will increase their savings to build a buffer to compensate for higher interest expenses from the point in time the interest rates fall due and are fixed once again. As previously mentioned, an interest rate increase can also lead to falling house prices via the balance and uncertainty channels, which risks further enhancing the consumption reduction.

## THE RISK OF A CONSUMPTION REDUCTION IS GREATEST IF INTEREST RATES RISE, BUT NOT INCOME.

The impact of interest rate increases on household consumption is also dependent on changes in household income. The greatest consumption reduction occurs when income growth is low at the same time as lending rates rise (see Diagram 14).

There are several scenarios where this type of development can occur. For example, a reduction in productivity in the economy leads to a reduction in the supply of goods and services. This can lead to rising prices and thus inflation, which in turn can lead to higher interest rates. This can occur at the same time as incomes in the economy remain unchanged or fall (see Adolfson et al, 2013). A sudden increase in risk premiums in the banks' financing costs can also have such consequences since this may mean higher lending rates without any parallel increase in household income.

In countries with variable exchange rates, in comparison, it has been unusual for the interest rate to rise without a parallel rise in income (see "Higher interest rate" in Diagram 15). Interest rates rose at the same time as income growth was low in only two per cent of all of the quarters in the past 20 years. Thus, rising interest rates occur often when income growth is high.

It is also important to take into consideration that the central bank often has the capacity and incentive to counteract rising lending rates in scenarios where income growth is low. By lowering the repo rate (and in more extreme cases, purchasing financial assets), the central bank is able to influence the market rates in the economy. It is also possible for the state, via the central bank or some other way, to counteract upswings in interest rates caused by financial shocks through

Diagram 15. Historical occurrence of outcomes when short-term interest rates and income growth progressed in opposite directions

(Per cent of the total number of observations)
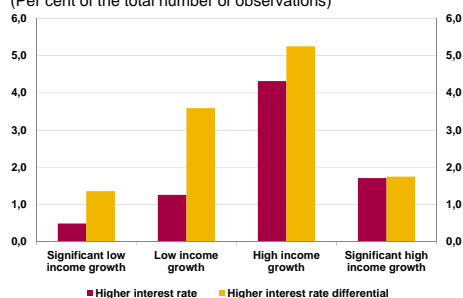


Note: The diagram is based on quarterly observations during the period 1996–2015 for 35 countries with a variable exchange rate. Low or high income growth refers to a growth rate in disposable income that is at the most one standard deviation below or over the average, respectively. Significant low or significant high income growth refers to a growth rate that is more than one standard deviation below or above the average, respectively. The "Higher interest rate" series is an annual increase in the short-term market rate corresponding to at least one standard deviation. "Higher interest rate differential" refers to an annual increase in the difference between the short-term market rate and the policy rate corresponding to at least one standard deviation. The short-term market rate corresponds to OECD's definition of "Short-term interest rates".

Source: OECD, Thomson Reuters and FI.

various types of liquidity supports. The risk for rising lending rates and low income growth is therefore at its highest when competent authorities for some reason are not successful in controlling the interest rates.

In countries with variable exchange rates, the short-term market rates often follow the policy rate. The difference between the short-term market rates and the policy rates usually also increases when income growth has been high (see the yellow bars in Diagram 15). Only in approximately five per cent of the cases has this interest rate differential risen even though income growth was low.

Today's economic conditions are unique, however, and it is not possible to rule out that there will be lower income growth and rising interest rates in the future. The recent economic development has been characterised by relatively high income growth and falling interest rates, which deviates from the normal relationship. As previously mentioned, the low interest rates also mean that it is more likely that interest rates will rise in the future than fall. The probability of a scenario of high mortgage rates and low income growth should therefore be higher than normal since the ability to counteract such a scenario with a lower policy rate is more limited than normal. From this it should follow that the value of an insurance against interest rate risk should be high now since the risks are elevated at the same time as the cost of insurance (the difference between fixed and variable interest rates) is low (see Diagram 7).

## INDIVIDUAL HOUSEHOLDS HAVE HIGHER INCOME RISK THAN THE HOUSEHOLD SECTOR AS A WHOLE

The estimated consumption reduction assumes a perfect correlation between the income development of individual households. In reality, however, individual households' income risk is higher than the income risk of the household sector as a whole.[16] While the probability of rising interest rates and low aggregate income growth is low based on empirical estimates, the probability of such a scenario may still be high for many households. The household could suffer unemployment and receive less income even in a strong economy when the aggregate income growth is high. For such a household, then, it is not certain that a loan at a variable rate provides insurance against changes in the household's income. The income growth of individual households is also often more sluggish than interest rate growth, since income often changes much later than market rates.

Many households would benefit from a higher share of loans at a fixed rate. It is therefore key for households to have good conditions for handling their interest rate risk by having the freedom to choose between fixed and variable rates.

As previously mentioned, the current design of the regulation for early repayment of mortgages creates incentives for households to choose variable rates to avoid being locked in by their bank. This lock-in effect limits the opportunities for households with fixed rates to effectively handle unforeseen situations. For example, a household with a fixed rate may experience a loss in income at the same time as interest rates rise. A reasonable reaction for the household may then be to sell its home in order to pay off the loan and instead buy a home at a lower

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16 See Heathcote et al (2009) for a discussion about the importance of considering the relationship between idiosyncratic and aggregate risks.

price. Given today's rules, the household would make a loss on the transaction since the interest rate would be higher.

# Conclusions

Households' interest rate adjustment periods are important for the economy's ability to recover from disruptions. Due to shorter interest rate adjustment periods and rising debt, the sensitivity of households to changes in the interest rates has risen to high levels. The credit risks caused by fluctuations in interest rate expenses have been counteracted by increases in households' margins, but the high sensitivity to interest rates means that households' margins could be reduced sharply if lending rates were to rise. In turn, this could affect household consumption, which could have both positive and negative effects.

On the one hand, interest rates usually follow household income. A high percentage of loans at variable rates therefore normally stabilises households' margins for consumption and savings. High sensitivity to interest rates also results in an immediate impact from changes to interest rates on household consumption. This should improve the opportunities for monetary policy to stabilise the development of prices in the economy in the event of shocks. For example, the short interest rate adjustment period contributed to the recovery of the Swedish economy after the financial crisis in 2009 despite the fact that the percentage of mortgages at variable rates was approximately 20 percentage points lower than today.

On the other hand, high sensitivity to interest rates introduces a large exposure to unexpected changes in the lending rates. There are several scenarios in which lending rates can rise even though income growth is low. In such a scenario, a high percentage of loans at variable rates could have undesired negative effects on household consumption and house prices. In turn, this could amplify the negative economic development in stressed scenarios.

Historical data indicates that the probability of the occurrence of these kinds of scenarios is low. In turn, this means that a significantly higher percentage of mortgages at fixed rates could be associated with costs for society as a whole if the procyclicality of lending rates and income were to decline.

However, from a consumer protection perspective, there is cause for prudence. Vulnerable households with low margins, high debt-to-income ratios or a high risk of a loss of income should be particularly careful about their choice of interest rate adjustment period. Banks should also promote a fixed rate when appropriate. The following factors are particularly important to consider:

- **Greater probability that interest rates will rise in the future than fall.** The current economic situation of low interest rates and high income growth will most likely not last. The cost of binding the interest rate is low, and it is probably particularly profitable to obtain insurance against interest rate risk at this point in time.

- **High debt and short interest rate adjustment periods make households very vulnerable.** A high debt-to-income ratio requires a long interest rate adjustment period so the household can build resilience by increasing its income and amortising the debt before the interest rate is readjusted.

- **The income risk of individual households is often higher than the income risk of the household sector at large.**
  There is therefore cause for individual households to carefully consider the need to choose a fixed interest rate in order to stabilise monthly margins.

It is key for households to be able to effectively manage their interest rate risk. This requires a good understanding of the difference between fixed and variable interest rates. Banks play a central role in providing concrete interest rate offers to customers with information about the advantages and disadvantages of the different interest rate adjustment periods. Furthermore, regulations are needed that do not influence households' options. Currently, the bank can handle its interest rate risk based on the needs on the financial markets. Households, on the other hand, are forced to choose between being unprotected against rising interest rates or being locked in by their current bank. This may lead to borrowers choosing loans at variable rates to a greater extent than what is desirable.

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# Appendix 1. Discretionary income calculation – a measure of households' margins

Households' margins are defined as the surplus or deficit that occurs in a discretionary income calculation. The standardised costs in Table B1 are also used as a measure to identify households with low margins.

The banks' discretionary income calculations contain detailed information about mortgage holders when they submit a loan application. We calculated the non-stressed discretionary income per month for each individual household as:

$$Discretionary\ income_i = \left(\frac{I_i}{12}\right) - 0{,}7 \times \left(\frac{r_i \times M_i}{12}\right) - C_i \qquad (B1)$$

where $i$ refers to the household, $I$ is income after tax, $r$ is an average interest rate, $M$ is the household's total liability and $C$ is the household's total standardised costs and amortisation payments. The interest rate expenses are reduced by 30 per cent to reflect the interest rate deduction. The annual income, $I$, is reported for each individual household. The borrowing cost is dependent on the household's total debt and the interest paid by the household. The interest rate, $r$, is calculated using information about the loan amounts and the interest rates for the new loans that are reported for the household in the mortgage survey, i.e.:

$$r_i = \frac{\sum_{j=1}^{K} V_{i,j} \times r_{i,j}}{\sum_{j=1}^{K} V_{i,j}} \quad , \qquad (B2)$$

where $r$ is the interest rate and $V$ is the loan amount for loan $j$ and household $i$. This means that the average interest rate for the household's total debt in equation (B1) is assumed to correspond to the volume-weighted interest rate for the household's new loans in the mortgage survey according to equation (B2). There is a risk that this assumption will overestimate or underestimate the household's interest rate expenses for the total debt depending on whether the interest rate for the household's old loans overestimates or underestimates the interest rate for the new reported loan.

Equation (B1) also includes the household's monthly fixed expenses. These expenses include actual tenant-owner housing charges and operating costs for the individual household. In the absence of information, banks use standardised costs that are based on the household size and composition and the type of home. FI's monthly calculation employs an average of these standardised costs (see below) for all households of the same type. The standardised costs only take into account the type of home, and not its size. Because the size of a home can have a major bearing on costs, for example heating, FI's calculations for individual households are not as precise as those of the banks.

*Table B1. FI's standardised costs in the monthly calculation (SEK)*

|  | 2015 | 2014 | 2013 | 2012 | 2011 | Swedish Consumer Agency 2015 |
|---|---|---|---|---|---|---|
| **Subsistence costs** |  |  |  |  |  |  |
| 1 adult | 9177 | 9099 | 9056 | 8979 | 8894 | 5,950 |
| 2 adults | 15890 | 15755 | 15680 | 15547 | 15400 | 10,520 |
| per child | 3407 | 3378 | 3362 | 3333 | 3302 | 2,800 |
| **Operating expenses** |  |  |  |  |  |  |
| Single-family dwell- | 4,000 | 3958 | 4100 | 3800 | 3700 |  |

| | | | | | |
|---|---|---|---|---|---|
| ings | | | | | |
| Tenant-owned housing | 3400 | 3199 | 3458 | 3100 | 3500 |
| Holiday homes | 1700 | 1911 | 1459 | 1500 | 1333 |

Source: Finansinspektionen

The standardised costs in the table are an average of the standardised costs used by the banks. Corresponding standardised costs from the estimation of the Swedish Consumer Agency for 2015 of the costs of attaining a reasonable consumption standard are shown to the right.

# Appendix 2. Descriptive statistics for microdata from the mortgage survey

In order to consider difference between households, we analyse FI's microdata from the mortgage survey. The survey includes data from Danske Bank, Handelsbanken, Länsförsäkringar Bank, Nordea, SBAB Bank, SEB, Skandiabanken and Swedbank.

The data contains information from a sample that has a large number of new loans at the household level. The sample includes all new mortgage agreements entered into during a period of one week at the end of August and September for the years 2011−2015.[17]

In total 123,405 households are included with information about, for example, the number of children at home, disposable income, the households' total loans, loans collateralised by the home, including home-related unsecured loans, interest rate levels, any amortisation and the market value of the collateral.

*Table B2. Descriptive statistics, mortgage survey 2011−2015*

|  | Average | Standard deviation | Min | Max |
|---|---|---|---|---|
| Margin (Discretionary income)[18], SEK | 17,370 | 85,000 | -28,868 | 23,000,000 |
| Average interest rate adjustment period, months | 13.3 | 16.1 | 0.0* | 120 |
| Debt-to-income ratio, total debt as a per cent of total income | 372.9 | 233.0 | 0.2 | 1,993 |
| Interest rate, per cent | 1.8 | 0.6 | 0.0 | 6.7 |
| Income, SEK | 40,372 | 85,682 | 1000 | 23,000,000 |
| Loan-to-value ratio, loan amount as a per cent of the value of the collateral | 62.5 | 23.3 | 0.1 | 200 |
| Age, years | 47.7 | 14.5 | 19 | 102 |
| Number of children in household | 0.7 | 1.0 | 0 | 22 |
| Number of bottom loans | 1.6 | 0.9 | 0 | 7 |
| Has a top loan, 1 for "Yes", 0 for "No" | 0.120 | 0.325 | 0 | 1 |
| Has an unsecured loan, 1 for "Yes", 0 for "No" | 0.065 | 0.246 | 0 | 1 |

Source: Finansinspektionen

Note: * An interest rate adjustment period of zero months refers to a loan at a variable rate.

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17 The data for 2011 refers only to the period 26 September-6 October.

18 The calculation of discretionary income is described in Appendix 1.

Table B3. *Average for households with different margins, mortgage survey 2011−2015*

| Year | Category | Number of observations | Margin, SEK | Interest rate adjustment period, months | Interest rate, per cent | Income, SEK | Debt ratio, per cent | Loan-to-value ratio, per cent | Age, years | Number of children in household | Monthly savings, SEK | Annual amortisation as a per cent of the loan, per cent | Total unsecured loan, SEK | Total mortgage, SEK | Total debt, SEK | Market value, home, SEK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2011 | 1 | 1,445 | -5,272 | 16.6 | 2.9 | 18,380 | 555 | 42 | 53 | 0.7 | | 1.4 | 3,013 | 925,491 | 1,271,606 | 2,793,113 |
| | 2 | 1,762 | 2,240 | 17.4 | 2.8 | 24,879 | 336 | 42 | 52 | 0.7 | | 1.7 | 8,835 | 836,840 | 1,051,239 | 2,558,787 |
| | 3 | 2,441 | 7,492 | 17.4 | 2.8 | 32,002 | 313 | 46 | 50 | 0.9 | | 1.6 | 9,017 | 1,016,233 | 1,253,490 | 2,913,323 |
| | 4 | 2,459 | 12,658 | 16.4 | 2.8 | 37,709 | 309 | 48 | 50 | 0.8 | | 1.4 | 7,348 | 1,206,339 | 1,472,816 | 3,261,921 |
| | 5 | 6,823 | 32,587 | 18.5 | 2.5 | 57,475 | 288 | 49 | 51 | 0.4 | | 0.9 | 6,464 | 1,617,189 | 1,908,103 | 4,265,918 |
| 2012 | 1 | 878 | -2,634 | 18.4 | 2.5 | 16,923 | 422 | 54 | 57 | 0.6 | | 2.3 | 9,319 | 725,838 | 887,088 | 1,463,043 |
| | 2 | 2,632 | 2,454 | 19.2 | 2.5 | 23,435 | 337 | 60 | 52 | 0.8 | | 1.7 | 8,878 | 807,256 | 977,502 | 1,477,070 |
| | 3 | 4,982 | 6,628 | 18.5 | 2.5 | 28,120 | 339 | 64 | 48 | 0.8 | | 1.5 | 10,157 | 977,017 | 1,166,131 | 1,619,544 |
| | 4 | 4,821 | 11,118 | 17.9 | 2.4 | 33,371 | 343 | 66 | 47 | 0.7 | | 1.4 | 9,987 | 1,157,240 | 1,387,446 | 1,858,774 |
| | 5 | 10,809 | 28,083 | 16.7 | 2.3 | 51,730 | 365 | 63 | 50 | 0.5 | | 1.2 | 9,727 | 1,702,041 | 2,181,915 | 2,840,243 |
| 2013 | 1 | 836 | -2,642 | 15.0 | 2.1 | 16,414 | 397 | 52 | 58 | 0.6 | | 2.0 | 7,992 | 672,205 | 788,669 | 1,455,153 |
| | 2 | 3084 | 2,473 | 14.6 | 2.1 | 23,840 | 335 | 63 | 49 | 0.8 | | 1.8 | 13,176 | 848,303 | 975,890 | 1,450,544 |
| | 3 | 5,443 | 6,927 | 13.4 | 2.0 | 29,344 | 355 | 68 | 45 | 0.8 | | 1.5 | 14,700 | 1,096,486 | 1,263,740 | 1,691,921 |
| | 4 | 5,036 | 11,808 | 12.5 | 2.0 | 35,016 | 361 | 68 | 45 | 0.7 | | 1.3 | 13,699 | 1,314,349 | 1,529,536 | 2,038,468 |
| | 5 | 10,584 | 25,591 | 10.5 | 1.9 | 49,922 | 368 | 63 | 49 | 0.5 | | 1.1 | 8,295 | 1,814,988 | 2,236,676 | 3,053,681 |
| 2014 | 1 | 615 | -2,267 | 12.2 | 1.7 | 16,408 | 457 | 52 | 58 | 0.5 | | 2.5 | 6,574 | 759,191 | 924,958 | 1,643,361 |
| | 2 | 2,481 | 2,502 | 12.8 | 1.7 | 23,169 | 339 | 60 | 50 | 0.8 | | 2.0 | 11,449 | 816,683 | 972,684 | 1,518,829 |
| | 3 | 5,319 | 6,842 | 12.1 | 1.6 | 28,322 | 360 | 67 | 44 | 0.8 | | 1.7 | 13,294 | 1,075,383 | 1,228,956 | 1,698,476 |
| | 4 | 5,672 | 11,546 | 11.2 | 1.6 | 33,899 | 381 | 68 | 44 | 0.8 | | 1.4 | 11,753 | 1,357,585 | 1,553,280 | 2,066,945 |
| | 5 | 14,124 | 26,134 | 9.7 | 1.5 | 49,798 | 404 | 65 | 48 | 0.6 | | 1.2 | 7,169 | 1,954,246 | 2,438,412 | 3,170,596 |
| 2015 | 1 | 577 | -2,357 | 13.4 | 1.3 | 15,878 | 459 | 51 | 58 | 0.4 | 253 | 2.2 | 4,102 | 716,857 | 874,418 | 1,645,204 |
| | 2 | 2,235 | 2,565 | 13.3 | 1.3 | 22,898 | 339 | 59 | 50 | 0.7 | 570 | 2.2 | 10,871 | 824,550 | 946,461 | 1,581,553 |
| | 3 | 5,099 | 7,076 | 12.3 | 1.3 | 28,698 | 378 | 66 | 44 | 0.8 | 740 | 1.6 | 10,973 | 1,165,389 | 1,307,945 | 1,897,512 |
| | 4 | 6,221 | 11,983 | 11.2 | 1.2 | 34,588 | 399 | 68 | 44 | 0.8 | 991 | 1.4 | 10,936 | 1,472,411 | 1,647,818 | 2,291,376 |
| | 5 | 17,090 | 27,309 | 10.1 | 1.1 | 50,906 | 423 | 64 | 47 | 0.6 | 1,676 | 1.1 | 6,149 | 2,131,674 | 2,601,479 | 3,522,764 |

Source: FI.

Note: Debt-to-income ratio is the total debt as a per cent of annual income after tax. Loan-to-value ratio is expressed as the total mortgage as a per cent of the home's market value. Category 1=negative margin. Category 2=margin is 0-25 per cent of the standardised cost. Category 3=margin is 25-50 per cent of the standardised cost. Category 4=margin is 50-75 per cent of the standardised cost. Category 5=margin is more than 75 per cent of the standardised cost.

# Appendix 3. Method descriptions for diagrams

This appendix describes the method for the diagrams that illustrate the results of more complex methods.

## DIAGRAM 9. ESTIMATED AVERAGE PERCENTAGE AT VARIABLE RATES FOR DIFFERENT MARGINS AND SIZES OF DEBT

The diagram illustrates the estimated percentage of loans at variable rates based on microdata in FI's mortgage survey for the years 2011–2015 based on the following equation:

$$y_{i,r,t} = \mu_r + \delta_t + \beta X_{i,r,t} + \epsilon_{i,r,t} \qquad (B3)$$

where

- $y$ is the percentage of new mortgages with an interest rate adjustment period of up to three months
- $i$ specifies the household
- $r$ specifies the region
- $t$ specifies the year in the range 2011−2015
- $\mu$ and $\mu$ och $\delta$ are region- and time-specific effects
- $X$ is a vector of the explanatory variables: volume-weighted interest rates, debt-to-income ratio (total debt as a per cent of income after tax), dummy variable (D1) if the household has a debt-to-income ratio of more than 600 per cent, dummy variables (D2-D5) for categories of margins (see the categories in Table B3), interaction between D1 and D2-D5, loan-to-value ratio (total mortgages as a per cent of the value of the pledged collateral), borrower's age, borrower's age squared, number of children in the household, if the household has a bottom loan, if the household has a top loan and if the household has an unsecured loan.

## DIAGRAM 10. SENSITIVITY IN HOUSEHOLDS' MARGINS TO AN INTEREST RATE INCREASE OF ONE PERCENTAGE POINT

Interest rate sensitivity is calculated as:

$$Interest\ rate\ sensitivity = \frac{1\% \times 0,7 \times M}{I} \qquad (B4)$$

where $I$ refers to households' total disposable income according to the national accounts of Statistics Sweden. An interest rate change of one percentage point is multiplied by 0.7 per cent to take into consideration the interest rate deduction. $M$ refers to MFI's total loans to households for housing purposes with a remaining interest rate adjustment period of up to one year. This amount has been estimated under the assumption that the following percentages of the loan are readjusted within one year:

- 1/1 of loans with an original interest rate adjustment period of up to one year. The assumption is made that all loans with an interest rate adjustment period of up to one year will be readjusted within one year.

- 1/3 of loans with an original interest rate adjustment period of 1-5 years. Given the assumption of an even distribution of mortgages over time, the share of fixed mortgages that will be

readjusted during the coming year corresponds to 1/X, where X is the interest rate adjustment period in years. We assume an average interest rate adjustment period of 3 years for loans with an original interest rate adjustment period of 1-5 years.

- 1/7 of loans with an original interest rate adjustment period of > 5 years. We assume an average interest rate adjustment period of 7 years for loans with an original interest rate adjustment period of more than 5 years.

The distribution of interest rate adjustment periods in lending from MFIs prior to December 2003 is estimated based on the historical distribution of the stock of lending from mortgage institutions.

### DIAGRAM 11. PERCENTAGE OF HOUSEHOLDS WITH LOW OR NEGATIVE MARGINS IN THE ORIGINAL DATA AND IN THE SCENARIO

The diagram shows the percentage of households with a discretionary income calculation that is negative or less than 25 per cent of their standardised costs before and after an interest rate increase of 7 percentage points that is assumed to occur over the course of one year. Loans with fixed interest rates also are given a higher interest rate in the scenario, which reflects the probability that loans at fixed rates will also be readjusted during the year that the interest rate shock occurs. For example, the probability is 1/3 for a loan with a three-year interest rate adjustment period and 1/5 for a loan with a five-year interest rate adjustment period. Households' discretionary income in the stressed scenario is calculated as follows:

$$Discr.income_i = \left(\frac{I_i}{12}\right) - 0{,}7 \times \frac{M_i \times \left(\frac{\sum_{j=1}^{K} V_{i,j} \times \left(r_{i,j} + \frac{7\%}{t_{i,j}}\right)}{\sum_{j=1}^{K} V_{i,j}}\right)}{12} - C \quad (B5)$$

where

- $i$ refers to households, $j$ refers to each new mortgage and $K$ is the household's total number of new mortgages
- $I$ refers to income after tax
- 0.7 is a factor that takes into consideration the interest rate deduction
- $M$ is total loans
- $V$ is the loan's nominal amount
- $r$ is the interest rate for the loan
- $t$ is the loan's interest rate adjustment period rounded up to a whole number
- $C$ is the household's standardised cost and amortisation payments

### DIAGRAM 14. CONSUMPTION REDUCTION FOLLOWING AN INTEREST RATE INCREASE OF 1 PERCENTAGE POINT

Diagram 14 shows the estimated reduction in consumption following an interest rate increase of 1 percentage point that is assumed to occur over the course of one year. The calculation is based on data from Statistics Sweden's statistics for 2015 and based on the microdata material in FI's mortgage survey from 2015.

The reduction in consumption based on Statistics Sweden's statistics is calculated as:

$$Consumption\ reduction = \frac{1\% \times 0.7 \times M}{K} \qquad \text{(B6)}$$

where M refers to MFI's total loans to households for housing purposes with a remaining interest rate adjustment period of up to one year. This amount has been estimated based on the distribution of loans with different remaining interest rate adjustment periods in the housing institutions' lending. $K$ refers to households' total consumption in 2015 according to Statistic Sweden's national accounts. An interest rate change of one percentage point is multiplied by 0.7 per cent to take into consideration the interest rate deduction.

The reduction in consumption based on the data in the mortgage survey is calculated as:

$$Consumption\ reduction = \sum_{i=1}^{L} -0.7 \times \frac{M_i \times \left( \left. \sum_{j=1}^{K} V_{i,j} \times \frac{1\%}{t_{i,j}} \middle/ \sum_{j=1}^{K} V_{i,j} \right. \right)}{I_i \times 90\%} \qquad \text{(B7)}$$

where

- $i$ refers to households, $j$ refers to each new mortgage, $L$ is the total number of households in the mortgage survey and $K$ is each household's total number of new mortgages

- $V$ is the loan's nominal amount

- $M$ is the household's total loan calculated as an adjusted sum of the household's new mortgages and other (old) loans. The adjusted amount corresponds to the total sum of new mortgages divided by two on the condition that the household's rate of amortisation is greater than zero. The adjustment is made to reflect the average debt level in the household sector under the assumption that lending historically would have had the same characteristics as lending in 2015. Under this assumption, the average debt level in the stock of mortgages corresponds to half of the average size of new loans during a period of one year.

- $t$ is the loan's interest rate adjustment period rounded up to a whole number. Like before, the interest rate's impact on households' interest rate expenses is adjusted to reflect the interest rate adjustment period. In this calculation, the assumption is that loans with different interest rate adjustment periods are evenly distributed over time. By dividing the interest rate change by the interest rate adjustment period, the impact of the interest rate change on the stock of loans is calculated. For example, it is possible to assume that the interest rate change will have a full impact on loans with three-month interest rate adjustment periods in the stock of mortgages while only 1/5 of the change in interest rate will affect the aggregate interest rate expense for the loans that have a five-year interest rate adjustment period. The change in interest rate thus has full impact on loans with interest rate adjustment periods up to one year, while the change in interest rate has been divided by the inter-

est rate adjustment period for loans with interest rate adjustment periods of greater than one year. When calculating the reduction in consumption when all loans are at fixed rate, the interest rate adjustment period is assumed to be 3.75 years, which corresponds to the average interest rate adjustment period of the loans issued with an interest rate adjustment period above three years in 2015.

- $I$ is the household's income after tax. Household consumption is estimated to 90 per cent of income after tax, which corresponds to the average share of households' total consumption as a per cent of total disposable income in 2015.