Macroeconomic effects of reducing household debt

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The Riksbank has for a long time emphasised that rising household debt is a concern for financial stability that needs to be addressed. Tighter macroprudential measures or tighter mortgage interest deduction are two alternative ways of tackling this problem. In this article, we study how these two approaches would affect different households using a macroeconomic model. We show that, contrary to what is often argued in the public debate, a tightening of the loan-to-value cap, the loan-to-income cap and the amortisation requirements would lead to a redistribution of resources from lenders to borrowers in the long-run. Moreover, tighter mortgage interest deduction affects households in different ways, depending on how the Government chooses to use the released budgetary resources. If borrowers are compensated, this policy could have positive effects for their consumption other than housing. We also analyse the implications for monetary policy of different measures to dampen household debt and show that the extent of mobility on the housing market plays an important role. In some cases, monetary policy might need to be more expansionary, and in other cases more contractionary. Finally, we study how household debt affects the transmission mechanism of monetary policy on inflation. The higher the indebtedness, the greater the effects of a rate hike on the interest expense and disposable income of borrowers. The effects of a rate hike on demand – and hence on inflation – are therefore greater today than when the inflation target was introduced in the mid-1990s.

1 Why is it important to dampen household debt?

In the past 20 years, household debt has rapidly increased in Sweden. Over the period 1995-2015, household debt in relation to disposable income – the loan-to-income ratio – increased from around 90 per cent to close to 180 per cent, see Figure 1a. When only taking into account households with mortgages, the loan-to-income ratio is currently even higher, at around 320 per cent. Swedish household debt is not just high in a historical perspective, but also in an international comparison. The loan-to-income ratio of Swedish households is among the highest in the OECD countries, see Figure 1b.

The increase in indebtedness has been coupled with increasing house prices, see Figure 2a. In the past 20 years, prices have almost quadrupled. Several factors could explain such an increase. For example, relatively few homes have been built in the past few decades; moreover, the homes that do exist are perhaps not being used efficiently due to rental market regulations.[1] But the prices might also have been pushed up by the increase in households' disposable income, while interest rates have been low at the same time. The interest-to-income ratio of households – their interest expense in relation to their disposable income – is currently at its lowest level in around 40 years, see Figure 2b.
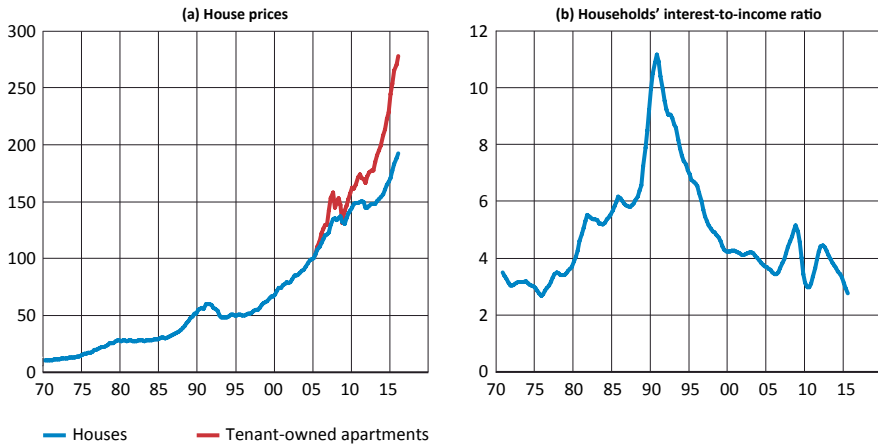
Figure 1. Households' loan-to-income ratio in Sweden and in an international perspective
Per cent of disposable income
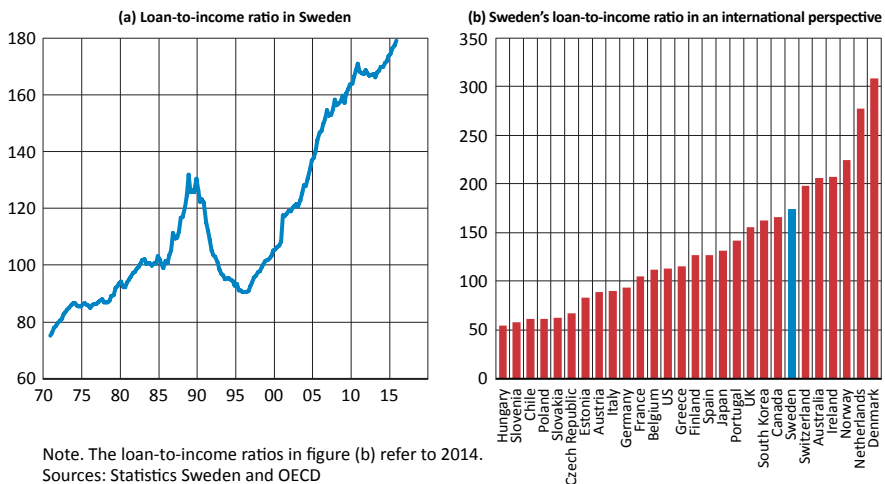
Note. The loan-to-income ratios in figure (b) refer to 2014.
Sources: Statistics Sweden and OECD

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1   See Emanuelsson (2015).

Figure 2. House prices and the interest-to-income ratio of households
Index 2005 = 100 and percentage of disposable income

Note. House prices refer to the house price index (private houses). Interest expense in the interest-to-income ratios is calculated after tax.
Sources: Statistics Sweden, Valueguard and the Riksbank

There are numerous cross-country examples showing that if household debt increases rapidly together with rises in house prices, vulnerability in the financial system, i.e. the risk of a financial crisis, increases. In many of the countries hit hardest by the global financial crisis of 2008-2009, the crisis was preceded by rapidly increasing debts and house prices. Moreover, the post-crisis slump risks to be deeper and more protracted if debts have been rising rapidly prior to the crisis.[2]

The most recent global financial crisis has also taught us that to monitor individual financial institutions, i.e. microprudential policy, is not enough; the functional capacity of the financial system as a whole, i.e. its exposure to systemic risk, must also be taken into account. This so-called macroprudential policy is a relatively new policy area that came into focus after the financial crisis to address systemic risk concerns. The purpose of macroprudential policy is both to maintain the resilience of the financial system, and to counteract risks.

The European Systemic Risk Board, ESRB, issues recommendations regarding macroprudential targets and specific measures in Sweden and other EU countries. According to ESRB, an intermediate target of macroprudential policy is to avoid excessively rapid credit expansion and high loan-to-income ratios.[3] In line

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2   See Emanuelsson et al. (2015) for an overview of empirical studies of financial risks linked to household indebtedness.
3   The other targets pertain to differences in maturities between liabilities and assets, concentrated exposures and misguided incentives for large institutions linked to the implicit or explicit public guarantees.

with this, the Riksbank has long been emphasising that rising household debt is problematic, and that the associated risks need to be addressed. Potential measures mentioned in the policy debate to deal with these risks include tightening the loan-to-value cap, introducing a loan-to-income cap, introducing an amortisation requirement, or tightening the mortgage interest deduction, i.e. reducing the tax relief on mortgage interest.[4]

The first three measures are examples of macroprudential tools that might be expected to dampen household demand for credit. The loan-to-value cap limits the size of the mortgage that may be granted to a household in relation to how much the home is worth. It therefore has a direct impact on how much debt a household may take. A loan-to-income cap also limits the size of the loan, but in relation to the borrower's income rather than the value of the home. The amortisation requirement potentially restricts the possibilities of households to take out loans. In particular, it poses a limitation for households that meet the down payment requirements, but which might have difficulty in saving further amounts in the first couple of years of the duration of the loan.

The tax relief on mortgage interest is a fiscal policy measure. Indebted households can currently deduct 30 per cent of their interest expense from their total tax, up to SEK 100,000. This mortgage subsidy incentivises households to take out larger mortgages than they would have done without the tax relief. If the tax relief on mortgage interest were reduced, it is therefore probable that households' demand for mortgages would decrease, and it would thus be an effective measure for curbing the build-up of debt.

2 Summary of our findings

In this article we study how different households are affected and what the macroeconomic consequences would be from tightening the loan-to-value cap, the loan-to-income cap and the amortisation requirements, and reducing the tax relief on mortgage interest. In our policy experiments, we use a macroeconomic model fitted to Swedish data.

We find that all the macroprudential measures considered in our study curtail indebtedness in the economy over time; this in turn brings about a reduction in both the interest expense of borrowers and the interest income of lenders. These measures lead to a redistribution of resources from debt-free to indebted households, i.e. from lenders to borrowers. Lenders will reduce their consumption of goods, housing services and leisure, since their interest income will be lower. On the other hand, borrowers can increase consumption of goods and leisure.

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4   See e.g. Sveriges Riksbank (2014, 2015 and 2016).

Whether or not they also increase their consumption of housing services depends on which measure is undertaken. A tighter loan-to-value cap will force borrowers to cut back on their consumption of housing services. While, if the amortisation requirement and loan-to-income cap are tightened, borrowers will also consume more housing services.

A reduction in the tax relief on mortgage interest leads in the long-run to a redistribution of the consumption of housing services from borrowers to lenders. However, if the Government uses the released budgetary resources to compensate borrowers, they can increase their consumption of goods and leisure.

The tightening of various macroprudential measures and the reduction of the tax relief on mortgage interest can also have short-term effects on demand and inflation. The central bank may need to consider this when setting the policy rate. How monetary policy reacts to lower household debt depends both on the measure underlying the reduction, and on residential mobility. If mobility in the housing market is relatively low, households will cut back on non-durables consumption, thereby dampening demand and hence inflation. In such a scenario, monetary policy may need to be more expansionary. If, however, the mobility in the housing market is relatively high, monetary policy may instead need to be tighter.

We also study how the level of household debt affects the impact of monetary policy on inflation and household consumption. A high degree of indebtedness makes borrowers more sensitive to changes in interest rates. The higher the indebtedness, the greater the effect of, for instance, a rate hike on borrowers' interest expense and disposable income, which in turn reduces their scope for consumption. This means that the effect on demand, and hence on inflation, from an increase to the policy rate would be higher today than previously. Specifically, a rate hike at the current level of indebtedness reduces borrowers' consumption much more than it would have done had indebtedness been at the same level as when the inflation target was introduced in the mid-1990s. The effect on inflation from this rate hike is thus also greater today than in the mid-1990s.

The paper is structured as follows. In the next section, we present the macro-economic model used in our policy experiments, and in the section after that we describe how the model has been fitted to Swedish data. Following that is a section showing the long-term macroeconomic effects of the alternative measures. We then discuss the short-term effects of deleveraging on inflation and the policy rate, and how the potency of monetary policy is affected by the level of household debt. Finally, we compare our findings with other studies on household debt.

3 The economic environment

This section presents the macroeconomic model we use in our policy experiments.[5] Figure 3 illustrates the structure of the model. The economy is populated by households, corporations, banks, a central bank and a fiscal authority. For the sake of simplicity, we disregard foreign trade and cross-border financial flows in the analysis.

The housing market is an important part of the model since the measures we study have a direct effect on the households' demand for housing. A simplifying assumption is that housing is in fixed supply. Households buy and sell housing services to a market determined price.[6] Furthermore, it is assumed that there are only two categories of households – "lenders" and "borrowers", who differ in the way they discount future consumption. Lenders save in bank accounts and finance their housing investments without a mortgage. On the other hand, borrowers finance primarily their housing investments with bank loans. In addition to these two categories of households, there are also "entrepreneurs" who take out bank loans to finance their investments.

Banks have two sources of funding, equity and households' deposit and can use a deposit facility at the central bank. The interbank rate is thus affected by the policy rate set by the central bank. It is assumed that different banks can offer slightly differentiated financial product, i.e. they operate under "monopolistic competition". The degree of their monopoly power determines over time the spreads between the central bank's policy rate and the banks' rates for households and corporations. In the short-term, these spreads will also be affected by the fact that banks are subject to adjustment costs when changing the interest rates. Household preferences are described by a utility function, which depends on their consumption of goods, housing services and leisure. Both categories of households are forward-looking, but they attach different weights to their expected future utility. The lenders are assumed to be more "patient" and care more about future consumption than borrowers do; this leads the lenders to save more.

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5   The model is based on Gerali et al. (2010), which provides a more detailed description. However, we have modified their model on some key points, in order to study the effects of amortisation requirements, a loan-to-income cap and reduced tax relief on mortgage interest. See Finocchiaro et al. (2016).

6   There are therefore no rented homes in this model. "Goods" refers to an aggregate of non-durable consumer goods and services other than housing services.

Figure 3. An overview of the model structure
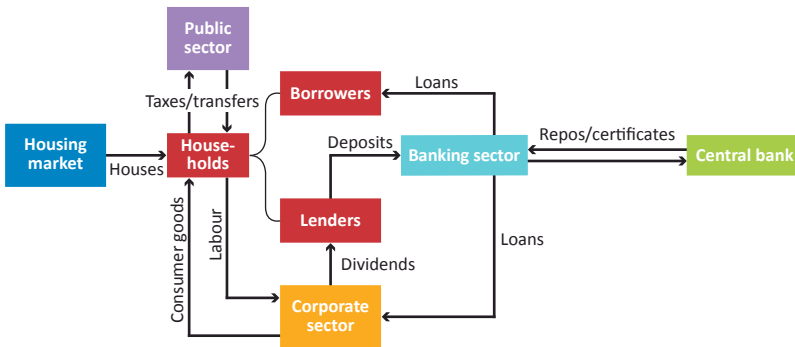
Source: Own illustration

The lenders choose how much they will work, spend on consumer goods and housing investments, and how much they will deposit in the bank to maximise utility. Their disposable income consists of wage income, interest on their savings and transfers or taxes from the public sector, as well as dividends from companies. Borrowers are subject to similar budget restrictions but they can also finance their housing with mortgages. In our analysis, we are particularly interested in which terms and conditions, besides the lending rate level, apply for households to be granted these loans.

Households can increase or reduce their housing holdings by buying or selling on the housing market. The houses depreciate over time at a rate of δ_H so the household's housing holding at a certain point in time t, H_t, is determined by undepreciated housing $(1 - \delta_H) H_{t-1}$ and new housing investments I_t,

(1) $H_t = (1 - \delta_H) H_{t-1} + I_t.$

Note that we can break down the housing investments of the household into depreciations of the existing homes and changes in the housing stock. In the long-run, total housing investments consist of replacement investments, $\delta_H \bar{H}$, where $\bar{H}$ is the constant volume of houses.[7] The total volume of houses is in fixed supply. This implies that if, for example, the borrowers buy more housing services the lenders must consume less.

The model can be used to study the effects of changes in both the loan-to-value cap and in the loan-to-income cap. The loan restriction for the borrowing households differs in these two cases. When borrowing is constrained by a loan-

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7   A dash over a variable denotes that it is a long-term value.

to-value cap, new loans of households, N, may not be greater than the share μ of the nominal value of housing investments,

(2) $N_t \leq \mu Q_t I_t,$

where Q is the nominal house price.[8] Aggregate household debt, B, is affected by households' amortisation of the existing debt ρB where the parameter ρ is the rate of amortisation.[9] Hence, indebtedness progresses according to the following relationship over time,

(3) $B_t = (1 - \rho)B_{t-1} + N_t = (1 - \rho)\,B_{t-1} + \mu Q_t I_t.$

In the second case, borrowing is limited by a loan-to-income cap. In that case, new loans may at most be a share σ of wage income,

(4) $N_t \leq \sigma W_t L_t,$

where W is the nominal hourly wage rate and L are the hours worked by the borrowing household.[10] In this case too, the households are assumed to amortise the loans at the rate of ρ. Household debt thus progresses according to

(5) $B_t = (1 - \rho)B_{t-1} + N_t = (1 - \rho)B_{t-1} + \sigma W_t L_t.$

The budget constraint of the borrowers is as follows:

(6) $P_t C_t + Q_t I_t + (\rho + R^H_{t-1})\,B_{t-1} + T_t + A_t = W_t L_t + N_t + \omega^{RH} R^H_{t-1} B_{t-1}.$

The left hand side shows expenditure, which besides purchases of consumer goods C at the price P and housing investments QI also consist of amortisation ρB and interest payments, $R^H B$ on the mortgage.[11] The households also pay lump-sum

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8   The loan restriction in equation (2) thus limits the household's new loans in relation to the value of housing investments, which is an approach proposed by Kydland et al. (2016). An alternative formulation of the loan restriction is that the loan stock of households is limited by (the expected) value of the housing stock as in e.g. Iacoviello (2005). This entails however that all loans are short (one period) and that the aggregate loan stock of households is directly affected by the development of house prices.

9   The "impatience" of the borrowers is considered to be so great that they always borrow up to the limit, i.e. the restriction in equation (2) is always binding. The same assumption is made for the restriction in equation (4).

10 The fact that the new loans N are limited by income from salary also implies that total loans, B, are limited. In the model calibration, the parameter σ is set so that the total debts of the borrowing households in relation to annual income, $\sigma / 4\rho$, has a reasonable value, see more below.

11 All interest rates in the model are floating (one period), so the households pay the same interest rate irrespective of when the loan was granted.

taxes T and adjustment costs A that arise when households change their housing investments.[12] These costs aim at capturing, in a simplified way, the effects of various factors that affect mobility on the housing market. The right hand side of the budget constraint shows the resources available to finance expenditures. Besides labour income WL the resources consist of new bank loans N (which are limited by equation (2) or equation (4)) and of government subsidies of the households' mortgage expenses $\omega^{RH} R^H B$. The degree of the subsidy is given by ω^{RH}. Another way of reducing household debt – besides limiting the loan-to-value ratio μ and/or the loan-to-income ratio σ or imposing demands for a higher amortisation rate ρ – is thus to reduce this subsidy.

In order to finance public consumption and mortgage interest subsidies, the public sector balances its budget by levying lump-sum taxes from the households, and a tax on the dividends that the lenders receive from the corporate sector. Government consumption is assumed to make up a constant share of GDP, while the lump-sum tax is distributed between the lenders and the borrowers in relation to their shares of the total wage sum.

The objective of monetary policy in Sweden is to maintain price stability, while at the same time monetary policy shall contribute to sustainable growth and a high level of employment. In the model, it is assumed that the central bank can adjust its policy rate R to stabilise both inflation π and GDP growth ΔY in the economy. Inflation is defined as the annual percentage change in the price of the consumer goods P. More specifically, the policy rate evolves according to,

(7) $R_t = \phi_R R_{t-1} + (1 - \phi_R)[\bar{R} + \phi_\pi (\pi_t - \bar{\pi}) + \phi_Y \Delta Y_t] + \varepsilon_t,$

where $\bar{R}$ is the long-term level of the policy rate, $\bar{\pi}$ is the long-term level of the inflation rate (which coincides with the central bank's inflation target) and ε a disturbance term that we use to capture the non-systematic (unexpected) component of monetary policy. The parameter ϕ_R is a measure of the inertia in setting the interest rate, while ϕ_π and ϕ_Y measure how much the central bank's choice of policy rate level is affected by inflation and growth fluctuations, respectively. In the long-run, monetary policy does not affect the rest of the economy. In the short term, however, the macroprudential and fiscal measures in our study may have an impact on demand and inflation, to which monetary policy may need to react.

Lower loan-to-value or loan-to-income caps, stricter amortisation requirements and reduced tax relief on mortgage interest are all examples of

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12   Lump-sum taxes means that the households pay a fixed amount in tax. The households' behaviour therefore does not affect the size of the tax payment.

alternative measures that have emerged in the Swedish debate as potential solutions for counteracting the risks associated to high indebtedness. In the model, changes to the parameters μ (loan-to-value cap), σ (loan-to-income cap), ρ (amortisation requirement) and ω^{RH} (tax relief on mortgage interest) correspond to these measures.

4 Fitting the model to Swedish data

In order to study the macroeconomic effects of reducing Swedish household debt, the model must be fitted to Swedish data. In other words, the model parameters much be assigned values so that the characteristics of the model reflect the Swedish economy. The parameters can be divided into two categories.

The first category consists of parameters that primarily affect the model's long-term characteristics. For those parameters, there is often an observable equivalent in data. An example is the parameter that determines the degree of competition on the mortgage market, which in turn determines the banks' average margins on mortgages. This parameter can be determined based on the average difference between mortgage rates and the repo rate. In Table 1 we describe long-term levels for certain variables in the model that are of particular importance. The aim is not to exactly match the long-term values with data, but rather to verify that the consistency is sufficiently good for the model to be used to study the effects of reducing household debt in Sweden.

The other category consists of parameters that primarily affect the short-term dynamics. An example of one such parameter is that which determines what impact a change to the repo rate will have on the mortgage rate. For these parameters, there is typically no observable equivalent in data, so other methods are needed to estimate them. We have used Bayesian econometrics to estimate them, entailing that we have combined information in data with judgements based on economic theory and empirics.

4.1 Household debt, loan-to-value ratio and amortisation

As we noted in the beginning of this article, the debt ratio of the Swedish households has increased from around 90 per cent in 1995 to close to 180 per cent in 2015. Around 75 per cent of those debts consist of loans collateralised by homes. Mortgages thus made up around 130 per cent of households' disposable income in 2015. The fact that this ratio has increased over the past 20 years makes it difficult to calibrate the debt ratio, because in the model it is constant in the long term. We have set the long-term ratio of mortgages to households' disposable income to 124 per cent, i.e. somewhat lower than the current level.

This ratio is mainly determined by how the households finance purchasing their homes, and how fast they pay down the loans. When the size of the loan is limited by how much the home is worth, the following relationship gives the loan-to-value ratio for the mortgage stock in the long term:

(8) $$\mu_B = \frac{\mu \delta_H}{\rho},$$

where μ_B is the loan-to-value ratio in the mortgage stock, μ is the loan-to-value ratio for new loans, δ_H is the rate of depreciation of the housing stock, and ρ is the amortisation rate. In the model, the loan-to-value ratio for new loans coincides with the loan-to-value cap, because the loan restriction is assumed to be binding and the borrowing households are identical. In reality, the loan-to-value ratio varies between households, and most households borrow below the loan-to-value cap. With the present level of the loan-to-value cap, the size of a loan collateralised by the home may amount to no more than 85 per cent of the value of the home. The average loan-to-value ratio for new loans was 72 per cent in 2014, while the loan-to-value ratio for the entire mortgage stock in the same year was 63 per cent.[13] Using microdata regarding household debts for 2013-2014, we can calculate the annual amortisation rate at around 2 per cent annually, more or less equalling an amortisation period of 50 years. Based thereon, we set μ_B = 65 per cent, μ = 75 per cent, and ρ = 0.7 per cent (quarterly).[14] The relationship above then gives a rate of depreciation of δ_H = 0.6 per cent (quarterly).

In order for the loan-to-income ratio in the model to be consistent with data, the borrowing households' share of the total wage sum is set to 40 per cent. Borrowers' mortgages in relation to disposable income will then be 456 per cent, which is in line with data. The average loan-to-income ratio for new loans was 387 per cent in 2014 and 406 per cent in 2015.[15] The volume-weighted average loan-to-income ratio was close to 500 per cent in 2014.

The loan-to-income cap limits how much households may borrow in relation to their wage income (see equation (4)).[16] In the model, $\sigma / 4\rho$ corresponds to the ratio of mortgage debt to the borrowing households' wage income, and is set at 251 per cent. Whichever measure of income we use, a tightening of the loan-to-income cap will affect debts as a share of both the wage income and the disposable income. In our calculations below, we will describe how they are affected in relation to wage income.

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13 For new loans, the volume-weighted average in Finansinspektionen's sample is used. See Finansinspektionen (2015).

14 With this amortisation rate, around half the value of a home will be amortised after 25 years.

15 See Finansinspektionen (2016).

16 The borrowing households' disposable income consists of wage income, less interest expenses and taxes.

4.2 Interest rates

The banks operate, to a certain degree, as monopolists. This creates a positive spread between their lending rates and the risk-free rate, while deposit rates are lower. The various spreads in the model are calibrated based on average deviations from the repo rate for the period 1995-2015. The average repo rate for that period was 2.7 per cent. The short mortgage rate was 4.0 per cent on average, the short corporate lending rate was 4.7 per cent, and the deposit rate 1.4 per cent.

4.3 The banking sector

The model describes a closed economy. The banks' assets and liabilities thus relate to domestic mortgages and corporate lending in the banks' balance sheets. Swedish mortgages make up around 15 per cent of the banks' assets, and lending to non-financial corporations makes up around 10 per cent of the assets. Hence, around one quarter of the Swedish banks' assets are covered by the model. The assets of the four large Swedish banks as a share of GDP are around 400 per cent, and they account for around three quarters of all deposits and lending in Sweden. We have therefore calibrated the banks' assets as a share of GDP to a value somewhat above 100 per cent. In the model, the banks' lending is only funded by household deposits and equity. In the data, deposits and borrowings from the general public make up around 35 per cent of the four large banks' funding.

The four large banks' equity in relation to their assets (leverage) varies in the range of 4 to 6 per cent. In the model, the leverage ratio of the banking sector is calibrated at 4.6 per cent. We also assume that the resources needed to run the banks, such as salaries for employees, depend on the size of the banks' capital. The banking sector's share of GDP is set at 3.6 per cent.

4.4 Tax relief on mortgage interest

The 30 per cent tax relief on mortgage interest equals 2.5 per cent of public expenditure in the model. In the model, the indebted households spend around 7.4 per cent of their gross income on interest payments. This is a relatively high percentage compared with recent data on the hosueholds' interest-to-income ratio and the difference may, at least partially, be explained by the fact that the interest rate in recent years has been much lower than its normal level.

Table 1. Calibration of long-term values in the model
Per cent

GDP components and tax relief on mortgage interest	Value
Consumption, percentage of GDP	49
Investments, percentage of GDP	22
Public expenditure, percentage of GDP	29
Tax relief on mortgage interest, percentage of public expenditure	2.5
Interest rates	
Repo rate	2.7
Mortgage rate, short	4.0
Corporate lending rate, short	4.7
Deposit rate, short	1.4
Debts, loan-to-value ratios and amortisation	
Mortgage debt, percentage of GDP	55
Mortgage debt, percentage of disposable income, all households	124
Mortgage debt, percentage of disposable income, indebted households	456
Mortgage debt, percentage of wage income, indebted households	251
Loan-to-value ratio, new loans	75
Loan-to-value ratio, mortgage stock	65
Amortisation, percentage of loan stock, by quarter	0.7

5 Long-term effects of reducing household debt

As discussed above, there are several different measures which Swedish authorities may undertake to dampen the increasing household debt. In this section we examine, from a macroeconomic perspective, what the long-term effects would be of four different measures:

- Tightening the loan-to-value cap
- Tightening the amortisation requirement
- Introducing a loan-to-income cap
- Reducing the tax relief on mortgage interest

We calculate how the different measures would affect households by applying each measure such that the borrowing households' loan-to-income ratio (the percentage of mortgage debt of income from salary) declines by 10 per cent. This implies that mortgage debt as a share of disposable income declines by around 12 percentage points. Such a standardisation will facilitate the comparison of the effects of the different measures.[17] We then calculate what the macroeconomic effects would be for the households. The level of the loan-to-income ratio can be seen as a measure of potential risks in household debt, because many households use their current income to pay their loan expenses.

5.1 Effects of tightening the loan-to-value cap

A loan-to-value cap means that the size of a mortgage is limited with respect to how much the home is worth. If the cap is tightened, households can thus finance a smaller proportion of their home purchases with loans. In Swedish data regarding loan-to-value ratios for new loans, there is a wide spread across households. Between 20 and 30 per cent of households are limited by the loan-to-value cap. In the model we assume that all borrowers have the same loan-to-value ratio for new loans μ. We also assume that the loan-to-value ratio of the households decreases if the loan-to-value cap is tightened. The loan restriction for the borrowing households (equation 2) can, in long-term equilibrium, be written as,

(9) $\qquad \dfrac{\bar{N}}{\bar{Q}\,\bar{l}} = \mu.$

Similarly, the debt equation (equation 3) can be written as

(10) $\qquad \bar{N} = \rho\,\bar{B},$

where the parameter ρ denotes the borrowers' amortisation rate and B their indebtedness. Hence, the new borrowing of households N equals their loan amortisation in the long run.

In the model, the mortgage rate over time is determined by two factors: the state of competition on the mortgage market, and households' preferences for consumption today in relation to consumption in the future. Changes to the loan-to-value cap therefore do not affect the mortgage rate, and neither do any of the other measures. That means, for example, that if the loan-to-value cap is tightened, the interest expense of borrowers will decrease – indebtedness will decline while the interest rate remains the same.

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17 The measure thus leads to the borrowing households' mortgage debts as a percentage of wage income decreasing from 251 to 226 per cent.

Figure 4 shows how new borrowing, amortisation (ρB) and indebtedness change over time if the loan-to-value cap is tightened. The loan-to-value cap is reduced at the point in time t. We can see that new borrowings drop immediately, while amortisation and indebtedness slowly adapt to new, lower levels. In time, indebtedness decreases in the same proportion as new borrowing, because a tightened loan-to-value cap does not change the amortisation rate.

Figure 4. Adjustments of new borrowings, amortisation and indebtedness following a tightened loan-to-value cap
SEK

New borrowings   Amortisation   Indebtedness
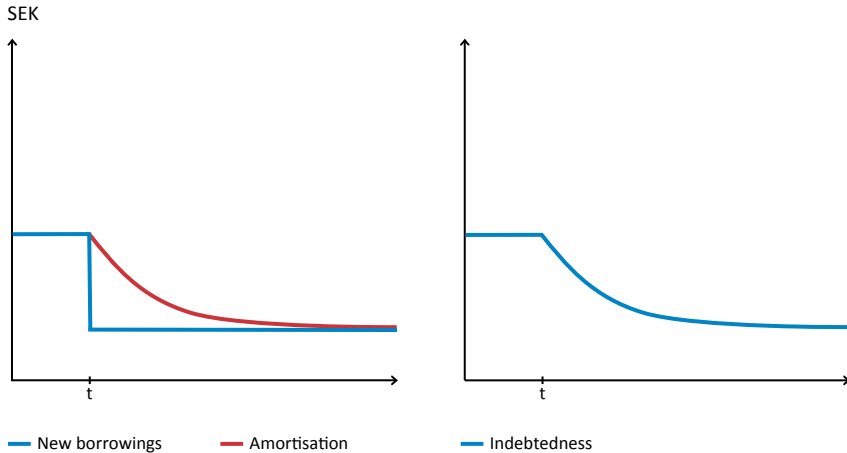
Source: Own illustration

In Table 2 the long-term effects for households from tightening the loan-to-value cap such that the loan-to-income ratio decreases by 10 per cent are shown. The average loan-to-value ratio for new loans then declines from 75 to 70 per cent. The borrowers use the funds released by the lower interest expense to increase consumption of goods (around 2 per cent) and leisure (around 1 per cent). But the tighter loan-to-value cap also brings about a reduction in the consumption of housing services of around 1.5 per cent.

In the model, the supply of homes is assumed to be constant, so only a redistribution of the housing stock between borrowers and lenders occurs. Because the borrowers cut down on their consumption of housing services, the lenders will increase their consumption to the same extent. In this case, the lenders' consumption of housing services increases by around 1 per cent.

For the lenders the lower loan-to-value cap leads to an increase in the consumption of housing services, while at the same time their savings decline

and hence their interest income too. Consequently, they increase labour supply somewhat and reduce their consumption of goods. The lower indebtedness in the economy thus brings about a shift in resources from lenders to borrowers.

5.2 Effects of increasing the amortisation rate

The purpose of an amortisation requirement is to make households amortise their debts faster. An increased amortisation rate will, like a lower loan-to-value cap, lead to debts decreasing and being lower in the new long-term equilibrium. However, the measures affect new borrowings in different ways, so the effects on households' consumption of goods and housing services will also be different with an increased amortisation rate ρ compared to with a lower loan-to-value cap. Assume that the amortisation requirement is tightened, leading to an increase in the amortisation rate . In that case, new borrowings and indebtedness will not change proportionally to each other, see equation (10). In the model, a faster amortisation rate leads to a decline in indebtedness, while new borrowings are largely unchanged both in the short and long term. The effect thus differs from a lower loan-to-value cap, which leads to new borrowings declining rapidly and being lower over time, because the loan-to-value cap directly limits new borrowings. An amortisation requirement does not have the same direct effect on new borrowings, and will therefore have less of an impact on the housing market. Figure 5 illustrates the effects after a tightening of the amortisation requirement at the point in time t. The increased amortisation rate leads to amortisations rising initially and being greater than new borrowings, to then fall back as indebtedness declines to a lower long-term level. In the long run, the size of amortisations ρB is more or less unchanged. The share of debt that is amortised each year ρ has increased but at the same time the debt B has decreased. Because new borrowings in time are affected in the same way as amortisations, this also means that new borrowings are largely unaffected over time.

This illustrates an important difference between tightening the amortisation requirement, and tightening the loan-to-value cap. Both measures lead to lower indebtedness over time, but a higher amortisation rate has little impact on new borrowings, while a lower loan-to-value cap leads to a drop in new borrowings in proportion to indebtedness. This is important because it is new borrowings, and not indebtedness, that affect the possibilities of borrowers to consume housing services.

Figure 5. Adjustments of new borrowings, amortisation and indebtedness following a tightened amortisation requirement
SEK

— New borrowings   — Amortisation   — Indebtedness
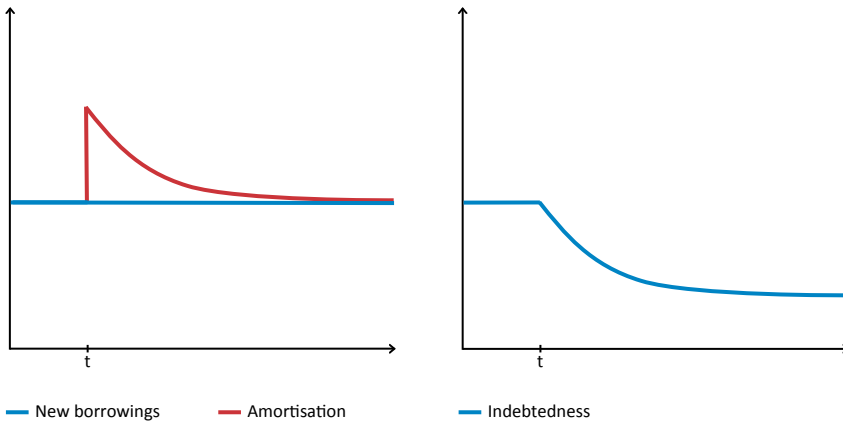
Source: Own illustration

Table 2 shows the quantitative effects of a tightening of the amortisation requirement. In order for the loan-to-income ratio to fall 10 per cent, the amortisation period must shorten from 50 to 45 years. New borrowings will be slightly lower in the long-term with this measure. The borrowing households use the money they have left over from reduced interest expense to consume goods and leisure, besides consuming slightly more housing services. The interest income of the lenders declines, because saving in the economy falls. Therefore, they cut down on the consumption of goods, housing services and leisure.

5.3 Effects of introducing a loan-to-income cap
The loan-to-income cap is a macroprudential measure that resembles the loan-to-value cap. The difference is that households' loans are not limited by the value of the home, but rather by the households' income from salary. Hence, the introduction of a loan-to-income cap leads to a change in households' new borrowings in relation to their indebtedness, just like after a tightening of the loan-to-value cap. However, unlike a tightening of the loan-to-value cap, a reduction in new borrowings due to a loan-to-income cap does not necessarily reduce borrowers' possibilities to consume more housing services, because new borrowings in this case are not linked to the value of the home.[18]

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18 Formally, this means that the restriction in equation (2) is not binding. Even if new borrowings decline, the borrowing households' consumption of housing services can be unchanged or even increase because their interest expense decreases, as long as they meet the budget restriction (6).

In order to reduce the loan-to-income ratio by 10 per cent, a loan-to-income cap must be introduced that reduces borrowers' loan-to-income ratio, i.e. their debts in relation to their wage income, by 25 percentage points from 251 to 226 per cent. The column at the far right in Table 2 shows the long-term effects this would have. Where the borrowers are concerned, this means that consumption of both goods and leisure increases. The fact that consumption of housing services increases is also noteworthy. This shows that a tightening of the loan-to-income cap need not in itself dampen borrowers' housing consumption. The lenders, for their part, cut down on their consumption of goods, housing services and leisure due to lower interest income. In purely qualitative terms, a tightening of the loan-to-income cap, or a tightening of the amortisation requirement, affects households in a similar way, although the quantitative effects differ.

Table 2. Long-term effects of tightened macroprudential measures
Per cent, except the amortisation requirement, which is in years

	Loan-to-value cap	Amortisation requirement	Loan-to-income cap
Initial value	75.0	50.0 years	251.2
End value	69.5	44.9 years	226.1
Loan-to-income ratio, change	−10.0	−10.0	−10.0
Borrowers			
Consumption goods, change	2.0	1.5	1.2
Consumption housing services, change	−1.7	0.2	1.2
Leisure, change	1.2	0.9	1.0
Lenders			
Consumption goods, change	−0.6	−0.5	−0.5
Consumption housing services, change	1.0	−0.1	−0.5
Leisure, change	−0.1	−0.1	−0.1

5.4 Effects of reducing the tax relief on mortgage interest

People who borrow money to purchase a home can, in their tax returns, deduct from their taxed amount 30 per cent of paid interest expense. This can be viewed as a government subsidy of loan financing to purchase a home.[19] If the tax relief on mortgage interest decreases, the subsidy will be less, and hence so too the Government's expenditure for it. The effect of reducing tax relief on mortgage interest therefore depends on what the Government uses the money for instead. In practice, it could be used to increase transfers, reduce taxes, increase public expenditure or to pay back the sovereign debt. In our model, which has a relatively simplistic description of the public sector, the funds released can only be used to increase transfers to lenders and borrowers, or to increase public consumption.[20, 21]

5.4.1 Decreasing the tax relief on mortgage interest lowers the borrower's consumption of housing services

We will study three different scenarios to illustrate what the effects will be from reducing the tax relief on mortgage interest, and how those effects depend on what the Government uses the released budget funds for. In the first scenario, the Government transfers the money to borrowers and lenders in proportion to the wage sum for each category of household. In the second scenario, the Government transfers the money entirely back to the borrowers. This means that the distorting effects of the tax relief on mortgage interest are weeded out. This scenario thus gives an indication of the extent to which the loan subsidy adds to excessive indebtedness and hence loan financing of home purchasing. In the third scenario, the Government instead uses the money entirely to boost public consumption.

In all three scenarios, the tax relief on mortgage interest declines to the level required to bring the loan-to-income ratio down by 10 per cent. In the first case, when the released budget funds are transferred to all households, the tax relief on mortgage interest must be reduced from the current level of 30 per cent to around 3 per cent, as shown in Table 3. The borrowers are affected mainly through two channels. First, the distorting incentives to take on debt will be lower. Second, they are subject to a negative effect on income because less than half of the released budget funds from the tax relief on mortgage interest are transferred back to them. On the whole, this leads to borrowers' consumption of housing

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19 Refers to interest expenses up to SEK 100,000 annually.

20 In the model, there are no distorting effects from taxes, with the exception of the tax relief on mortgage interest, so there is no difference between increasing transfers and reducing taxes.

21 See also Englund (2016) for a study of the effects of reducing tax relief on mortgage interest.

services declining by around 7 per cent, while at the same time their consumption of goods and leisure is more or less unchanged. Where the lenders are concerned, the reduction in the tax relief on mortgage interest gives a positive effect on income, because more than half of the money is transferred to them. Therefore, consumption of both goods and housing services increases.

In the second scenario, the money from the tax relief on mortgage interest is transferred entirely back to the borrowers. In order for the loan-to-income ratio to decline 10 per cent, the tax relief on mortgage interest must be reduced to around −6 per cent in this case. The tax relief on mortgage interest being negative means that it is a tax on loan financing for homes. So, a 6 per cent tax on loans for homes is needed for the loan-to-income ratio to decrease by 10 per cent. In that case, borrowers' consumption of housing services declines by more than 6 per cent, while consumption of goods increases by over 3 per cent, and leisure by around 2 per cent. These calculations illustrate the distorting effects of the tax relief on mortgage interest, because the Government fully transfers back the money from the tax relief on mortgage interest to the borrowers. The tax relief on mortgage interest thus leads to the borrowers consuming "too much" of housing services, but also to them consuming "too little" of other goods. The lenders, for their part, cut down on their consumption of goods and leisure due to lower interest income. However, their consumption of housing services increases because the total housing stock is unchanged.

In the third scenario, the Government uses the money from the tax relief on mortgage interest entirely to boost public consumption. In order for the loan-to-income ratio to decline 10 per cent, in this case it suffices to reduce the tax relief on mortgage interest to around 6 per cent. It is therefore the most appropriate alternative if the aim of reducing the tax relief on mortgage interest is solely to reduce household debt. Where the borrowers are concerned, however, it is an expensive alternative – despite interest expense being lower – because they miss out on the entire loan subsidy. The borrowers' consumption of housing services declines by over 6 per cent and the consumption of goods and leisure by just shy of 1 per cent each. The consequences for lenders are more beneficial. Consumption of housing services increases by just shy of 4 per cent, while at the same time the consumption of goods and leisure is more or less unchanged. However, in order to perform an accurate macroeconomic evaluation of this alternative, the utility to households provided by higher public consumption must also be weighed in.

Table 3. Long-term effects of reducing tax relief on mortgage interest
Per cent

	Transfers to both borrowers and lenders in proportion to total salary	Transfers only to borrowers	Public consumption
Initial value of tax relief on mortgage interest	30.0	30.0	30.0
End value of tax relief on mortgage interest	2.8	−6.5	6.2
Loan-to-income ratio, change	−10.0	−10.0	−10.0
Borrowers			
Consumption of goods, change	−0.1	3.1	−0.8
Consumption housing services, change	−7.0	−6.1	−6.4
Leisure, change	0.1	1.8	−0.5
Lenders			
Consumption of goods, change	0.5	−1.1	0.1
Consumption housing services, change	4.2	3.7	3.8
Leisure, change	0.4	−0.3	−0.1

5.5 Which measure is the most effective in reducing household debt?

There are different ways of evaluating which measure is the most effective in reducing household debt from a macroeconomic perspective. In the model, household utility is an appropriate measure for such an analysis. The utility depends on the consumption of goods, housing services and leisure. The fact that the utility is affected by leisure is an important assumption because it means that an increase in consumption due to working more does not necessarily increase household utility, because a higher labour supply means less leisure time.

GDP per capita is another measure that is commonly used to quantify macroeconomic benefit or welfare in a society. It is a simple measure and is therefore often used in practice. However, a drawback with GDP per capita is that welfare does not only consist of material wellbeing, but also other factors that are more difficult to measure, such as leisure and health.

Table 4 shows the effects of reducing the loan-to-income ratio by 10 per cent through the four different measures that we analysed above: loan-to-value cap,

amortisation requirement, loan-to-income cap and tax relief on mortgage interest. For the tax relief on mortgage interest, we show the same three cases as before. In the first two, the money released from the tax relief on mortgage interest is used for transfers to households, and only to borrowers in the second. In the third case, the money is used for public consumption. As a measure of household welfare from a macroeconomic perspective, household consumption of goods, housing services and leisure is shown on the one hand, and GDP per capita on the other.[22]

The households' aggregate consumption of housing services is not changed by the various measures, because the total supply is constant. If the borrowers and lenders value housing services consumption in the same way, the effects on households' housing consumption would thus have no bearing on judging which measure is most effective for reducing indebtedness.[23] The change to the consumption of goods is also close to zero for these measures, although it increases by around 0.2 per cent for the tax relief on interest income when the Government uses the money released for transfers to both categories of household. The change to households' leisure is of greater significance, declining by 0.3 per cent when the government uses the money released from reduced tax relief on mortgage interest for public consumption, but increases by 0.6 per cent when the money is instead used for transfers to borrowing households only. The change in public consumption from these measures also appears to be significant, particularly when the Government uses the money from the reduced tax relief on mortgage interest payments for public consumption. In that case, public consumption increases by 2 per cent.

These results show that, from a macroeconomic perspective, it is difficult to draw any clear-cut conclusions about which measure would be most effective in reducing household debt. The three macroprudential measures have slight effects on consumption of goods, while leisure increases by around 0.3-0.4 per cent, but public consumption drops by around as much. In terms of the tax relief on mortgage interest, the effects also diverge slightly. If the budget funds released from reducing tax relief on mortgage interest are used for transfers to all households, the improvement would however be clear because consumption of both goods and leisure increases while at the same time consumption of housing services and public consumption are unchanged.[24]

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22 The population is normalised to one, and hence there is no population growth in the model, so GDP and GDP per capita are the same.

23 In the model, the borrowers gain slightly more utility than the lenders from consuming housing services, so the difference in terms of utility is not zero.

24 The fact that household consumption of goods can increase at the same time as GDP per capita decreases is due to a reduction in both capital formation and the consumption of entrepreneurs.

If the macroeconomic effects are instead evaluated using GDP per capita, a reduction in tax relief on mortgage interest, with the reduction in Government expenditure being used for public consumption, is most effective. That measure would increase GDP by around 0.3 per cent. It is worth noting that all other measures lead to a reduction in GDP per capita, because those measures lead to households opting for more leisure time, so the number of hours worked will be lower.

Table 4. Long-term effects of reducing the loan-to-income ratio by 10 per cent from a macroeconomic perspective

Per cent

	Mortgage cap	Amortisation requirement	Loan-to-income cap	Tax relief on interest expense transfers to both borrowers and lenders	Tax relief on interest expense transfers to borrowers only	Tax relief on interest expense public consumption
Initial value	75.0	50	251.2	30.0	30.0	30.0
End value	69.5	44.9	226.1	2.8	−6.5	6.2
Loan-to-income ratio, change	−10.0	−10.0	−10.0	−10.0	−10.0	−10.0
Consumption						
Goods, change	0.0	0.0	−0.1	0.2	−0.1	−0.1
Housing services, change	0.0	0.0	0.0	0.0	0.0	0.0
Leisure, change	0.4	0.3	0.4	0.3	0.6	−0.3
Public consumption, change	−0.4	−0.3	−0.4	0.0	0.0	2.0
GDP per capita, change	−0.4	−0.3	−0.4	−0.3	−0.6	0.3

6 What are the short-term implications for monetary policy of reducing household debt?

Changes to the various macroprudential measures and to the tax relief on mortgage interest have long-term macroeconomic effects, but can also have short-term effects on, for instance, demand and inflation. The tax relief on mortgage interest affects demand in the economy through changes in public sector income and expenditure, while various macroprudential measures affect demand through household dept. The central bank may need to consider this when setting the policy rate.

In order to evaluate the implications for monetary policy from reducing household dept, we have studied the effects of introducing the four different measures (loan-to-value cap, amortisation requirement, loan-to-income cap and tax relief on mortgage interest). Each measure is introduced at a certain point in time, and is then in place for a long time, but gradually reverts to its original level. In all cases, the levels of the various measures are set such that household dept after 10 years is around 10 per cent lower than its initial level.

We show that an important factor affecting the measures' short-term effects is mobility on the housing market. We compare two cases. In one case, mobility on the housing market is high, but low in the other case.

Figure 6 shows how inflation and the policy rate are affected if household debt declines when mobility is high. Reducing the loan-to-value cap or tax relief on mortgage interest has similar effects on the policy rate and inflation. Inflation rises at most by just under 0.2 per cent and the policy rate by 0.2 per cent. Tightening the amortisation requirement has the opposite effect on the policy rate and inflation, however, as both decreases with this measure.

In the case when mobility instead is low, the effects on the policy rate and inflation are different, as shown in Figure 7. Inflation declines irrespective of the measure and by up to almost half a percentage point when amortisation requirements are tightened. The central bank therefore cuts the policy rate to dampen the drop in inflation.

The impact on monetary policy therefore does not only depend on which measure is implemented, but also the extent of mobility on the housing market. If mobility is low, households are forced to cut down on their consumption of other goods. In that case, inflation will be lower and monetary policy more expansionary. However, this also leads to a drop in mortgage rates, which partially counteracts the effects of the measures on indebtedness. The findings thus illustrate that the different measures have implications for monetary policy that may diverge, and that it is important to also consider mobility on the housing market.

Figure 6. A tightening of the loan-to-value cap, tax relief on mortgage interest and amortisation requirement with high mobility on the housing market
Deviations from long-term levels, in percentage points
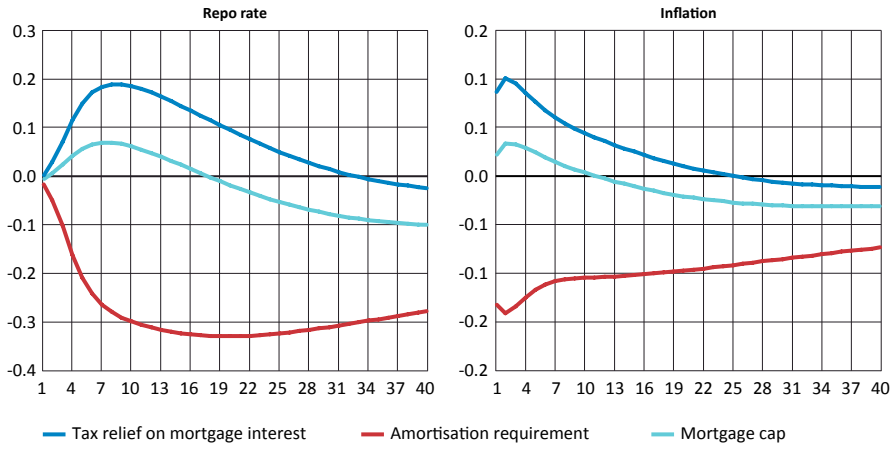
Source: Own calculations

Figure 7. A tightening of the loan-to-value cap, tax relief on mortgage interest and amortisation requirement with low mobility on the housing market
Deviations from long-term levels, in percentage points
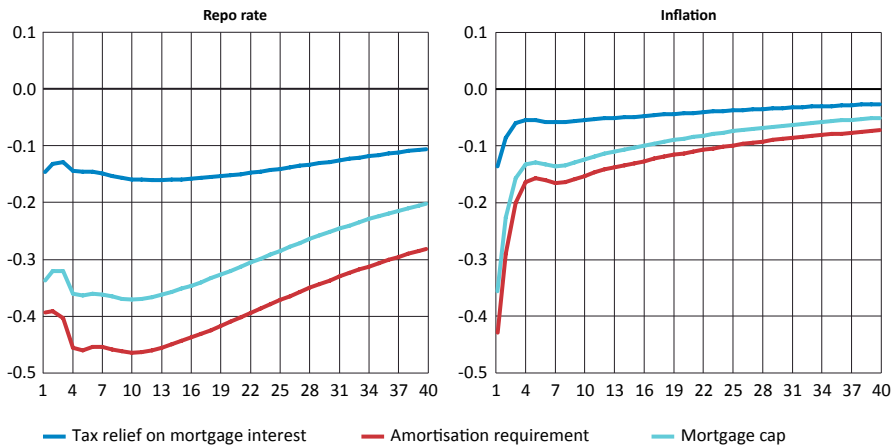
Source: Own calculations

7 How does the level of long-term debt affect monetary policy?

The rapidly increasing indebtedness of Swedish households since the mid-1990s has probably made many households more sensitive to changes in interest rates. If interest rates rise, this has a direct effect on the households' disposable income, and brings about a redistribution of resources from borrowers to lenders. The higher the indebtedness, the greater the effect of a rate hike on borrowers' interest expense and disposable income, which in turn reduces households' scope for other consumption. However, the extent of the impact depends on several factors, such as how long a rate hike lasts, and how the debts are distributed among the households.

According to this argument, the impact of a policy rate hike on demand – and hence on inflation – would be greater now than before. In order to illustrate the potential extent of the effects, we compare how the effects differ depending on three different loan-to-income ratio levels, see Figure 8. In all three cases, the repo rate is increased by 1 percentage point to be then adjusted back to the original level according to the monetary policy rule (see equation (7)). In the first case we assume that the loan-to-income ratio is at the present level, i.e. close to 180 per cent, when the rate hike occurs. In that case, the aggregate consumption of households (both borrowers and lenders) declines by around 0.7-0.8 per cent in the first year. But the borrowers are the ones hardest hit by the rate hike. Their consumption drops by almost 2 per cent, while the lenders' consumption is largely unaffected. We can also see that inflation drops by just over 0.5 percentage points.
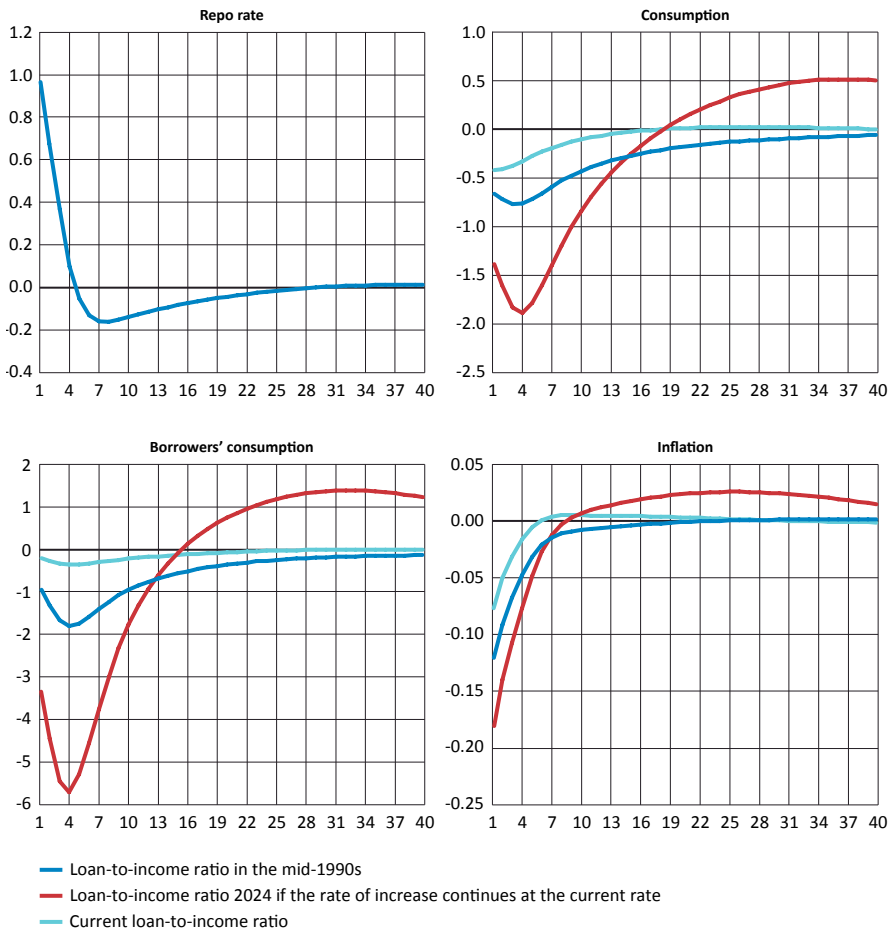
We can compare that case with what the effects on consumption and inflation would be had the loan-to-income ratio instead been at the same level as when the inflation target was introduced in the mid-1990s, i.e. around 90 per cent. In this case, the effect on consumption will, as expected, be smaller, and in particular the effect on the borrowers' consumption will be much smaller. Their consumption only drops by a couple of tenths of a percentage point. The effect on inflation is also smaller, although the difference is relatively small.

In the third case we assume a loan-to-income ratio of 210 per cent. That level could be reached within 10 years if the loan-to-income ratio continues to increase at the current rate from today's level. With that debt level, the effects of a rate hike on consumption would be much greater. For example, an interest rate that is one percentage point higher could lead to a drop in borrowers' consumption of almost 6 per cent. The impact on inflation would also be greater.

These calculations provide an indication of the importance of the household loan-to-income ratio on the transmission mechanism of monetary policy. The higher the loan-to-income ratio, the greater the share of borrowers' income that will be spent on interest payments and consumption of housing services, and the lower the amount that can be spent on consuming goods.

Figure 8. Effects of hiking the repo rate at different loan-to-income ratios
Deviations from long-term levels in per cent, in percentage points
(repo rate, inflation) and per cent (consumption)

Loan-to-income ratio in the mid-1990s
Loan-to-income ratio 2024 if the rate of increase continues at the current rate
Current loan-to-income ratio

Source: Own calculations

8 Concluding remarks

We have shown that, over time, household debt could be reduced by tightening different macroprudential tools and reducing the tax relief on mortgage interest. This would also lead to a redistribution of resources from lenders to borrowers. This redistribution effect is contrary to the conventional wisdom according to which macroprudential measures are negative for borrowers. Forlati and Lambertini (2014) describe similar findings. They study the effects of the new loan contracts with lower down payments and lower amortisation requirements that came into use in the US in the latter half of the 1990s. In their model, easier access to credit pushes borrowers to borrow more and demand more housing services, without considering the impact of their behaviour on housing prices. In the aggregate the resulting higher housing demand will push-up house prices. As a result, borrowers will have to cut down their consumption and work more, thereby reducing their welfare in the long term.

We have also shown that a reduction in the tax relief on mortgage interest affects households in different ways, depending on how the Government chooses to use the money instead. If it compensates the borrowers, such a measure can be positive for their consumption other than housing. Hence, those that may be hurt financially of a reduction in the tax relief could be compensated with other transfers.

A caveat of our analysis is that we disregard the impact of household debt on the risk of entering a financial crisis. The main purpose of macroprudential policy is indeed to prevent financial crises, and that is also important from a macroeconomic perspective. This is however something we cannot quantify in the model we have used.

Another conclusion from the analysis is, not surprisingly, that the different measures have implications for monetary policy that can go in different directions and are affected by the extent of mobility on the housing market. Using the model, we have also illustrated how the level of household debt affects the impact of monetary policy on the rest of the economy.

A limitation in this study is that we have disregarded foreign trade and possibilities of cross-border transactions. The results in Chen and Columba (2016), however, show that this does not affect the results to any considerable extent in a model similar to ours. They also analyse the effects of various macroprudential measures on household debt, and their findings are in line with ours.

The National Institute of Economic Research (2016) has recently conducted a study to assess the macroeconomic impact of introducing a loan-to-income cap. Assuming that all borrowers borrow up to the limit, they conclude that the

introduction of the new policy will lead to a decrease in the household loan-to-income ratio by 11-14 percentage points after 10 years while nominal GDP will be 0.1-1.7 per cent lower, and the price level measured by the CPIF 0.1-0.7 per cent lower. According to our model, real GDP declines by 0.4 per cent in the long term.

Another study that looks at how household debt is affected by macroprudential and fiscal policies, i.e. a property tax and tax relief on mortgage interest – is Alpanda and Zubairy (2016). Their model is calibrated on US data and has a relatively detailed description of the mortgage market, but lacks a banking sector which intermediates funds between lenders and borrowers. According to their analysis, the most efficient policy is reducing the mortgage interest duduction, followed by tightening the loan-to-value cap and introducing a property tax.

In our macro model, we make the simplified assumption that borrowers are always limited by a loan restriction. Both Hull (2015) and Svensson (2016) diverge from that assumption and study effects of amortisation requirements using – in some regards – more detailed models of the loan contracts. Hull (2015) studies the amortisation requirement introduced by Finansinspektionen on 1 June 2016. In his model, besides amortisation requirements, households must also meet a debt service ratio cap. The analysis is conducted in an "overlapping generation model" with 60 generations, in which the loan contracts of the household sector are largely consistent with the actual design of loan contracts in Sweden with Swedish-style mortgage contracts. According to Hull's analysis, amortisation requirements lead to somewhat smaller effects than in our model (the household loan-to-income ratio decreases by just over 2 percentage points at most), because the households can optimally choose to regularly renegotiate their loans.

According to Svensson (2016) household debt could, on the contrary, increase rather than decrease if an amortisation requirement is introduced. This is because households can choose the same savings as without amortisation requirements by borrowing more initially, investing the surplus in a savings account and then making withdrawals at the rate required to meet the amortisation requirement. The average debt will therefore be higher than without amortisation requirements. A crucial assumption in Svensson's analysis is that mortgages are not limited at the same time by loan-to-value caps, loan-to-income caps or other factors that prevent borrowers from financing their amortisations with loans, such as the cost of renegotiating loans.

Just like in the theoretical literature, the empirical literature contains a high degree of uncertainty about which effects various macroprudential tools have. Guibourg et al. (2015) summarise the findings of some important empirical studies. Several of these studies show that both loan-to-value caps and loan-

to-income caps can be effective in preventing household mortgages from rising too quickly. Loan-to-value caps and loan-to-income caps also appear to be the macroprudential tools most used to reduce demand for credit, and often in combination with each other. Housing-related taxes such as property tax or tax relief on mortgage interest also have effects on mortgages. Housing-related taxes and loan-to-value caps also appear to have significant effects on house prices.

In this study, we have quantified by how much different macroprudential policies and mortgage interest deductions have to be tightened in order to attain a certain effect on the loan-to-income ratio. The macroeconomic effects of these different measures will be fairly equal for the population on average, but differ between borrowers and lenders.

References

Alpanda, Sami and Sarah Zubairy (2016), "Addressing household indebtedness: monetary, fiscal or macroprudential policy?", revised Bank of Canada Working Paper no. 2014-58.

Chen, Jiaqian and Francesco Columba (2016), "Macroprudential and monetary policy interactions in a DSGE model for Sweden", IMF Working Paper 16/74.

Emanuelsson, Robert (2015), "Supply of housing in Sweden", *Economic Review*, 2015:2, Sveriges Riksbank, pp. 47-73.

Emanuelsson, Robert, Ola Melander and Johan Molin (2015), "Financial risks in the household sector", *Economic Commentaries*, no. 6.

Englund, Peter (2016), "More neutral capital taxation: Distribution effects of limited tax relief on mortgage interest" [*En mer neutral kapitalbeskattning: Fördelningseffekter av begränsade ränteavdrag]*, Report for the Swedish Fiscal Policy Council 2016/3.

Finansinspektionen (2015), "The Swedish mortgage market 2015", report from 14 April 2015.

Finansinspektionen (2016), "The Swedish mortgage market", report from 14 April 2016.

Finocchiaro, Daria, Magnus Jonsson, Christian Nilsson and Ingvar Strid (2016), "Macroeconomic costs of deleveraging", mimeo, Sveriges Riksbank.

Forlati, Chiara and Luisa Lambertini (2014), "Mortgage amortization and welfare", École Polytechnique Fédérale de Lausanne Working Paper.

Gerali, Andrea, Stefano Neri, Luca Sessa and Federico M. Signoretti (2010), "Credit and banking in a DSGE model of the euro area", *Journal of Money, Credit and Banking*, vol. 42, pp. 107-141.

Guibourg, Gabriela, Magnus Jonsson, Björn Lagerwall and Christian Nilsson (2015), "Macroprudential policy – effects on the economy and the interaction with monetary policy", *Economic Review*, 2015:2, Sveriges Riksbank, pp. 29-46.

Hull, Isaiah (2015), "Amortization requirements and household indebtedness: an application to Swedish-style mortgages", Working Paper 298, Sveriges Riksbank.

Iacoviello, Matteo (2005), "House prices, borrowing constraints, and monetary policy in the business cycle", *American Economic Review*, vol. 95(3), pp. 739-764.

National Institute of Economic Research (2016), "Short-term macroeconomic effects of credit-limiting macroprudential measures" *[Kortsiktiga makroekonomiska effekter av kreditbegränsande makrotillsynsåtgärder]*, Occasional study no. 50, May.

Kydland, Finn, Peter Rupert and Roman Sustek (2016), "Housing dynamics over the business cycle", *International Economic Review,* to be published.

Svensson, Lars E. O. (2016), "Amortization requirements may increase household debt: a simple example", IMF Working Paper 16/83.

Sveriges Riksbank (2014), Monetary Policy Report, July 2014.

Sveriges Riksbank (2015), Monetary Policy Report, September 2015.

Sveriges Riksbank (2016), Financial Stability Report 2016:1.