

Memorandum

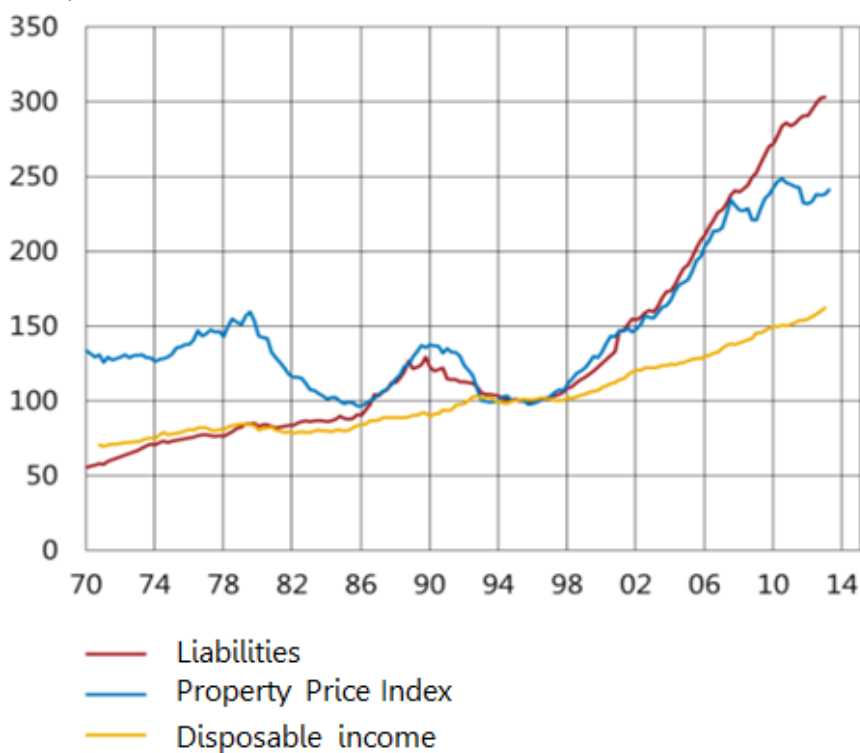
DATE: 27 January 2014

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Jakob Winstrand

■ Appendix, Memo 6 - Diagrams and appendices

Diagram 1. Real debt, house prices and disposable incomes in Sweden

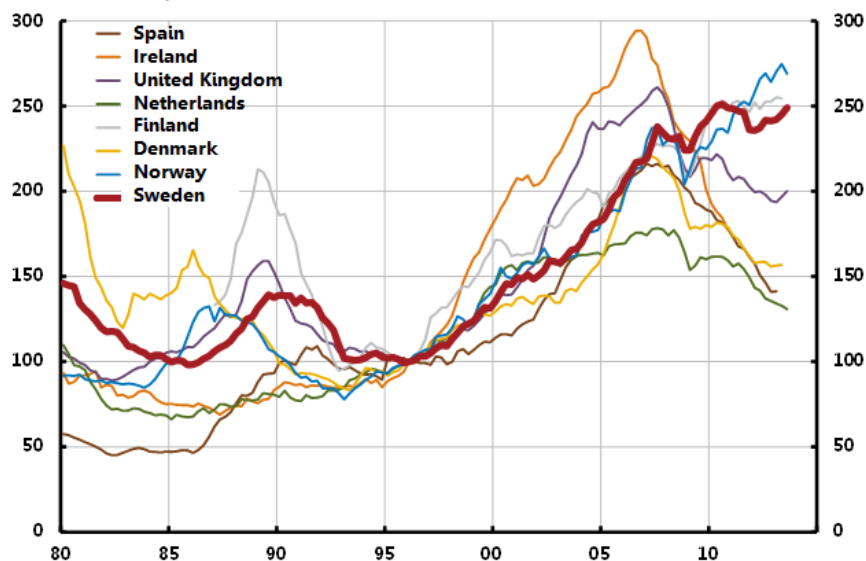
Index, 1995 = 100



Note. The series have been deflated using the CPI.
Source: Statistics Sweden

Diagram 2. Real house prices in various countries

Index, 1996 Q1 = 100

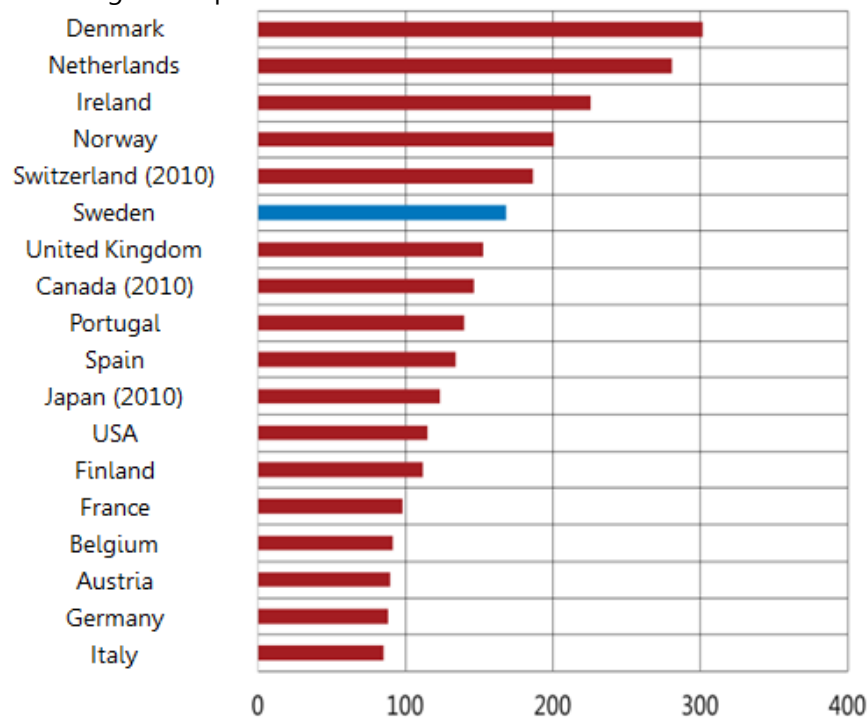


Note. The series have been deflated using the CPI.

Sources: Statistics Sweden and the Riksbank

Diagram 3. Household debts in various countries, 2011

Percentage of disposable income

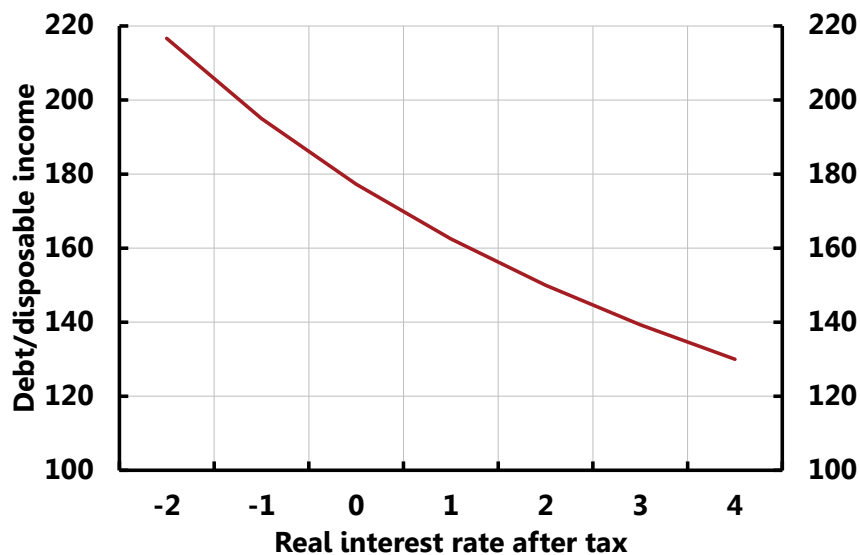


Note. The data for Japan, Canada and Switzerland is from 2010.

Source: OECD

■ **Diagram 4. Relation between long-term debt ratio and real interest rate after tax in a user-cost approach**

Per cent

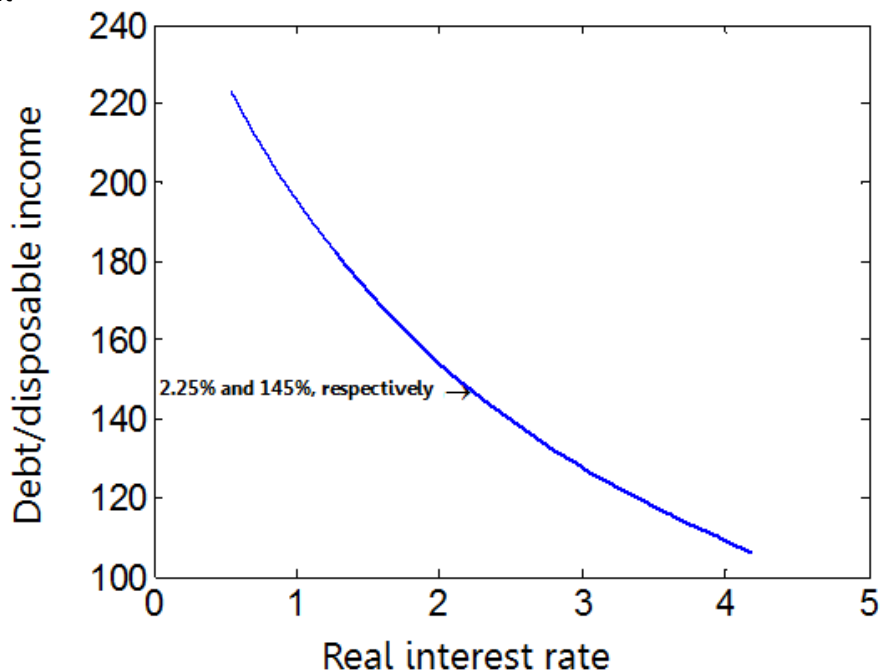


Sources: The Riksbank

Note. In the calculations, $m + \Omega = 0.11$ has been used.

Diagram 5. Relation between long-term debt ratio and real interest rate in a general equilibrium model

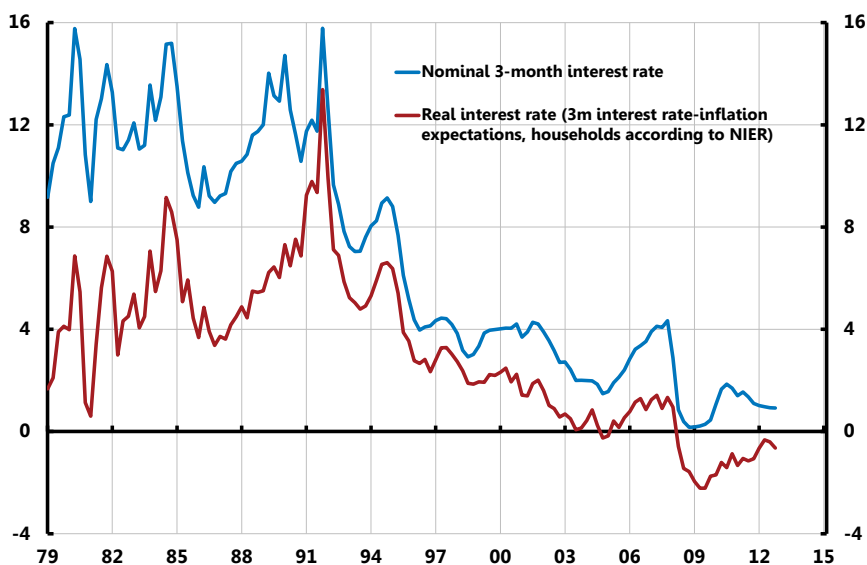
Per cent



Source: The Riksbank

Diagram 6. Nominal and real short-term interest rates

Per cent

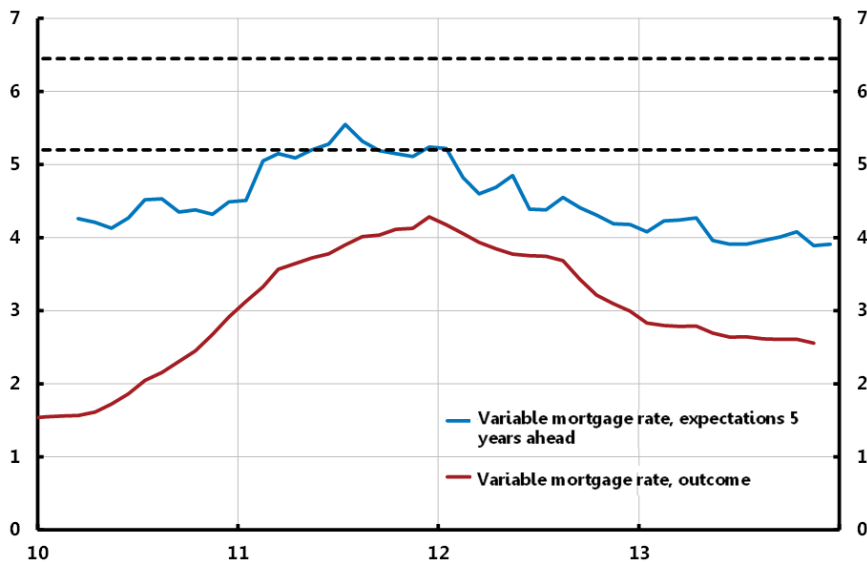


Sources: Statistics Sweden and the Riksbank

Note. The interest rate pertains to a three-month treasury bill.

Diagram 7. Interest-rate expectations among households regarding variable mortgage rate 5 years ahead in time

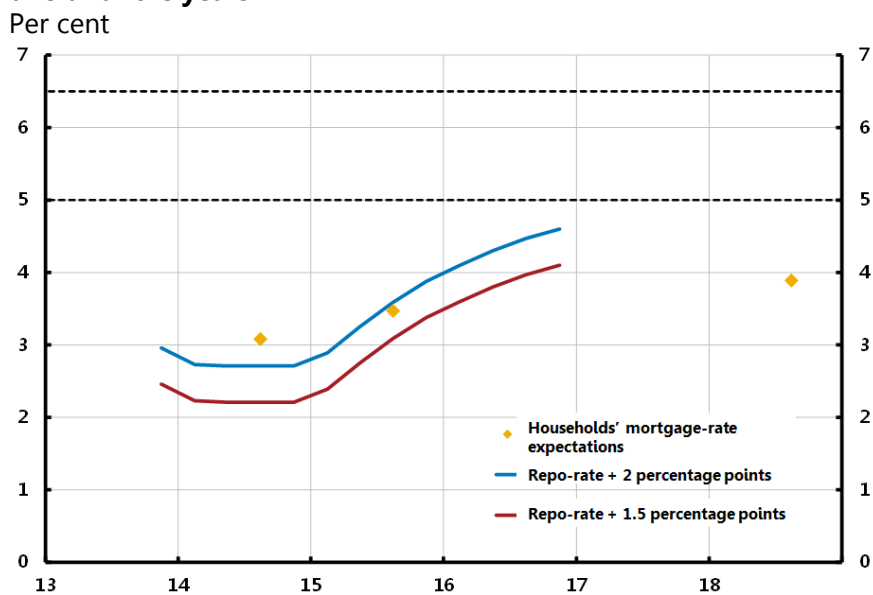
Per cent



Sources: National Institute of Economic Research and Statistics Sweden.

Note. The dashed lines show an interval for the long-term level of the variable mortgage rate. This interval is based, firstly, on an interval of 3.5-4.5 per cent for the long-term repo rate and, secondly, on an interval of 1.7 to 2 percentage points for the difference between a three-month mortgage rate and the repo rate.

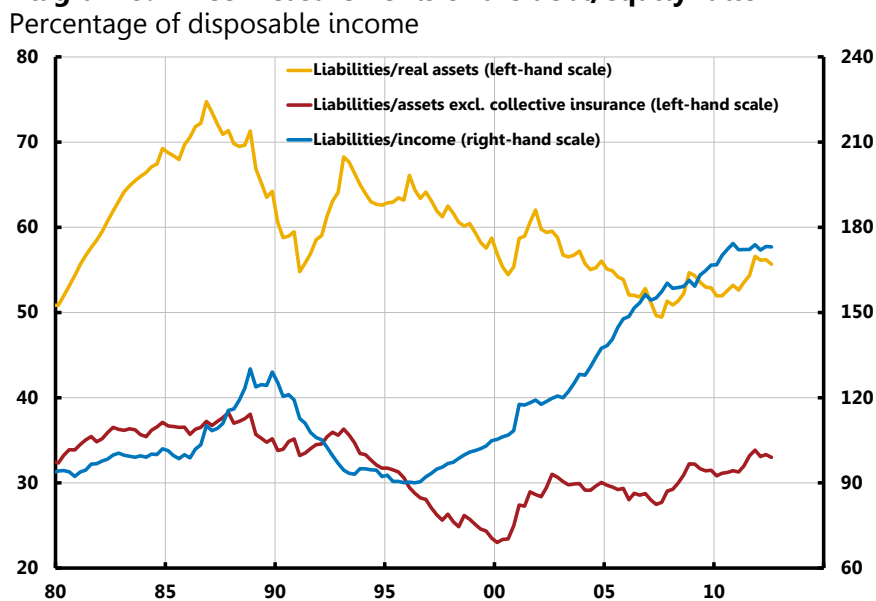
Diagram 8. Mortgage-rate expectations of households in a perspective of one, two and five years



Sources: National Institute of Economic Research and the Riksbank

Note. Repo rate forecast is from MPR October. The mortgage-rate expectations of households pertain to expectations concerning the variable mortgage rate. The dashed lines show an interval that is based, firstly, on an interval of 3.5-4.5 per cent for the long-term interest rate and, secondly, on an interval of 1.7 to 2 percentage points for the difference between a three-month mortgage rate and the repo rate.

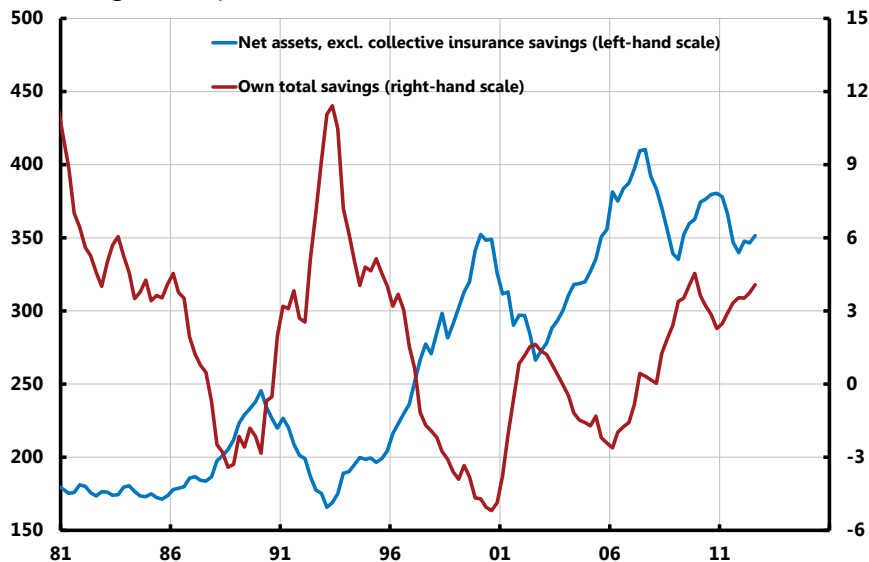
Diagram 9. Three measurements of the debt/equity ratio



Sources: Statistics Sweden and the Riksbank

■ **Diagram 10. Own savings and net assets (excluding collective insurance savings)**

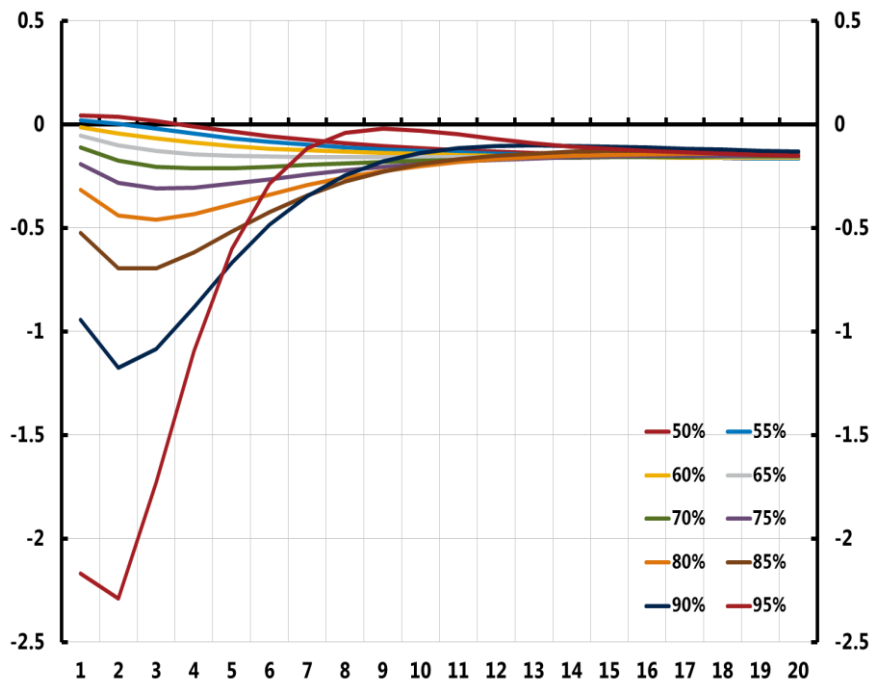
Percentage of disposable income



Sources: Statistics Sweden and the Riksbank

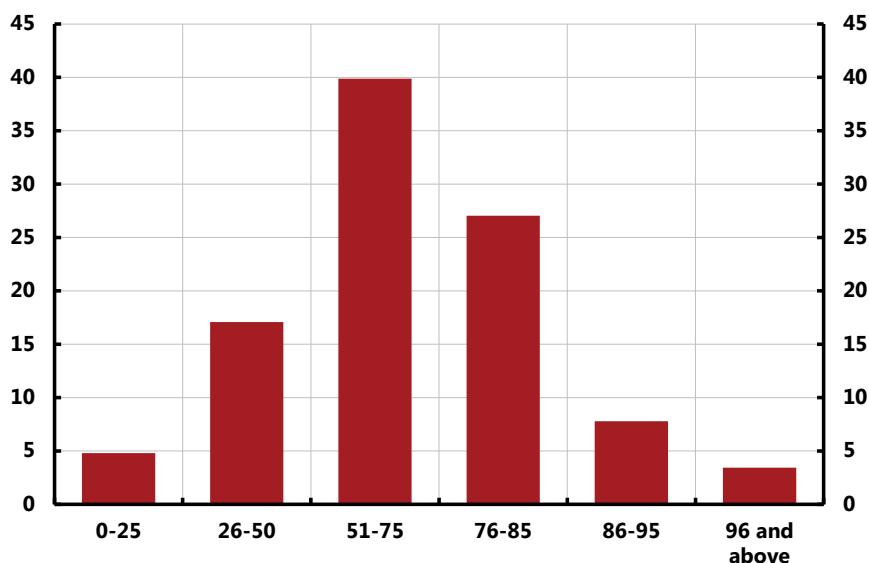
Diagram 11. Effects on household consumption of a decline in housing prices at various LTV requirements/LTV ratios.

Percentage deviation from long-term equilibrium



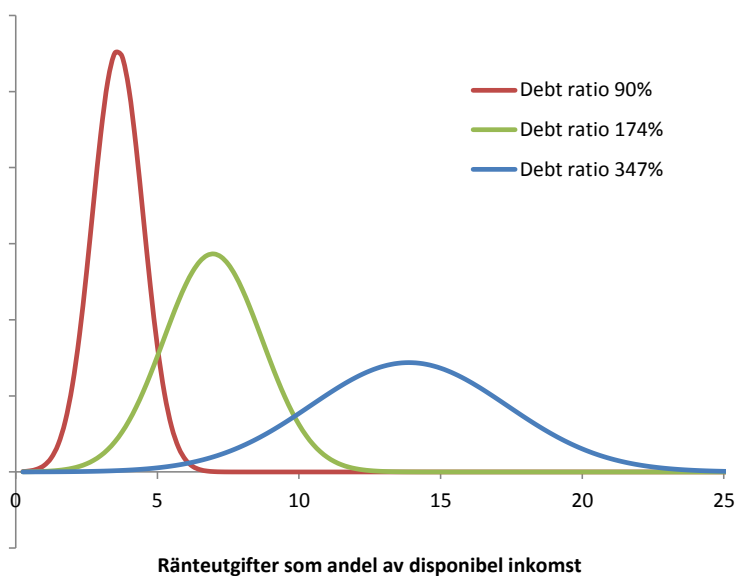
Source: The Riksbank

■ **Diagram 12. Breakdown of loan-to-value ratio among existing mortgages.**
Per cent of households with different loan-to-value ratios



Source: The Riksbank and the banks' own data.

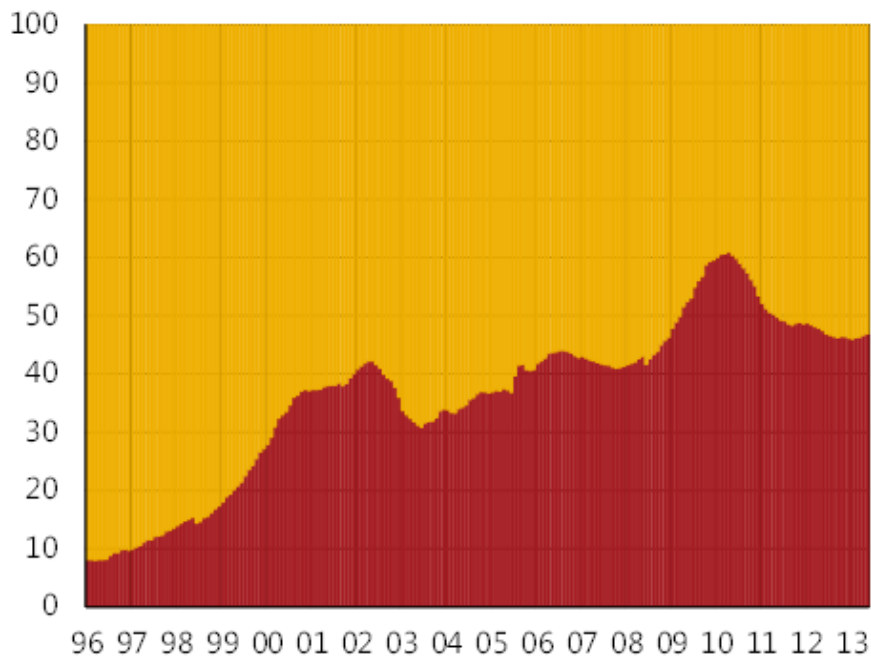
Diagram 13. Breakdown of interest expenses as a percentage of disposable income in connection with changes in the interest rate



Source: The Riksbank and Statistics Sweden.

■ **Diagram 14. Proportion of mortgages in Sweden with variable and fixed rates of interest**

Per cent



■ Variable

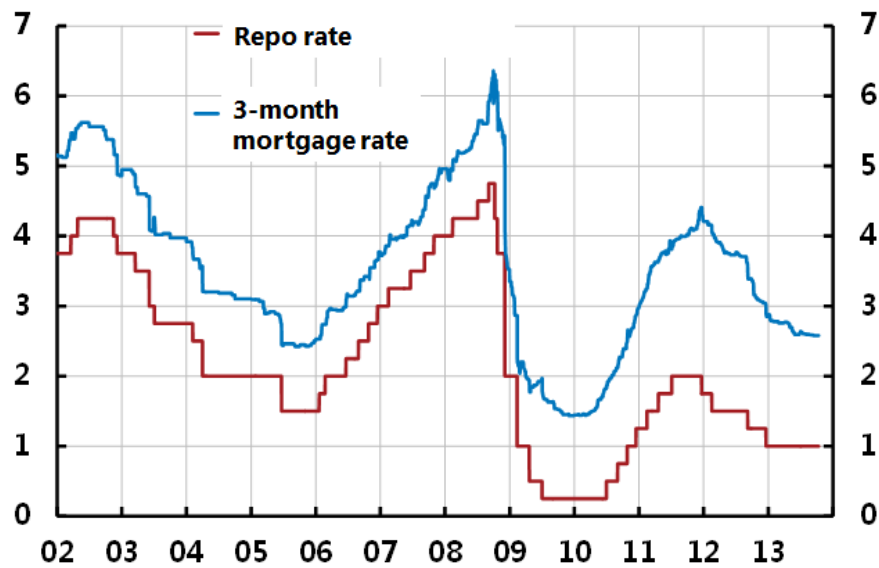
■ Fixed

Source: Statistics Sweden

Note. Based on the lending of mortgage institutions

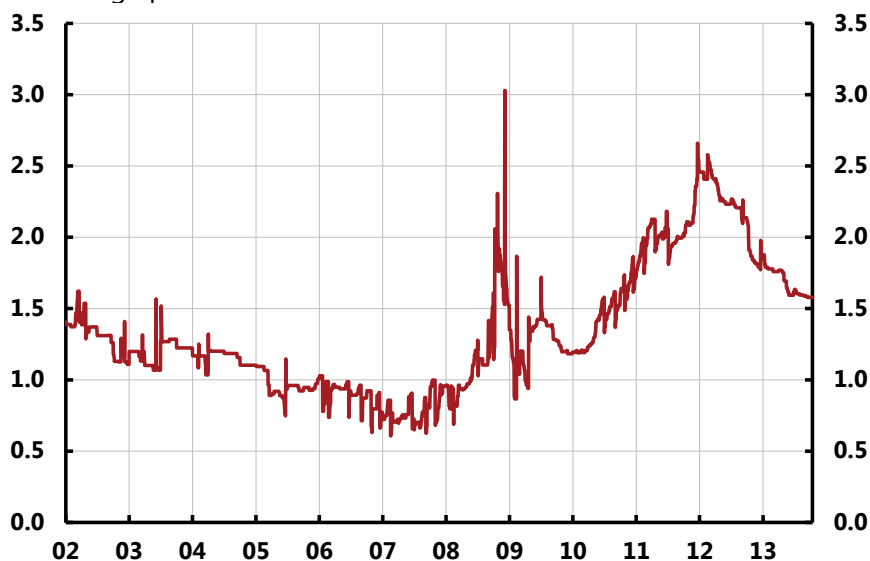
Diagram 15a. 3-month mortgage rate and repo rate

Per cent



Source: Reuters EcoWin and the Riksbank

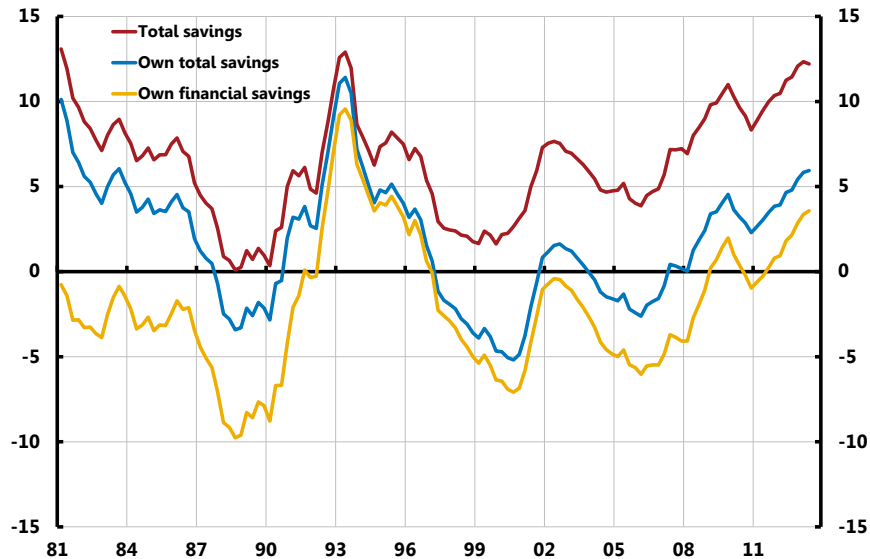
■ **Diagram 15b Difference between the 3-month mortgage rate and the repo rate**
Percentage points



Source: Reuters EcoWin and the Riksbank

Diagram 16. Household savings in Sweden

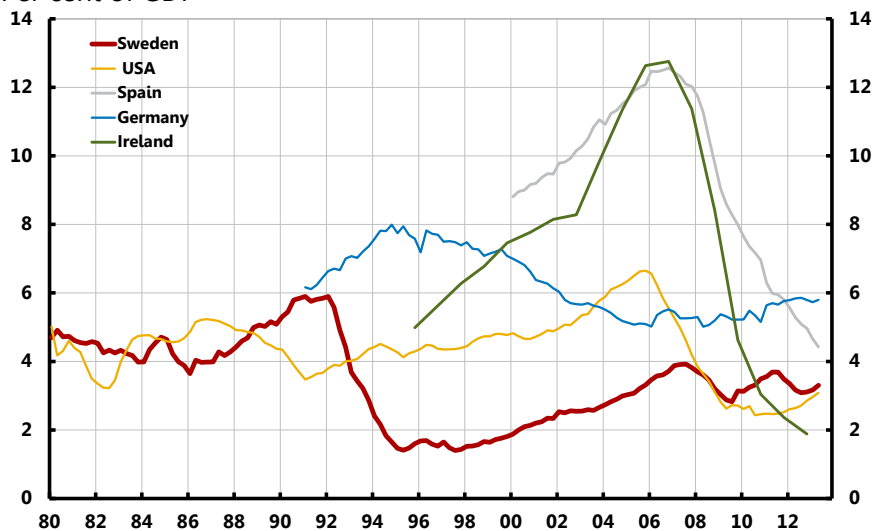
Percentage of disposable income



Note. Own total savings does not include collective insurance savings, but does include real savings. Own financial balance is defined as total savings excluding collective and real savings.
Sources: Statistics Sweden and the Riksbank

Diagram 17. Residential investments in various countries

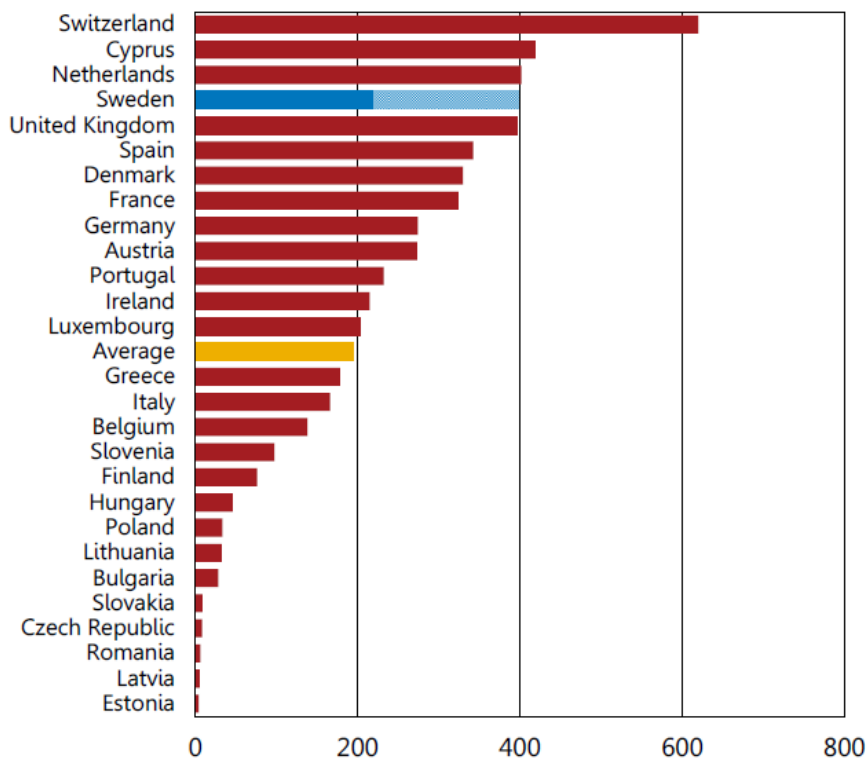
Per cent of GDP



Source: National sources and Statistics Sweden

Diagram 18. The banks' assets in relation to GDP, December 2012

Per cent

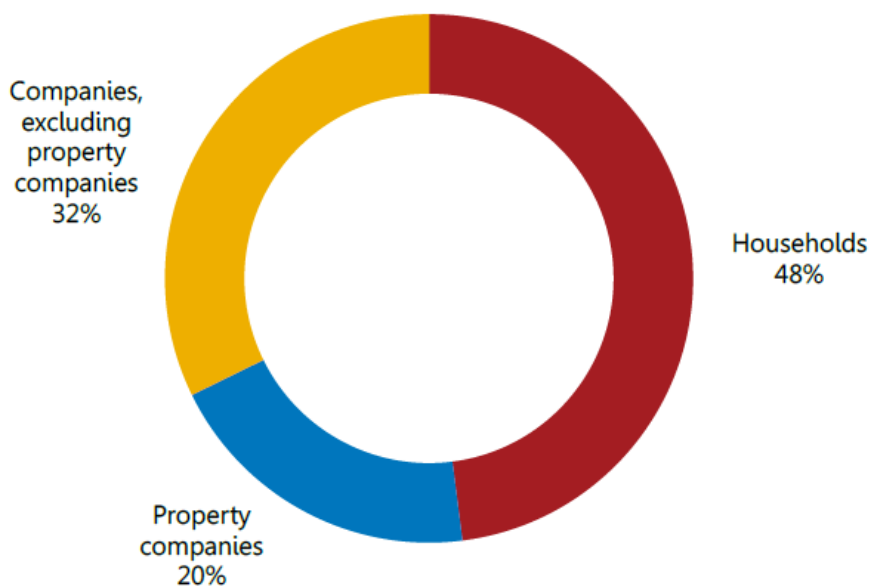


■ The major Swedish banks' foreign operations

Note. Bank assets include all of the assets of the country's banking groups, meaning their assets both in and outside the country. The shaded part of the blue bar shows the overseas assets of the four major Swedish banks in relation to Sweden's GDP.

Sources: ECB, the European Commission, Swiss Banking and the Riksbank

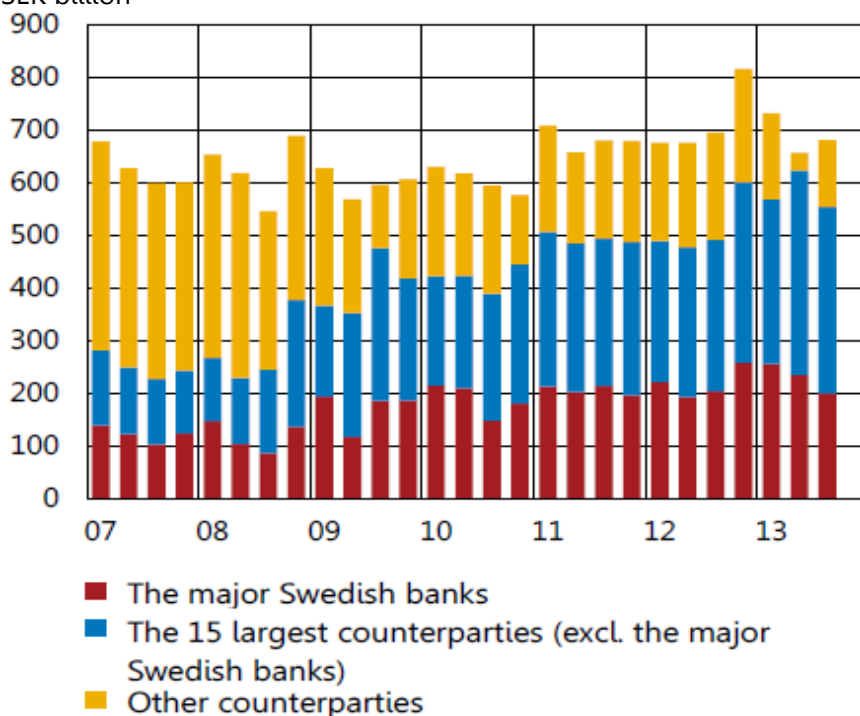
■ **Diagram 19. The major Swedish banks' lending broken down by borrower category, September 2013**
Per cent



Note. Including interbank lending and excluding repos.
Sources: The banks' income statements and the Riksbank

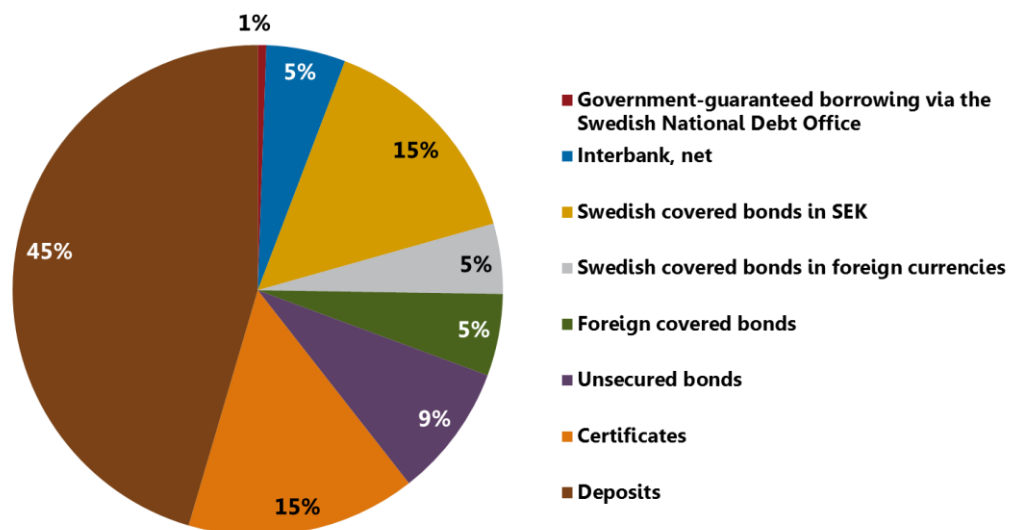
Diagram 20. The major banks' counterparty exposures through securities holdings

SEK billion



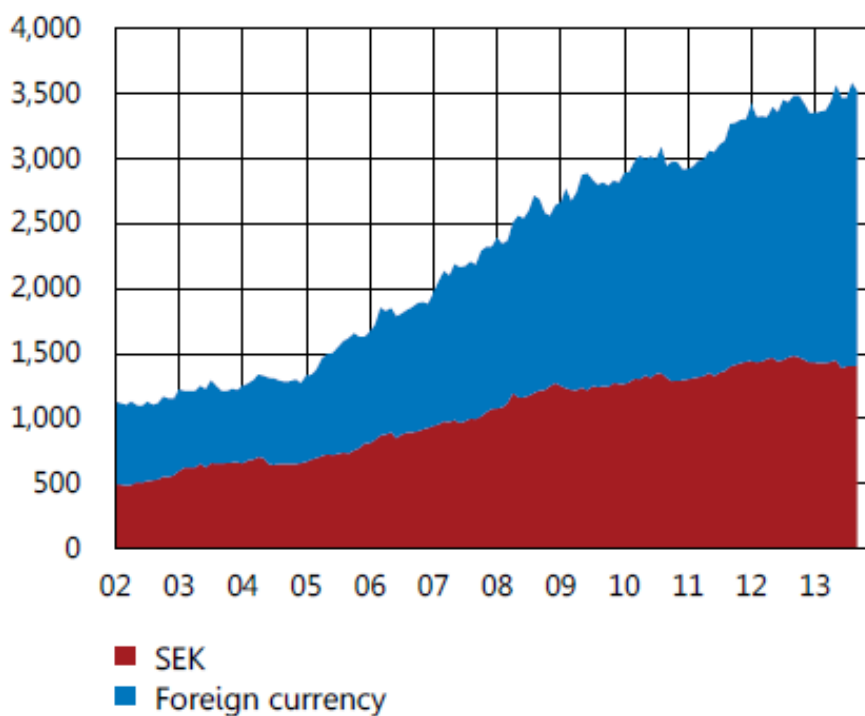
Note. The diagram shows the major banks' total securities holdings broken down on the basis of the party that has issued the securities.
Source: The Riksbank

■ **Diagram 21. Funding of the major Swedish banks, March 2012**
Per cent



Note. The major banks' funding amounts to approximately SEK 8,300 billion.
Sources: Banks reports and the Riksbank

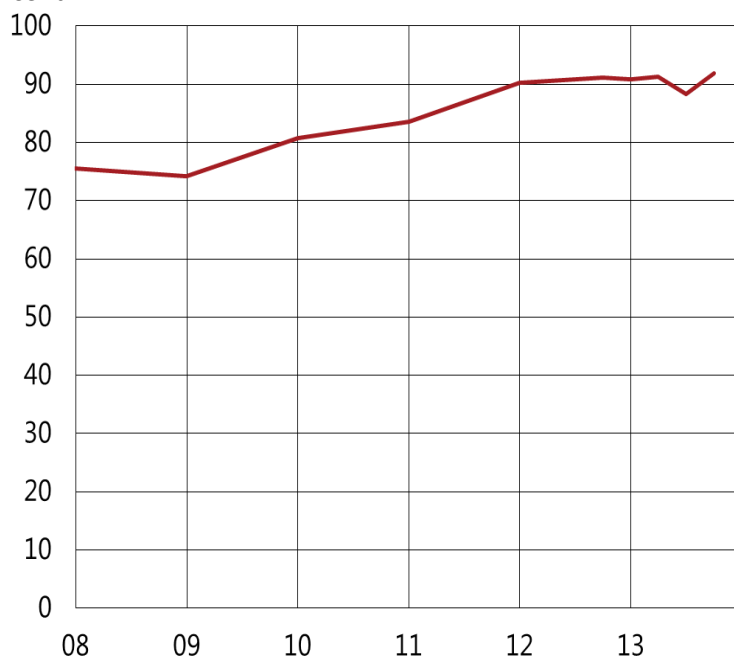
Diagram 22. Market funding via Swedish parent companies and subsidiaries
SEK billion



Sources: Statistics Sweden and the Riksbank

■ **Diagram 23. The major banks' results from the Riksbank's structural liquidity measure**

Per cent



Note. Pertains to an average for the Swedish major banks. For a comprehensive description of the Riksbank's structural liquidity ratios, see the Riksbank (2010).

Sources: Liquidatum and the Riksbank

Diagram 24. Equity in relation to total assets, Swedish banks

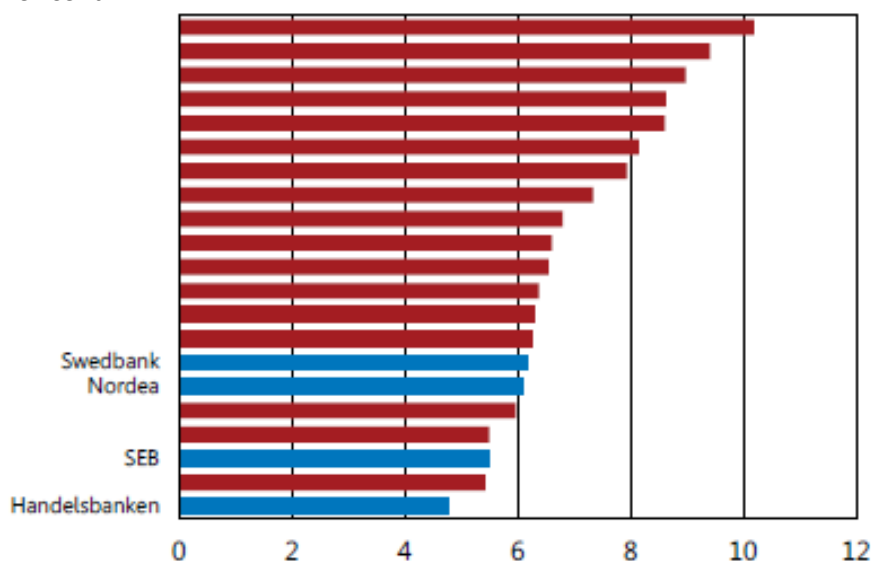
Per cent



Sources: Hortlund (2005) and the Riksbank

Diagram 25. Equity in relation to total assets, June 2013

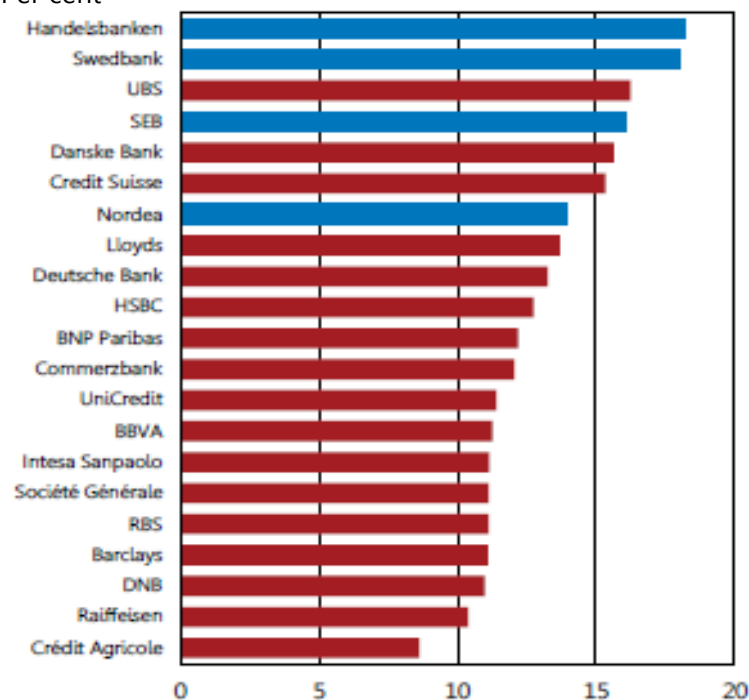
Per cent



Note. The ratios pertain to the equity of Swedish banks (blue bars) and a selection of European banks (red bars) in relation to their total assets reduced by reverse repos, derivative instruments and insurance assets. This ratio is not to be confused with the Basel Committee's leverage ratio. Source: Liquidatum and the Riksbank

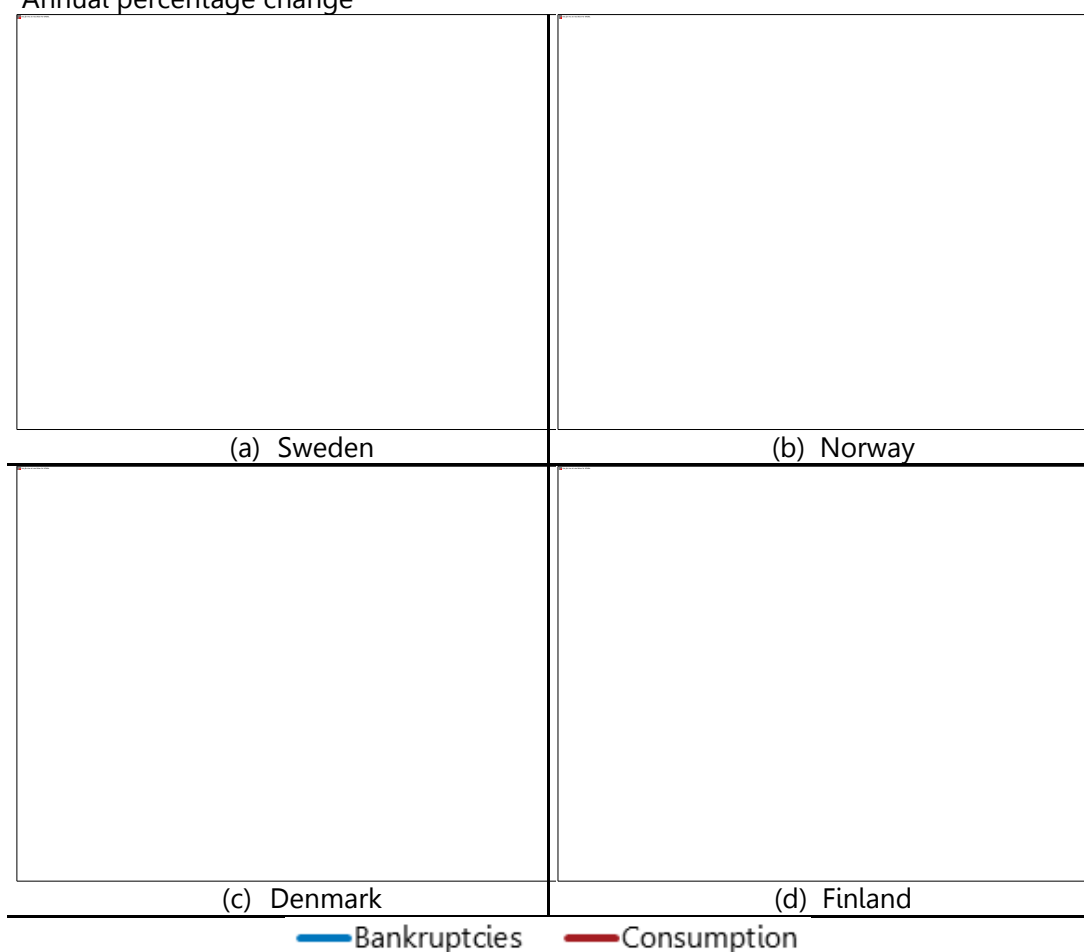
Diagram 26. Core Tier 1 capital according to Basel II, June 2013

Per cent



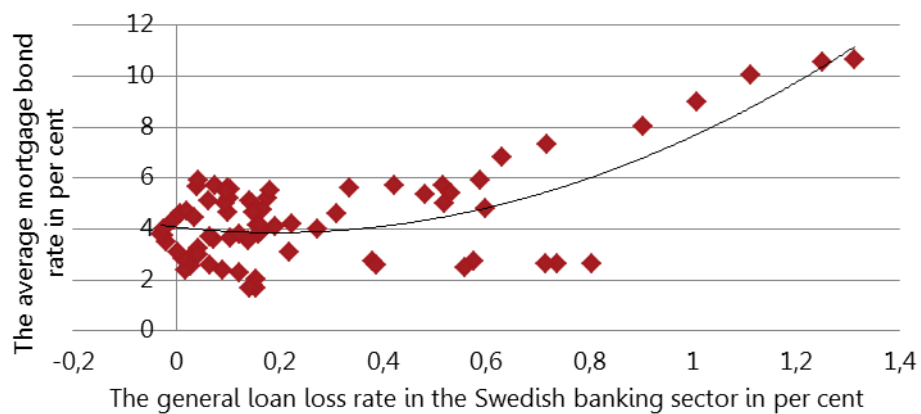
Sources: SNL Financial and the Riksbank

■ **Diagram 27. Degree of bankruptcy and consumption in the Nordic countries**
Annual percentage change



Note. The annual percentage change in the number of bankruptcies is calculated on the basis of an index in which 100 is the average number of bankruptcies per capita over a ten-year period (2002-2012). Consumption is shown on the right axis.
Sources: The Riksbank and Reuters EcoWin

Diagram 28. Correlation between the average mortgage bond rate and the general loan loss rate in the Swedish banking sector.

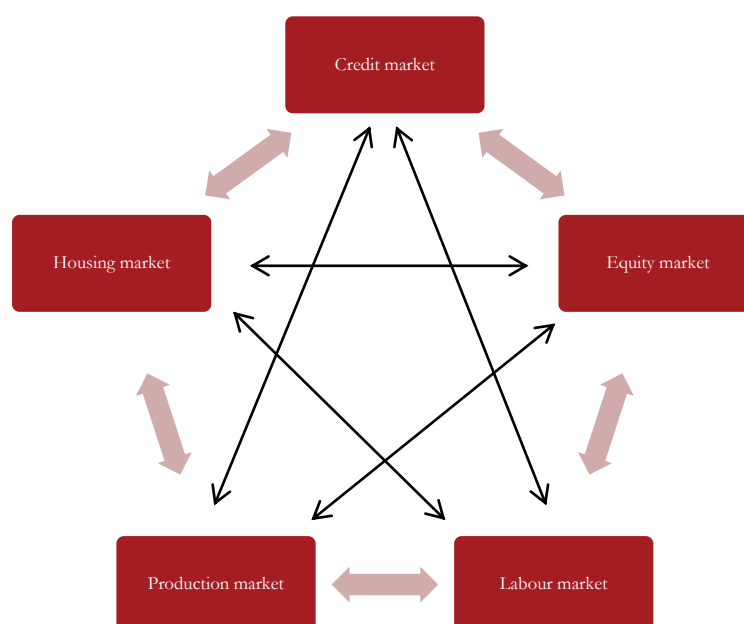


Note. The average mortgage bond rate per quarter for all maturities (Handelsbanken Markets' mortgage index for all maturities). Data pertains to the period 1995 Q1 – 2013 Q2.
Sources: The Riksbank and Reuters EcoWin

Appendix 1. A non-technical summary the model's components

The IceAce model features a large number of economic agents such as households, production companies, construction companies and banks. The model also includes an equity market in the form of a mutual fund, a government and a central bank. Since the model is agent-based, no driving equilibrium is assumed (although it is probable that such a state exists). Instead, the economy is examined on the basis of how a network of submarkets (which affect each other) is affected by individual agents' interactions. The behaviours of the individual agents are based on microeconomic theory and on empirical observations. This enables an investigation of how the various submarkets work together in a complex adaptive system. A schematic illustration of the links between the IceAce model's submarkets is presented in Figure 1 below.

Figure 1. Schematic illustration of the IceAce model



In the model, the two types of companies (production and construction) both use labour and capital in the production process. The production technology is of the Leontief type. The companies acquire labour from the households in a decentralised labour market in which wages are determined by market conditions and the companies can employ and dismiss labour as necessary.

The households use their earned income to buy a homogeneous product that is manufactured by the production companies. Consumption is determined in accordance with the households' budgets and is modelled on the basis of the "buffer-stock saving" theory (Caroll, 2001; Deaton, 1992). As a result, household consumption is dependent on a precautionary saving motive, which is determined on the basis of a specific aim of the households to have liquid assets in relation to income. It is also assumed that household consumption varies in line with the households' wealth. This wealth effect is assumed to be such that consumption rises by 7 per cent of the increase in wealth, in accordance with the empirical correlation of Calomiris et al. 2012. The households can also choose to invest in newly produced housing units (one unit may be interpreted as one square metre of living area)

■ produced by the construction companies. These housing units can then be bought and sold freely in the housing market.

Banks offer loans to both the companies and households at an interest rate for businesses and a mortgage rate, respectively. These interest rates are a function of the key policy rate determined by the central bank. The banks also take care of any savings in the form of deposits from households and companies, and the banks are permitted to borrow from the central bank if they need liquidity. The banks are also forced to keep capital based on a capital adequacy rate determined by the government (in the model, this is assumed to be 8 per cent of the value of the bank's loans to businesses and households). The companies are permitted to roll over their loans for an indefinite period of time while mortgages are subject to a variable interest rate and have to be repaid over a period of 40 years.

The central bank decides the key policy rate, which is determined in accordance with a Taylor rule that takes into account prevailing rates of inflation and unemployment. The central bank also provides a standing facility to the banks and acts as a lender to the government when required. The model also includes collective unemployment insurance and transfers between households are paid for by the state, which finances the transfers by means of a tax on income from both employment and capital. The government is assumed to work towards a surplus target (not a deficit) and varies the tax rate to achieve this aim. The mutual fund is assumed to own all of the shares in businesses and banks, whereby any surplus resulting in a dividend accrues to the fund. The shares in the fund are evenly distributed among the households and the fund pays the dividends to the households. The mutual fund also acts as a market financier should the businesses require capital in connection with credit tightening by the banks. In such a case, the market financing activities comprise unpaid dividends.

To arrive at results that are more relevant to Swedish circumstances, the simulations have been adapted to Swedish conditions by having the credit market dominated by four major banks and by adapting the initial start values in the model to the prevailing economic climate. The initial policy rate has been set at one per cent and the interest rate on business loans and mortgages has been adapted to the actual interest rates on lending (Financial Market Statistics, June 2013).

However, because the price level in the housing market has not been adapted to Swedish conditions, the model results in a higher debt ratio in an initial phase. In the simulations, it is assumed that there is a mortgage prepayment requirement (from the banks), at the same time as the simulations are based on generous lending terms. This is because a household, in order to qualify as an acceptable customer, can be approved for a loan principal that generates a quarterly cost (given the prevailing interest-rate conditions and mortgage prepayment rate) that corresponds to a full 40 per cent of the households' disposable income. As a result, the model can easily be used to study the effect of a loan-to-income requirement, which is also studied by Erlingsson et al. 2013.¹

The simulations show that the price of housing declines in connection with a sudden surplus of supply (see diagram A.1). Such a surplus arises during an economic downturn which is, in turn, due to the interaction between household consumption and residential construction. The simulations also show that the bankruptcy rate rises sharply during the economic downturns that coincide with a decline in housing prices

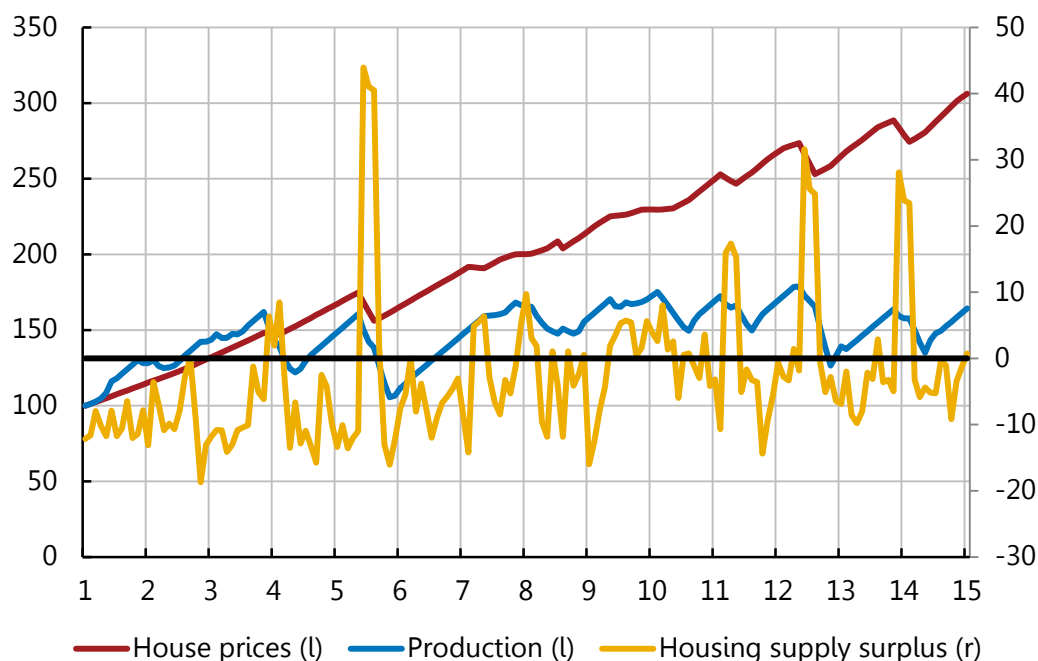
¹ Among the results found by Erlingsson et al. is that a more generous lending policy leads to growth increasing in the short term but also to the economy becoming less stable. Accordingly, a tighter lending policy results in the economy more rarely ending up in a major recession and the authors argue that a balance has to be found between an exceptionally stable economy generating low growth and an exceptionally credit-driven economy subject to substantial oscillations in GDP.

- (see Diagram A.2). The reason for this is that the decline in housing prices reduces the households' inclination to consume, through a wealth effect, and this leads to an additional decline in economic conditions, resulting in an increase in corporate bankruptcies. In the artificial economy, however, the value of the housing stock grows, at the same time as the households only save a small portion in liquid assets. However, the mortgage prepayment requirement results in a steady decline in debts, as a percentage of disposable income, throughout the simulated period (15 years). Accordingly, the debt ratio declined during the simulations.

Diagram A.1. House prices, production and housing supply surplus

Index, 100 = year 1

Per cent



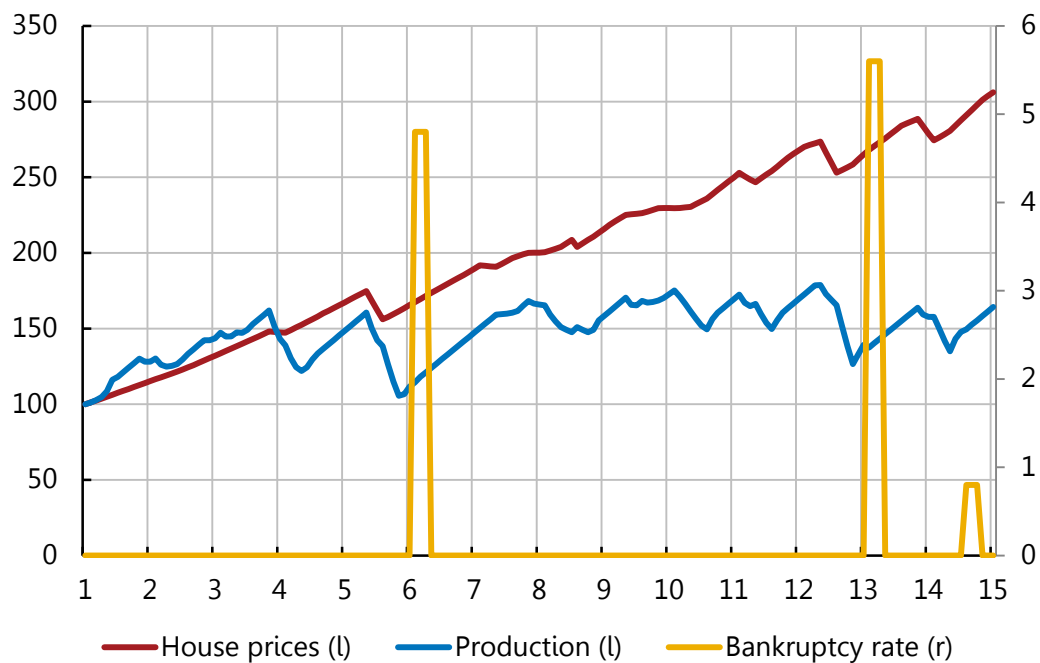
Note. The housing supply surplus is expressed as the number of housing units that are not demanded by households as a percentage total demand.

Source: The Riksbank

■ **Diagram A.2. House prices, production and corporate bankruptcy rate**

Index, 100 = year 1

Per cent



Source: The Riksbank

Appendix 2. Correlation between consumption and the number of corporate bankruptcies

In this appendix, the correlation between consumption and bankruptcies is examined. This is done by first approximating the increase in the bankruptcy rate with the indexed bankruptcy rate, as defined above. Subsequently, we examine how a decrease in consumption, measured as the annual rate of change, affects the rate of increase in bankruptcies. To avoid the problem of unit roots, data is used in a differentiated form and we study whether the quarterly change in annual consumption growth has a Granger causality effect on the quarterly rate of change in the annual growth in the number of bankruptcies and vice versa. Since we have a panel of countries, panel data is estimated using VAR models and the Granger causality effect is studied within the framework of this model.

In Table A.1 below, the results of the test are reported, whereby one significant result indicates that the variable is Granger-affected in the direction shown by the arrow.

Table A.1. Granger causality test (Walds χ^2) given estimated panel data VAR models with five lags (fixed effects).

		χ^2
Nordic region (1996[Q1]-2013[Q1])	Consumption $_{t-\tau}$ \rightarrow Bankruptcies $_t$	27.11***
	Bankruptcies $_{t-\tau}$ \rightarrow Consumption $_t$	18.34***
Nordic region, Germany, France and South Korea (1996[Q1]-2013-[Q1])	Consumption $_{t-\tau}$ \rightarrow Bankruptcies $_t$	110.83***
	Bankruptcies $_{t-\tau}$ \rightarrow Consumption $_t$	22.19***
Balanced panel of all countries in the study excl. South Africa ^a (2003[Q1]-2013[Q1])	Consumption $_{t-\tau}$ \rightarrow Bankruptcies $_t$	12.89**
	Bankruptcies $_{t-\tau}$ \rightarrow Consumption $_t$	30.34***
South Africa ^b (2008[Q1]-2013[Q1])	Consumption $_{t-\tau}$ \rightarrow Bankruptcies $_t$	12.87***
	Bankruptcies $_{t-\tau}$ \rightarrow Consumption $_t$	3.09

Significance codes: ***:1%, **:5%, *:10%

a: Nordic region, Germany, France, Spain, South Korea, Hong Kong, Japan, Malaysia, England and Wales

b: Due to the short series, this model is estimated using only two lags.

The results indicate that there is a Granger causal correlation between the bankruptcy rate and consumption, whereby consumption tends to have a Granger causality effect on the bankruptcy rate. This applies to all countries apart from South Africa.