# An index for financial conditions in Sweden

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Understanding financial conditions is important for a central bank as it is primarily via the financial markets that monetary policy can affect the economy. In this article, we construct an index that captures the overall financial conditions in Sweden. The index is aggregated with the assistance of principal component analysis and is based on twelve financial variables. Together, they give an overall view of how financial conditions, related to real economy developments, have developed in Sweden. The analysis shows that the index captures both events on the financial markets and historical economic fluctuations relatively well and that it has been an early indicator indicator of GDP development. Another conclusion is that the index includes information that complements other early indicators that are usually used to make forecasts for GDP in the short term, for example the Purchasing Managers' Index and the Economic Tendency Survey.

## 1 Why does the Riksbank monitor financial conditions?

Developments on the financial markets are an important component of the Riksbank's analysis and it is primarily via various financial channels that the Riksbank can affect the economy with the assistance of its monetary policy. Financial conditions are also affected by many other factors. Consequently, it is important for a central bank to understand the interplay of monetary policy, financial conditions and the real economy.

A central bank's monetary policy affects the economy through several different channels. One important channel lies through various interest rates in the economy, both interest rates determined on financial markets and interest rates faced by households and companies, for example interest rates for mortgages. The Riksbank's most important instrument for governing these interest rates is the repo rate. When the repo rate is raised, both market rates and final interest rates for households and companies usually rise.[1] When interest rates rise, households and companies face higher borrowing costs, which leads them to consume and invest less. Another channel is through lending in the economy. In Sweden, it is primarily the Swedish banks that grant credit to households and companies. Various types of uncertainty and risk in the economy also affect the financial conditions. Of course, this very much applies to risks and vulnerabilities in the financial system. If the risks increase and the banks' access to funding becomes impaired, this may lead the banks to raise their lending rates and reduce their lending, which, in turn, reduces consumption and investments.[2]

Monetary policy also affects various asset prices, which, in turn, affect the willingness and ability of households and companies to consume or invest. If the repo rate is raised and

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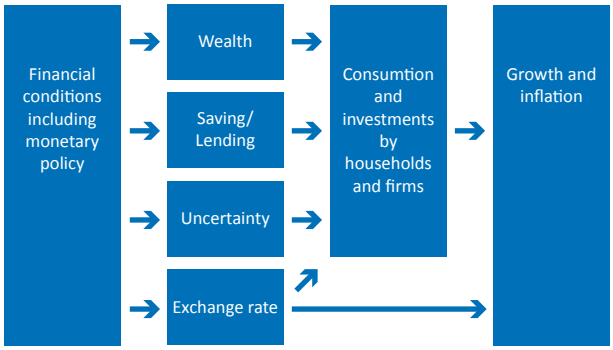
1 For a more detailed description of the framework for the implementation of monetary policy, see, for example, Nessén, Sellin and Å. Sommar (2011).

2 See, for example, Bomfim, D. and Soares (2014) and Basel Committee on Banking Supervision (2012).

prices for assets such as housing or equities become subdued or fall, the value of households or companies' assets will also become subdued or fall. If these assets also form collateral for loans, the lenders may tighten collateral requirements or make the loan conditions for the household or company less favourable. Increased uncertainty in the form of large price fluctuations on the financial markets may also lead to precautionary saving among households and companies, which reduces consumption and investments.[3]

The development of the Swedish krona primarily affects Swedish companies with large amounts of exports. If the Riksbank raises the repo rate, the krona will get stronger, making it more expensive for foreign customers to purchase goods and services from Sweden, which will restrain demand. There is also a direct link between the krona and inflation, as a stronger krona makes it cheaper to import from abroad, leading to lower inflation. Monetary policy and other factors affecting financial conditions thus affect households and companies through several different channels and have a close connection to the development of the real economy (see Figure 1).

**Figure 1. The link between financial markets and the real economy**




Note. This is a simplified figure and only shows the schematic link between financial markets and the real economy.

The connection between the development of the financial markets and the real economy has been particularly substantial in the last decade. This can be seen first in the shape of the financial crisis that paralysed the global economy in 2008 and then in the subsequent debt crisis in the euro area. At the same time, the complexity of the financial markets has increased and different financial markets are becoming increasingly interconnected, both via financial instruments and between different countries. This means that the financial conditions need to be analysed more broadly so as, for example, to capture different contagion effects.[4] Central banks and various participants have therefore had to modify several of the economic models used to make forecasts for the economy. This applies, for example, to models that have previously only used a short interest rate to capture the monetary policy transmission mechanism and financial conditions.[5]

In this article, we construct an index to capture the development of the financial conditions, based on information from various financial channels. The index includes a broad spectrum of financial variables, with the aim being the creation of a quantitative measure that may have several areas of use. For example, a central bank may need to make an overall assessment of how the financial conditions have developed between two monetary policy meetings. Many financial variables are available in real time and are usually measured at a high frequency. Events affecting both the financial markets and the real economy can, therefore, be observed at an early stage on the financial markets and can contribute towards predicting economic developments. The aim of creating an index is to avoid capturing

3 See, for example Hopkins, Linde and Söderström (2009).
4 Noyer (2007), Singh, Razi, Endut and Ramlee (2008).
5 Angelopoulou, Balfoussia and Gibson (2013).

temporary movements in individual variables and, instead, to attempt to capture those overall trends on the financial markets that we also judge affect the real economy.

The index includes twelve financial variables that are aggregated with the assistance of principal component analysis. The method is not based on a structural description of the economy. Instead, the weights of the financial variables included are based solely on historical correlations in which the weights are determined by covariation between the financial variables. In such a framework, it can be difficult to separate exogenous financial shocks from endogenous events that depend on monetary policy and the development of the real economy, as these can mutually affect each other. But, by including a broad spectrum of financial variables, we can capture both movements derived from monetary policy and those arising exogenously on the financial markets, for example after a shock on a specific market. In the analysis, monetary policy is deemed to make a significant contribution to the financial conditions and therefore the repo rate, among other such factors, is included as a variable in our index. But other variables in the index will also be affected in the event, for example, of an interest rate adjustment. To further capture the effects of monetary policy on the financial conditions, it would also have been desirable to be able to include a measure of the Riksbank's repo rate path in the index, but this is not possible as the Riksbank did not start to publish its repo rate path until 2007.

Our analysis shows that the index manages to capture historical economic fluctuations relatively well and that this has been an early indicator for the development of GDP. The ability to forecast GDP also improves when we aggregate different financial variables, compared with when we only use individual variables. In addition to this, our results indicate that the index includes information that complements other early indicators that are usually used to make forecasts for GDP in the short term, for example the Purchasing Managers' Index and the Economic Tendency Survey.

# 2 Background

## 2.1 A broader analysis of the financial conditions is needed

Studies of the monetary policy transmission mechanism have a long history. One early study is Friedman and Schwartz (1963), who identified monetary policy shocks in the United States and estimated their effects on the real economy. But econometric models used to make forecasts of real variables or to study the effects of shocks include, in most cases, only one monetary policy interest rate. This is probably not sufficient to capture the interaction between the financial conditions and the real economy as the complexity of the financial markets has increased. Neither is it sufficient in periods of disruption on the financial markets.

There has consequently been some interest in creating broader measures of the financial conditions. The Bank of Canada is one of the pioneers in this area and presented, in the mid-1990s, what is known as a Monetary Conditions Index (MCI), which is an aggregate of the policy rate and the exchange rate.[6] In the latter part of the 1990s, this index was extended to include more financial variables, at which point it started to be called the Financial Conditions Index (FCI).[7]

In the 21st century, banks and international institutions started to create their own indices for financial conditions. Consequently, there are today a number of established indices that are used by private agents, institutions and central banks. Some examples are Goldman Sachs, Deutsche Bank, OECD, IMF, ECB and Chicago Fed.[8]

6 Freedman (1994).
7 Hatzius, Hooper, Mishkin, Schoenholtz and Watson (2010).
8 Dudley and Hatzius (2000), Hooper, Mayer and Slok (2007), Guichard and Turner (2008), Swiston (2008), Angelopoulou, Balfoussia and Gibson (2013), Brave and Butter (2011).

Over the years, a number of different methods have been developed to construct an index and to determine which variables should be included. The literature describes two main empirical methods.[9] The first method involves constructing an index with the assistance of principal component analysis, with the aim of attempting to capture the common variation in a large number of financial variables. The second method is based on an aggregate index in which the weights are determined in the basis of the different variables' relative effects on, for example, GDP or inflation. In this article, we use the first method, which is to say principal component analysis.

Since 2011, the Riksbank has used an index that measures financial stress in Sweden and just recently also constructed an early warning indicator of fragility in the financial system.[10] The index that measures financial stress is used as a tool for analysing the development on financial markets and financial stability. However, the index differs from the index we present here both in terms of its aim and of how it is constructed. The index for financial stress is primarily used to identify disruptions that can damage the financial markets' ability to efficiently fulfil their role as intermediary between borrower and lender or buyer and seller. This is done by studying measures of risk of various types. A clear indicator of financial stress is when different risk measures are highly correlated with each other. Instead, in this article, we attempt to create a financial index that captures the overall financial conditions to give a comprehensive view of the development of the financial markets, related to real economy developments. Such an index could also include various measures of risk, but is also based on other financial variables. In Figure A1 in the appendix, we show how the two indices differ markedly. However, it can be seen that periods of less favourable financial conditions usually coincide with period of increased financial stress. The early warning indicator of financial fragility is in turn designed to give a numerical assessment of the build-up of systemic fragility in the credit sector of the economy.

# 3 An index for financial conditions in Sweden

In this paragraph, we start by describing the empirical method we have used to aggregate a large number of different financial variables. We discuss which financial variables should be included in an index for financial conditions in Sweden and evaluate their connection with the real economy. We then study the index's development and analyse how it has moved in various periods. We also examine more closely which variables have had the greatest effect on the index's development.

## 3.1 Aggregating financial variables with principal component analysis

One way of constructing an aggregate index for financial conditions is to use principal component analysis.[11] This is a statistical method that captures the common variation in a set of variables and identifies different patterns in the data. In this way, the number of variables can be condensed into a smaller number of components that capture the common variation in the variables. The components can be arranged according to their information content and the first components are normally enough to capture the primary driving forces in the relevant data set.

The advantage of principal component analysis is that the construction does not require a structural model in which we would have to make various assumptions to estimate the weights of the different variables. The disadvantage is that it is difficult to make a direct economic interpretation of the index. According to the construction, the index only captures

9 Hatzius, Hooper, Mishkin, Schoenholtz and Watson (2010).
10 For more information, see Johansson and Bonthron (2013) and Giordani, Spector and Zhang (2017).
11 Angelopoulou, Balfoussia and Gibson (2013).

the shared variation in the financial variables and thus does not necessarily have any connection to the development of GDP, for example. But many studies nevertheless show that an aggregate index of financial variables would have a better forecasting ability for GDP in the short term compared with models that only include lagged values of GDP or individual financial variables.[12] The weights for the variables in those components included in the index can also be examined to identify the forces driving the development of the index. We do this in the next section.

## 3.2 Financial variables that can be included

There exist a large number of variables that, in various ways, capture the financial conditions and the selection of variables differs from study to study and from country to country. Our aim is to create a relatively broad index that captures different parts of the financial channels in Sweden. We therefore divide the financial variables into the following groups: asset prices, volumes, interest rate differentials and measures of risk.

### 3.2.1 Asset prices

In financial theory, it is often assumed that participants on financial markets are forward-looking, which means that all available information should be reflected in the asset price. The theory thus says that, if the financial markets are functioning perfectly and no frictions are present, the price of various financial instruments should suffice to completely describe the financial conditions.[13] A higher price for a financial asset is interpreted to mean that the financial conditions are more expansionary. The relationship between price and rate is such that, when the price of an interest-bearing asset rises, the expected yield on the asset decreases and the rate falls. This makes it easier for households and companies to borrow and consume more. Commonly-occurring variables included in different studies are interest rates with various maturities, stock market movements and the exchange rate.[14] Housing prices are also included in many studies as housing usually forms collateral for loans.

### 3.2.2 Volumes

However, the financial markets do not always function perfectly and, occasionally, frictions arise. Consequently, particularly in periods of financial stress, we deem that the asset price does not fully reflect the financial conditions. For example, many studies show that variables that capture volumes or the availability of credit in the economy provide important information.[15] Examples of series that are usually used include lending to households and companies, issues of corporate bonds, various measures of credit terms in the economy and the money supply. For example, Swiston (2008) argues that the availability of credit according to surveys better captures the supply of credit than various measures of credit growth. Credit growth only reflects companies' external funding and demand for external funding tends to increase at the start of a downturn, when access to internal funding deteriorates.

### 3.2.3 Interest rate differentials

The difference in the rate between various types of asset may reflect both different maturities between asset types and different risk profiles such as credit and liquidity risks, for example. When a shock occurs on the financial markets, there is normally a rise in the risk premium that investors demand to hold higher-risk assets. An increase in the interest rate differential between safe and higher-risk assets thus reflects generally tighter financial

12 Hatzius, Hooper, Mishkin, Schoenholtz and Watson (2010).
13 Swiston (2008).
14 Angelopoulou, Balfoussia and Gibson (2013).
15 Swiston (2008), Hatzius, Hooper, Mishkin, Schoenholtz and Watson (2010).

conditions. For example, an increase of the interest rate differential between Stibor and a treasury bill with an equivalent maturity indicates a shock on the interbank market which means that the banks are demanding a higher interest rate when lending money to each other. A rising risk premium can also be captured by an increased interest rate differential between higher risk bonds, such as corporate and mortgage bonds, and safe bonds such as government bonds. A company would then need to pay a higher interest rate to borrow money on the bond market and thus the company's funding costs would rise.

Many studies also include variables that capture the slope of the yield curve, which is to say the difference between a government rate with a longer maturity and one with a shorter maturity.[16] A reduced interest rate differential may mean that the financial conditions are becoming more expansionary, as it is becoming cheaper to obtain funding over the long term. But the slope of the yield curve can also be seen as an indicator that captures the sentiment on the financial markets. According to the expectation hypothesis, longer-term rates are determined by expectations of the future short-term rate plus a term premium that investors usually demand due to the uncertainty surrounding how the rate may change over the long term. If sentiment on the financial markets deteriorates and more participants expect a downturn, the long-term interest rates should fall, as the short-term rate will be expected to eventually become lower. In turn, the short-term rate is steered to a greater extent by the central banks' policy rates and the market's expectations of monetary policy. The central bank does not necessarily have to cut its policy rate as soon as sentiment deteriorates. The central bank's actions also depend on how expansionary monetary policy is to start with. In recent years, many central banks have been restricted by their policy rates being close to what is considered to be a lower limit. Studies also show that, over short periods ahead of an economic slowdown, the yield curve can be inverted, which is to say that the shorter-term rates are higher than the long-term rates.[17] A lower interest rate differential between long-term and short-term rates can thus indicate lower future growth.

#### 3.2.4 Measures of risk

Other measures that can capture tensions on the financial markets include various measures of risk that measure the actual or expected volatility of pricing on various markets. Rising volatility on, for example, the stock or bond market is often a sign of increased uncertainty and stress on the financial markets. These measures can thereby be used to capture the overall risk sentiment on the financial markets.

## 3.3 Which variables should be included?

Many of the studies made of financial indices use data from the United States. Access to corresponding Swedish data is more limited, but our goal is to use similar variables as far as is possible and to include variables that capture the various financial channels. One purpose is to create an index that can be used to better understand the connection between the financial conditions and the real economy. Most studies that have been made of both central banks and other participants are aimed at trying to understand the development of GDP.[18] One way of selecting the variables that should be included in the index is thus to test the individual variables' covariation with the development of GDP.

One advantage of creating an index with the assistance of principal component analysis is that the number of variables does not need to be limited. Based on previous studies, we analyse a large number of financial variables and evaluate their ability to explain the development of the real economy.[19] We evaluate the coefficient of determination in a

16 Hatzius, Hooper, Mishkin, Schoenholtz and Watson (2010).
17 See, for example, Estrella and Hardouvelis (1991) and Rudebusch and Williams (2009).
18 See, for example, Dudley and Hatzius (2000), Hooper, Mayer and Slok (2007), Guichard and Turner (2008), Swiston (2008), Angelopoulou, Balfoussia and Gibson (2013), Brave and Butter (2011).
19 See, for example, Hatzius, Hooper, Mishkin, Schoenholtz and Watson (2010).

regression in which we attempt to explain the development of GDP two or four quarters ahead with the use of lagged values of GDP and lagged values of the financial variable (see equation 1).

(1) $$y_{t+h} - y_t = \beta_0 + \Sigma_{i=1}^{p_y} \beta_1 \Delta y_{t+1-i} + \Sigma_{i=i}^{p_x} \beta_2 x_{t+1-i} + e_{t+i}$$

The data included stretches from 1998 until the first six months of 2016. GDP is expressed as the logarithm of real GDP, in which $y_{t+h} - y_t$ shows the percentage change between quarter $t+h$, which is two or four quarters ahead, and the last quarter. $x_t$ indicates the financial variable and $p_y$ and $p_x$ indicates the number of lagged values of $\Delta y$ and $x$ that are included in the regression, which, in this study, is four. Among the financial variables are interest rates and survey data expressed in levels, while other variables refers to the first difference of the log transformed variables. The regression is estimated from quarterly data, and the coefficient of determination of the financial variables is evaluated using an F-test that jointly tests whether the coefficients for the financial variable are separated from zero. A p-value for the F-statistic close to zero indicates that we can reject the hypothesis that the coefficients for the financial variable is zero. This means that the financial variable improves the coefficient of determination for the development of GDP. In Table 1 below, we show the result for the variables we consider to be of greatest interest.

**Table 1. Evaluation of various financial variables' ability to predict GDP development**

| Variable | F-test* | |
|---|---|---|
| | h=2 | h=4 |
| Repo rate | 0.00 | 0.00 |
| Stibor 3 months | 0.00 | 0.00 |
| Stibor – T-bill, 3 months | 0.00 | 0.00 |
| Government bond yield, 5 years | 0.31 | 0.07 |
| Government bond yield, 10 years | 0.36 | 0.11 |
| Government bond yield, 10 years – Repo rate | 0.00 | 0.00 |
| Government bond yield Sweden – Germany, 2 years | 0.09 | 0.03 |
| Mortgage bond yield – Government bond yield, 5 years | 0.06 | 0.05 |
| Stock market, OMX Stockholm | 0.01 | 0.07 |
| Volatility Index, VIX | 0.06 | 0.18 |
| House prices, HOX-index | 0.00 | 0.00 |
| KIX-index | 0.54 | 0.70 |
| Lending to non financial companies | 0.06 | 0.01 |
| Lending to households | 0.18 | 0.17 |
| Money, M2 | 0.00 | 0.02 |
| Lending conditions, companies | 0.00 | 0.02 |

*The tabel shows p-values. A value less then 0.10 indicates that we can reject the null hypothesis that the coeficients are not significantly different from zero.

In the table, it can be seen that the development of most financial variables seems able to help explain the development of GDP. For many variables, the p-value is close to zero both two and four quarters ahead. The variables that stand out in the table and which do not seem to have any coefficient of determination for GDP development are mostly longer

government bond yields and KIX, which is a competition-weighted index for the krona exchange rate.

However, it seems reasonable to believe that the effects a specific shock would have on the economy would depend on its nature. For example, positive news on the development of the real economy would probably contribute towards a strengthening of the exchange rate at the same time as GDP would grow faster. On the other hand, an exogenous shock on the exchange rate causing only the krona to appreciate would probably lead to lower growth. The results shown in Table 1 thus need not mean that exogenous changes in long-term interest rates or the KIX index have no significance for the future development of GDP. In equation 1 above, we only include earlier values for the financial variables. When we also include simultaneous movements for the financial variables, the coefficient of determination improves in general (see Table A1 in the appendix). This indicates that GDP development also covaries with the financial conditions over the current quarter. In this test, the five-year government bond yield and the KIX index also seem to improve the coefficient of determination for GDP development.

The results shown in Table 1 form the basis for the financial variables that we have chosen to include in the index. Other important selection criteria include the data available over the entire period, the variables considered to be most important to the financial conditions according to economic theory and the manner in which the variables affect the composition of the index. Based on this, we have chosen to include, for example, both the five-year government bond yield and the KIX index, as they are central variables in the discussion of the financial conditions.

In Table 2, we have compiled the variables we include in the index. A more in-depth description of the data is available in Table A2 in the appendix. The financial markets usually move faster than the real economy and many variables become available on a daily basis. However, to capture more overall trends in the financial conditions, we have chosen to construct the index on a monthly basis. All variables have been normalised to ensure that the index is not affected by the measurement of the variables in different units. This means that the index is based on an average of the financial variables over the period we study and that the scale specifies the number of standard deviations by which the index deviates from the average. The variables are also transformed so that a higher value means that the financial conditions are becoming more expansionary. This means that we change the signs for interest rates and interest rate differentials, for example. This is to facilitate the interpretation of the weights in the index. However, the interest rate differential between the ten-year government bond yield and the repo rate is an exception, as our analysis shows that an increase in the interest-rate differential coincides with periods in which the financial conditions are becoming more expansionary. It is also worth noting that, as in other studies, we have chosen to use surveys for companies' credit terms instead of credit growth for companies, as these better capture the supply of credit.[20]

20 Swiston (2008), Hatzius, Hooper, Mishkin, Schoenholtz and Watson (2010).

**Table 2. Variables in the index**

| Variable |
|---|
| Repo rate |
| Stibor – T-bill, 3 months |
| Government bond yield, 5 years |
| Government bond yield, 10 years – Repo rate |
| Government bond yield Sweden – Germany, 2 years |
| Mortgage bond yield – Government bond yield, 5 years |
| Stock market, OMX Stockholm |
| Volatility Index, VIX |
| House prices, HOX-index |
| KIX-index |
| Lending to households |
| Lending conditions, companies |

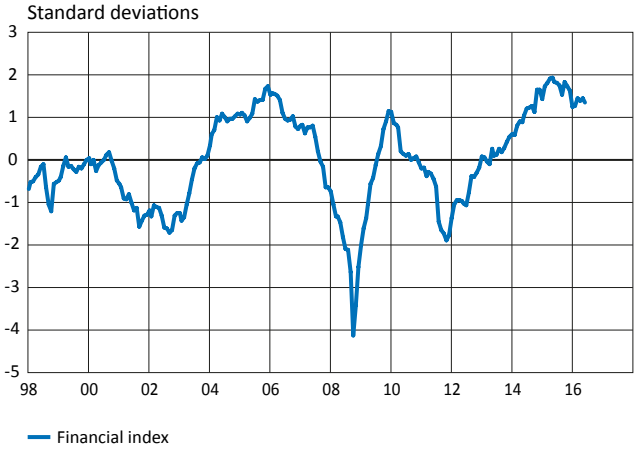
## 3.4 An index for financial conditions in Sweden

To aggregate the financial variables in Table 2 into an index, we use principal component analysis. Our goal is to find the primary driving forces in the data, at the same time as we wish to capture different parts of the financial conditions. This means that we have to strike a balance regarding how many components we will include, which is to say how large a part of the variation in the data set the index will be based on. As in other studies, we set the value at about 70 per cent.[21] In our data set, the first three components explain about 70 per cent of the total variation in the 12 financial variables we include. We therefore base the index on the first three components. The components are then weighted with the proportion of the total variation that each individual component can explain. The first component can explain about 32 percentage points of this variation. As we include the first three components that together explain 70 per cent of the total variation, the first component is given a weight corresponding to 32 per cent divided by 70 per cent. This means that the first component is given about half of the weight in the index.

Figure 2 shows the financial index on a monthly basis from January 1998 until May 2016. As the variables are normalised, the index measures the financial conditions in relation to the index's average over the period and deviations from zero are shown in the number of standard deviations. In general, we can note that there have been three cycles in the financial conditions in Sweden since the end of the 1990s. The downturns in the index coincide well with the IT crash at the start of the 21st century, the financial crisis of 2008-2009 and the debt crisis in the euro area in 2011-2012. Following these periods, there has been a clear recovery of the financial conditions. In the mid-2000s above all, we can see a relatively long period of expansionary financial conditions in the figure. The financial conditions have also been expansionary in recent years.

21 See, for example, Angelopoulou, Balfoussia and Gibson (2013).

**Figure 2. Financial index for Sweden**
Standard deviations




Sources: Thomson Reuters and Sveriges Riksbank

## 3.5 What is driving the development in the index?

To more closely study what is driving the index, we can study how much weight the different variables have in the principal components. Table 3 shows the weight of the different variables in the three components, as well as the aggregated total weight of the variable in the three components. The variables have been sorted into descending order on the basis of how large a proportion of the total variation they can explain.

**Table 3. The individual variables' weight in the three first principal components**

| Variable | PC 1 | PC 2 | PC 3 | Aggregated weight |
|---|---|---|---|---|
| Repo rate | 6.4 | 52.5 | 24.4 | 17.7 |
| Lending conditions, companies | 27.0 | 35.5 | -6.1 | 16.2 |
| Volatility Index, VIX | 34.0 | 26.9 | -13.8 | 15.4 |
| House prices, HOX-index | 43.4 | -5.4 | 12.0 | 14.3 |
| Government bond yield, 5 years | -8.3 | 52.8 | 26.0 | 13.3 |
| Stock market, OMX Stockholm | 33.4 | 21.1 | -17.9 | 13.3 |
| Government bond yield Sweden – Germany, 2 years | 20.3 | -9.6 | 60.8 | 12.5 |
| Stibor – T-bill, 3 months | 40.7 | -10.7 | -6.5 | 9.7 |
| Government bond yield, 10 years – Repo rate | 26.4 | 4.2 | -0.7 | 9.4 |
| Mortgage bond yield – Government bond yield, 5 years | 39.7 | -25.8 | -1.8 | 6.4 |
| KIX-index | -6.8 | -11.6 | 64.2 | 3.7 |
| Lending to households | 25.0 | -31.1 | 13.2 | 2.5 |
| **Share of total varians** | **32.1** | **23.5** | **13.5** | **69.1** |

A first stage is to look for patterns in the three components that reflect different influences in the data. Most variables have a relatively large weight in the first component. In total, it explains about 32 per cent of the variation in the entire data set. The variables that have the greatest weight in the first component are primarily various measures of risk, which is to say interest rate differentials between higher risk and safe assets, and variables that are linked to the stock market. Housing prices also have a relatively high weight. The second component explains a further 24 per cent of the variation in the data set. In this component, various interest rates stand out. Both the repo rate and the five-year government bond yield

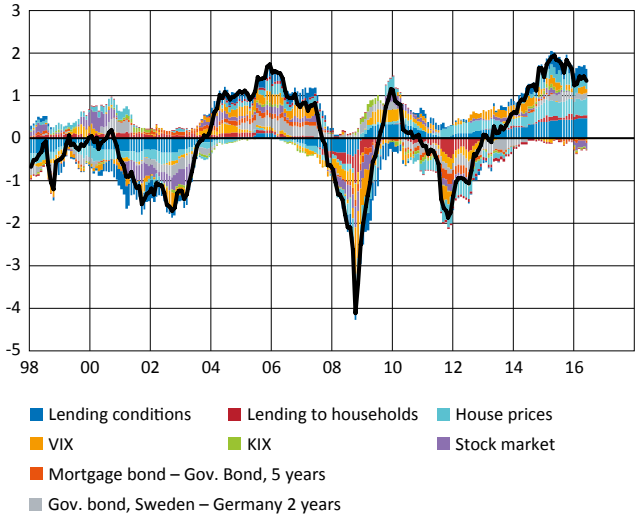
have high weights. Finally, the third component explains about 14 per cent of the variation. In this component, above all the KIX index and the interest rate differential between Sweden and Germany have high weights. As we have discussed above, we deem that the Riksbank's monetary policy affects several financial variables. But the analysis of the components shows that the direct effect of monetary policy is most substantial in the second and third components, while the first component to a greater extent reflects the overall development of the financial markets.[22]

The aggregate weight of the different variables is shown in the final column of Table 3. Many variables have about the same weight in the index, which indicates that most variables are important for the development of the index. On the other hand, lending to households, the KIX index and the interest rate differential between a five-year housing bond and a government bond have little weight in the index. One conclusion is that these variables probably follow another pattern than many of the others. However, we deem that the variables still contain valuable information and may be particularly important during certain periods. For example, the Riksbank has placed relatively heavy emphasis on the development of the krona in recent years to cause inflation to rise towards target. The development of the krona has therefore been important for the financial condition in recent years.

## 3.6 A closer analysis of the development of the index

Another way of analysing the contribution made by the different variables is to study how they have contributed towards the development of the index over time. Figure 3 shows the financial index together with the contribution made by the different variables. It provides an indication of which variables have been important over different periods. As we described above, the principal components capture the common variation in the financial variables and the weight of each variable is thereby affected, to a certain extent, by which variables we include. It is also important to remember that the weights for the different variables are based on historical correlations.

**Figure 3. Index for financial conditions in Sweden and contributions from the different variables**
Standard deviations




Sources: Thomson Reuters and Sveriges Riksbank

As we describe in the introduction to this article, it is difficult to separate the effects of monetary policy from other financial shocks and several variables are affected when, for example, the Riksbank raises or cuts the repo rate. We have therefore chosen to include

22 See Figure A2 in the appendix for the development of the individual components.

monetary policy as a part of the financial conditions. The repo rate is also the variable that is given the greatest weight in the index. To study the role of monetary policy in the financial conditions, we also use the repo rate as the basis of our analysis of how individual variables have affected the index.

The dark blue columns in Figure 3 illustrate the contribution made by the repo rate. The figure also shows that the repo rate has been relatively important over the entire period and that monetary policy, via the repo rate, has contributed towards both tighter and more expansionary financial conditions. However, before we analyse the repo rate's effects in more detail, it is important to point out that the contribution made by each variable depends on the average for the variable over the period we are studying. This means that monetary policy has contributed negatively to the index's value at the points in time at which the repo rate has been higher than average. As interest rates have shown a falling trend in recent decades, we deem, that this has affected the development of the index to a certain extent. Partly to manage this problem, we have chosen not to start the index until 1998. This allows us to avoid the large interest rate cuts taking place in the mid-1990s after the Riksbank introduced inflation targeting in 1993 (see Figure A3 in the appendix).[23]

Figure 3 shows that the repo rate made a negative contribution to the index from the mid-2000s. This can primarily be explained by the fact that the repo rate was relatively high at this point and, except for a brief period at the end of the 1990s, the repo rate was around 4 per cent. This can be compared with the average for the entire period, which is just over 2 per cent. Financial conditions periodically deteriorated over this period, but, in general, the index was close to its historical average all the way until 2001. The financial conditions then deteriorated markedly in conjunction with the so-called IT crash. This resulted in heavy downturns on the world's stock exchanges and economic activity in Sweden declined.[24] But, at this point, inflation was nevertheless above the Riksbank's target of 2 per cent. Consequently, it took until the end of 2002 until the Riksbank cut the repo rate, from just over 4 per cent to a low point of 1.5 per cent at the end of 2005.

In general, the financial markets were characterised by a positive mood in the mid-2000s with relatively low interest rates, rising share and housing prices and strong credit growth. To dampen the strong development that was characterising both the financial markets and the real economy, the Riksbank raised the repo rate by just over 3 percentage points between 2006 and September 2008. But in 2007, the financial conditions started to deteriorate. At this point, increasingly serious problems were discovered on the US mortgage market and this uncertainty spread to other financial markets. In 2008, financial conditions in Sweden deteriorated markedly, which can be explained by falling asset prices and rising risk premiums on several markets. High inflation also led the Riksbank to continue to raise the repo rate for a period.

The financial crisis became acute in the autumn of 2008, when the US investment bank Lehman Banks filed for bankruptcy. A lack of confidence in counterparties' credit ratings reduced access to credit and certain markets more or less ceased to function. Many financial institutions that had earlier funded themselves cheaply through short-term loans had problems renewing their loans, and if they obtained new loans, these were much more expensive than before. This development on the financial markets contributed towards an international economic slowdown with falling growth and rising unemployment in many countries. Public authorities around the world began to implement strong measures to stop the negative trend. In Sweden, the Riksbank, the Government and other Swedish authorities took a number of measures to alleviate the effects of the international financial crisis and to

23 See, for example, Armelius, Bonomolo, Lindskog, Rådahl, Strid and Walentin (2014) and Ohlsson (2016).
24 See, for example, Dillén and Sellin (2003).

improve the functioning of the financial markets in Sweden. During a short time period, the Riksbank also cut the repo rate from 4.75 per cent to 0.25 per cent.[25]

These measures contributed towards the improvement of the financial conditions at the end of 2009 and in 2010. During this period, the Swedish economy had also recovered and inflation had started to rise, which led the Riksbank to raise the repo rate to 2 per cent in 2010-2011. But at the end of 2011, the economic outlook in the euro area deteriorated again, at the same time as inflationary pressures in Sweden eased off. The debt crisis in Europe resulted in a new crisis of confidence on the financial markets, and the financial conditions deteriorated again.

Since 2011, the Riksbank has conducted an expansionary monetary policy to get inflation to rise towards the target. Since February 2015, the repo rate has been negative and, in addition, the Riksbank has made its monetary policy even more expansionary through the purchase of government bonds. Low interest rates, both in Sweden and abroad, have contributed towards falling funding costs for both households and companies, which, in Sweden, has also led to strong credit growth. These low interest rates have also led investors both in Sweden and abroad to turn to other, higher-risk assets, which has resulted in the strong development of the world's stock markets, falling risk premiums and low volatility. Housing prices have also continued to rise. Recent years' expansionary financial conditions are deemed to be one of the causes of the strong economic development in Sweden.

The index thus seems to be able to capture the major events on the financial markets. In the index, it is possible to follow how monetary policy has affected the financial conditions, in particular via the direct contribution made by the repo rate. But monetary policy also directly and indirectly affects many other financial variables. For example, the turquoise columns in Figure 3 indicate that a low five-year government bond yield has contributed towards the expansionary conditions of recent years. Our assessment is that it has fallen partly as a result of lower interest rates internationally, but also as a result of the Riksbank's more expansionary monetary policy in the form of a lower repo rate and purchases of government bonds.[26] However, according to the index, the average financial conditions have been affected relatively marginally by the development of the krona. But the expansionary monetary policy of recent years has, on the other hand, contributed towards a weakening of the krona, which is also captured by the index. For example, the light blue columns in Figure 3, which show KIX, indicate that a weaker krona contributed towards slightly more expansionary financial conditions in 2014 and 2015.

## 3.7 The index covaries with the development of GDP

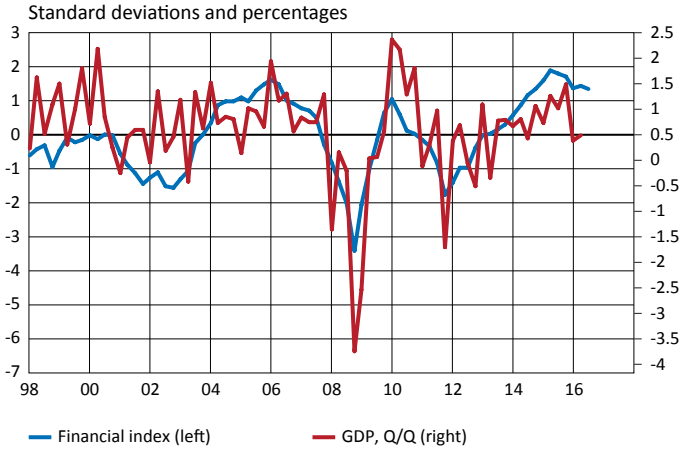
The method used constructing the index is a statistical method that only captures the common variation in the variables we analyse. The different variables' weight in the index is thus not optimised to covary with GDP development. But, as we have described above, we partly base our selection of variables for the index on their ability to help explain GDP development. It is therefore reasonable to believe that the index may include information that can help predict GDP development in the short term. Figure 4 shows the financial index together with the quarterly change in GDP. In this figure, the index has been levelled out with a three-month moving average to match GDP, which uses quarterly data. It has also been projected forward by one month, as the index seems to lead GDP development slightly. In Figure 4, it can also be seen that the index seems to be able to capture the development of GDP relatively well and the correlation between the two series is 0.64. When we estimate the index for GDP development, the coefficient of determination becomes 0.59.[27]

25 Elmér, Guibourg, Kjellberg, Nessén (2012).

26 For a more in-depth description of how purchases of government securities are deemed to have affected the economy, see, for example, Alsterlind, Erikson, Sandström and Vestin (2015), De Rezende (2015) and De Rezende, Kjellberg and Tysklind (2015).

27 To avoid the wide fluctuations of the financial crisis, we include a dummy variable for this period.

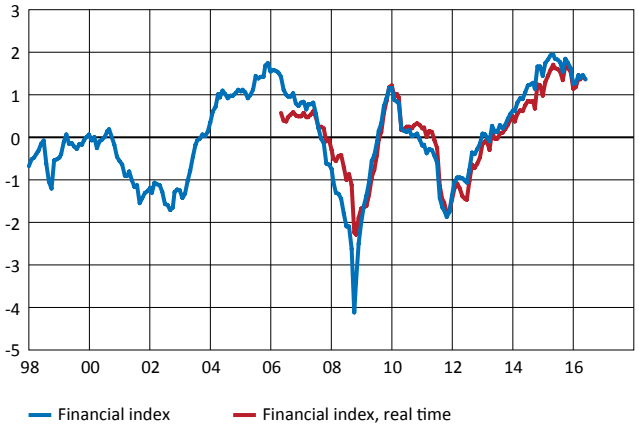
**Figure 4. Index for financial conditions and GDP on a quarterly rate**
Standard deviations and percentages




Note. The index has been normalised and has an average of zero and a standard deviation of one. GDP is expressed as a percentage quarterly change and the financial index has been levelled out by a three-month moving average and projected forward by one month.
Sources: Thomson Reuters and Sveriges Riksbank

Figure 4 shows the index based on data for the entire period. To fully evaluate the index's ability to tell us anything about GDP development in real time, we also recursively estimate an index from 2006. This involves estimating the index anew for each month after 2006 using the information that was available at that point. We do this to see whether the index can also capture, in real time, the fluctuations it captures when we estimate it over the entire period. It also gives us an indication of how well we would have been able to describe the financial conditions at various turning points, for example. Figure 5 shows such a retrospective construction of a real-time index, together with the index for the entire period. We can see that they correspond well and that the real-time index manages to capture most of the upturns and downturns of the financial conditions. However, it is worth noting that, during the financial crisis, the real-time index did not really fall to the same extent as the index based on the entire period. Furthermore, it fell slightly later. This shows that it is usually more difficult to gain an overview of the effects of major shocks when they are in the process of occurring, as compared with studying them afterwards. As we include more historical data in the real-time index, the more stable we expect it to become, and, in recent years, the development of the two indices has been largely the same. The covariation with GDP on a quarterly rate is also largely the same for the real-time index as for the index estimated on data for the entire period.

**Figure 5. Indices for financial conditions estimated recursively**
Standard deviations




Note. The indices have been normalised and have an average of zero and a standard deviation of one. The real-time index has been estimated using data up until 2006, after which the index is estimated anew for every new month.
Sources: Thomson Reuters and Sveriges Riksbank

## 3.8 Does the index include any new information?

As a final stage in the evaluation of the financial index's ability to predict GDP development, we investigate the index's information value in relation to other indicators, such as the Purchasing Managers' Index and the Economic Tendency Survey, which are usually used to predict Swedish GDP development in the short term. In Figure 5, our index can be seen together with the Purchasing Managers' Index for the industrial sector and the Economic Tendency Survey in which all indices are normalised. The Figure shows that these series covary relatively well but diverge in certain periods, which indicates that our index may provide further important information. During the period we study, the correlation between the financial index and the Purchasing Managers' Index and Economic Tendency Survey is 0.58 and 0.56 respectively, while the correlation between the Purchasing Managers' Index and the Economic Tendency Survey is almost 0.8.

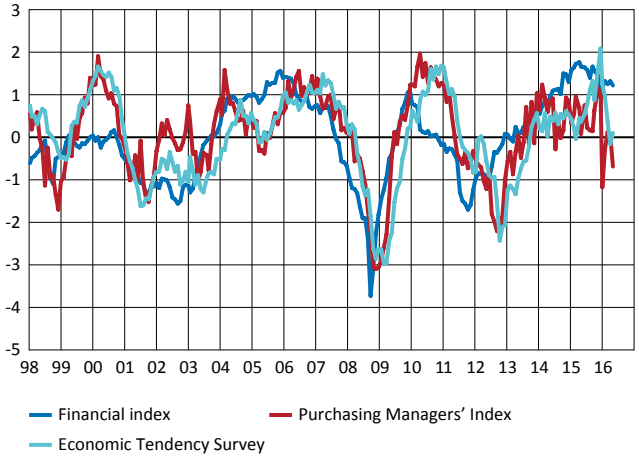
In Figure 6, we can see how the three indices have developed over time. Overall, the financial index seems to fluctuate less than the other indices. All three indices manage to capture the large upturns and downturns in the economy, but the financial index seems to lead the development slightly. However, it is worth noting that the financial index's 'leading' characteristics decrease slightly when we study the financial index that is estimated in real time, above all in comparison with the Purchasing Managers' Index. One advantage of the financial index, compared with the others, is that it can be updated on an ongoing basis, as many of the variables included are available as daily data.

When we study the three indices in detail, we also see that there are periods in which they diverge. One such example is in recent years, when the financial index has successively risen and indicated expansionary financial conditions. But the Purchasing Managers' Index and the Economic Tendency Survey have been more volatile and are now close to their historical averages. This difference corresponds relatively well with recent years' economic development. The financial conditions have been expansionary, with low interest rates, rising asset prices and strong credit growth, which we consider has contributed towards strong domestic demand. On the other hand, development within the export-heavy industrial sector has been weaker, and this has been the case both in Sweden and abroad.

We therefore consider that the indicators capture different parts of the economy and may, therefore, be good complements to each other. When we attempt to explain GDP development with the help of the three different indices, the coefficient of determination

becomes about the same. At the same time, regressions show that, when the financial index is included in estimates together with the other indicators, the coefficient of determination rises slightly. This indicates that the financial index complements the other indicators.

**Figure 6. Index for financial conditions, Purchasing Managers' Index and Economic Tendency Survey**
Standard deviations




Note. The indices have been normalised and have an average of zero and a standard deviation of one.
Sources: Thomson Reuters and Sveriges Riksbank

# 4 Conclusion

In this article, we have created an index for the financial conditions in Sweden. For a central bank, it is important to understand the development of the financial markets, as it is through various financial channels that monetary policy acts. Economic developments in recent years, with first the financial crisis and then the debt crisis in the euro area, also bear witness to a close link between the financial markets and the real economy. Our approach is therefore to create a financial index that aggregates twelve financial variables that capture the development of the financial markets. The variables' weights are determined by using principal component analysis, which is a statistical method that compresses the number of variables to capture the common variation in the variables. Our assessment is that an aggregated financial index could provide an overall view of the financial conditions and thereby facilitate the discussion of how the financial markets are developing and what effect this could have on the real economy.

According to the construction, the index only captures the common variation in the financial variables. It is therefore important to point out that no direct statistics or theoretical link exists between the index and the development of the real economy. Despite this, however, our assessment is that many of the financial variables contain valuable information for the prediction of GDP development in the short term, for example. We therefore partly base our selection of financial variables on their ability to explain GDP development, but also on our desire to have a broad selection of series that together cover a large part of the development of the financial markets.

Our analysis shows that the financial index manages to capture the major events on the financial markets and explains the economic fluctuations relatively well. The analysis shows that the Riksbank's monetary policy has been an important factor for the financial conditions. We also deem that the financial index can be used as an early indicator of GDP development, and that the coefficient of determination for GDP improves when we aggregate the financial variables, compared with when we only use individual variables. In addition to this, our

results indicate that the index includes information that could complement other early indicators that are usually used to make forecasts for GDP in the short term, for example the Purchasing Managers' Index and the Economic Tendency Survey.

Our conclusion is therefore that a financial index complements other analyses of the financial conditions in Sweden. The index is a quantitative measure that helps describe the common significance of different financial channels. Of course, as with other economic models, this measure has deficiencies and, in particular, uncertainty can be associated with the method and data we use. But, as long as the index is interpreted with a degree of caution, it can provide valuable information.

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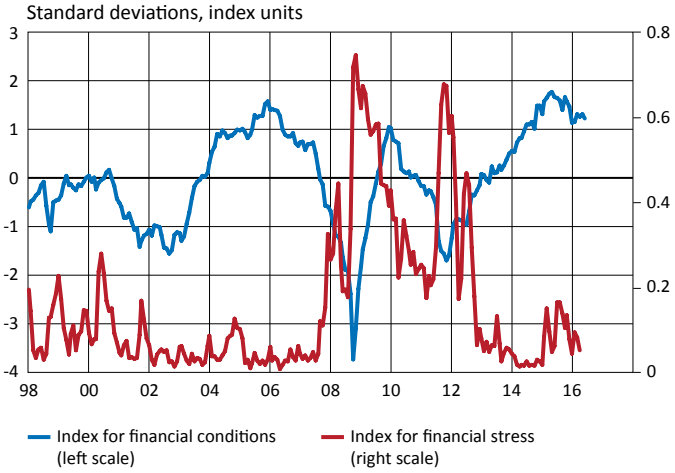
# Appendix

**Figure A1. Index for financial conditions and index for financial stress**
Standard deviations, index units




Note. The financial condition index has been normalised by an average of zero and a standard deviation of one. The index for financial stress is constructed according to the method in Johansson and Bonthron (2013).
Sources: Thomson Reuters and Sveriges Riksbank

**Table A1. Evaluation of various financial variables' ability to predict GDP development, including current movements**

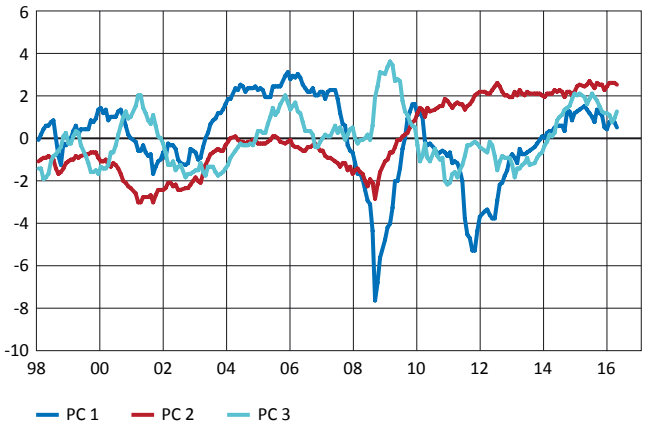
| Variable | F-test* | |
|---|---|---|
| | h=2 | h=4 |
| Repo rate | 0.00 | 0.00 |
| Stibor 3 months | 0.00 | 0.00 |
| Stibor – T-bill, 3 months | 0.00 | 0.00 |
| Government bond yield, 5 years | 0.04 | 0.01 |
| Government bond yield, 10 years | 0.35 | 0.12 |
| Government bond yield, 10 years – Repo rate | 0.00 | 0.00 |
| Government bond yield Sweden – Germany, 2 years | 0.13 | 0.05 |
| Mortgage bond yield – Government bond yield, 5 years | 0.01 | 0.01 |
| Stock market, OMX Stockholm | 0.00 | 0.00 |
| Volatility Index, VIX | 0.00 | 0.00 |
| House prices, HOX-index | 0.00 | 0.00 |
| KIX-index | 0.02 | 0.02 |
| Lending to non financial companies | 0.08 | 0.02 |
| Lending to households | 0.00 | 0.00 |
| Money, M2 | 0.00 | 0.00 |
| Lending conditions, companies | 0.00 | 0.00 |

*The table shows p-values. A value less than 0.10 indicates that we can reject the null hypothesis that the coeficients are not significantly different from zero. h indicates the number of quarters ahead in time.

**Table A2. Description of data**

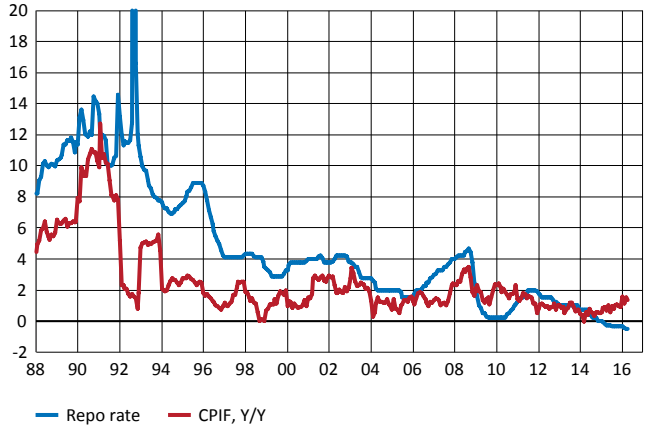
| Variable | Description of data |
|---|---|
| Repo rate | The repo rate expressed in level and per cent, opposite sign (Sveriges Riksbank) |
| Stibor – T-bill, 3 months | The difference between Stibor 3 month and Swedish 3-month T-bills, expressed in percentage points, opposite sign. Zero coupon rate interpolated from bond prices using the extended Nelson-Siegel method. (Thomson Reuters, Sveriges Riksbank) |
| Government bond yield, 5 years | 5 year Swedish government bond yield expressed in per cent, opposite sign. Zero coupon rate interpolated from bond prices using the extended Nelson-Siegel method. (Thomson Reuters, Sveriges Riksbank) |
| Government bond yield, 10 years – Repo rate | Difference between 10 year government bond yield and the repo rate expressed in percentage points. Zero coupon rate interpolated from bond prices using the extended Nelson-Siegel method. (Thomson Reuters, Sveriges Riksbank) |
| Government bond yield Sweden – Germany, 2 years | Difference between Swedish and German 2 year government bond yields expressed in percentage points, opposite sign. Zero coupon rate interpolated from bond prices using the extended Nelson-Siegel method. (Thomson Reuters, Bundesbank, Sveriges Riksbank) |
| Mortgage bond yield – Government bond yield, 5 years | Difference between 5 year Swedish mortagage and government bond yields expressed in percentage points, opposite sign. Zero coupon rate interpolated from bond prices using the extended Nelson-Siegel method. (Thomson Reuters, Sveriges Riksbank) |
| Stock market, OMX Stockholm | OMX Stockholm Benchmark Index (OMXSPI), price return, yearly change (Thomson Reuters) |
| Volatility Index, VIX | Chicago Board Option Exchange (CBOE) Volatility Index, S&P 500, 30 days implied volatility, opposite sign (Thomson Reuters) |
| House prices, HOX-index | Nasdaq OMX Valueguard-KTH Housing Index (HOX), yearly change. Before 2005 we use SCB real estate price index (FASTPI), seasonally adjusted (Valueguard, SCB, Sveriges Riksbank) |
| KIX-index | Nominal effective exchange rate for the Swedish krona, index 1992-11-18=100, yearly change (Sveriges Riksbank) |
| Lending to households | Lending to household from MFI, yearly change (SCB) |
| Lending conditions, companies | Economic Tendency Survey conducted by National Institute of Economic Research, credit- and lending conditions among companies, diffusion index, standardized. Between 2004 and 2008 we use the lending indicator from ALMI and before 2004 we use Senior Loan Officer Opinion Survey (SLOOS) for the US, standardized (SCB, ALMI, Federal Reserve, Sveriges Riksbank) |

**Figure A2. The three first principal components**
Standard deviations




Sources: Thomson Reuters and Sveriges Riksbank

**Figure A3. Repo rate and CPIF**
Per cent




Sources: Thomson Reuters and Sveriges Riksbank