

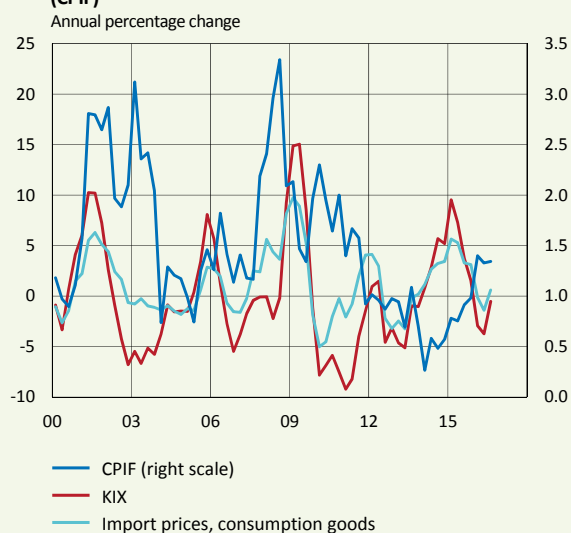
ARTICLE – The impact of the exchange rate on inflation

The exchange rate is one of several factors that influences inflation and is therefore important from the perspective of monetary policy. Since 2014, inflation has shown a rising trend in Sweden and the depreciation of the krona that has taken place over this period is deemed to have contributed to this development. Results of time series models show that there is a relationship between exchange rate fluctuations and inflation. But the effect on inflation depends on what the causes of exchange rate movements are and the inflation effects can be both greater and smaller than what has been the case on average. The Riksbank's inflation forecast is based on the slow appreciation of the krona as international economic activity strengthens. If the krona should appreciate more rapidly, inflation could become lower than in the Riksbank's forecast.

A weaker krona has contributed towards higher inflation

The exchange rate has varied heavily in recent years, and this has impacted the development of inflation. Since the start of 2014, the krona has depreciated by just over 10 per cent overall, due to the more expansionary monetary policy and other factors. This has led to rising import prices in the producer sector, which covary clearly with the exchange rate (see Figure 4:14).¹⁰

Figure 4:14. Nominal exchange rate (KIX), import prices for consumer goods in the producer sector, and consumer prices (CPIF)



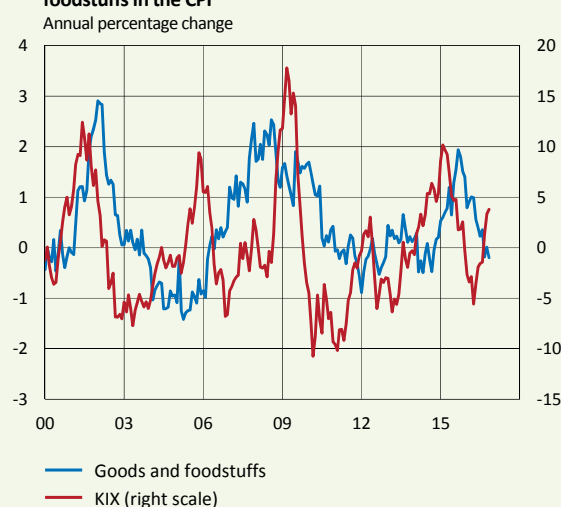
Note. The import prices refer to goods consumed by the producer sector. The CPIF is the CPI with a fixed interest rate.

Sources: Statistics Sweden and the Riksbank

The weaker krona has also contributed towards a higher rate of increase in consumer prices. Like many other countries, Sweden has had very low inflation for a number of

years. However, since 2014, inflation has risen in Sweden and the depreciation of the krona has been significant for this development. For example, prices for the product groups in the CPI that are most affected by the exchange rate, goods and foodstuffs, rose clearly last year. Over the course of 2016, the rate of price increase for goods and foodstuffs has fallen, which is deemed to be due to the appreciation of the krona that took place until last spring (see Figure 4:15). The depreciation of the krona since 2014 has also entailed a strengthening of economic activity in Sweden. Stronger economic activity usually leads to inflation rising, after a certain delay.¹¹ The krona thereby also contributes indirectly, via higher resource utilisation, to a continued rise in inflation in the period ahead.

Figure 4:15. Nominal exchange rate (KIX) and goods and foodstuffs in the CPI



Note. Goods and foodstuffs is a combination of the aggregate goods and foodstuffs in the CPI. Together, these account for 43 per cent of the CPI.

Sources: Statistics Sweden and the Riksbank

¹⁰ Import prices in the producer channel are measured at the Swedish border. Some of the goods are priced in foreign currency, in which case the price is translated to kronor using the current exchange rate.

¹¹ See the article "The relationship between resource utilisation and inflation" in the Monetary Policy Report, October 2016.

Difficult to assess the impact of the exchange rate

The development of the exchange rate is an important factor for the Riksbank's inflation forecast. One difficulty in this context is that the relationship between exchange rate and prices can look different in different situations, depending, for instance, on why the exchange rate has changed. Companies also adjust their prices in different ways, depending on how persistent a change in the exchange rate is expected to be. If the change is assumed to be temporary, companies may be less inclined to adjust their prices. The variations in the exchange rate therefore mostly affect the profit margin. This relationship can also vary over time as the behaviour of various participants in the economy changes.¹²

A weakening of the exchange rate may affect consumer prices in Sweden via several different channels. One of these is that finished products that are imported become more expensive. A few examples are prices of fruit, vegetables, and fuel. However, all goods, irrespective of the degree of their imported content, are sold on the Swedish market and are hence affected by Swedish salaries, transport costs, and so on. Consequently, a 'one-for-one' relationship cannot be expected to prevail between changes in the exchange rate and consumer prices for mainly imported goods. A weakening of the exchange rate can also affect consumer prices relatively quickly via increasing prices for imported input goods and thereby increasing production costs for domestically-produced goods and services. These more direct effects can arise following both temporary and more permanent exchange rate fluctuations.

It can also be expected that more expensive imported goods will lead to demand and prices rising for domestically-produced articles, to the extent that these form a substitute. Another channel involves exports. If the exchange rate is weakened, scope will be created for Swedish companies to cut prices for their goods and services on the export market. Increased demand may then lead to higher wages and rising production costs, which will ultimately also entail higher consumer prices. It is more likely that such indirect effects will arise if exchange rate changes are seen as persistent.

A weaker exchange rate may also lead to rising inflation expectations, which, in itself, may make it easier for companies to raise prices. Rising inflation expectations may also lead to upward pressure on prices and other production costs, which, in turn, will be passed on to consumers in the form of higher prices.

The reason that exchange rate fluctuations determine the impact of inflation

The magnitude of the effect on inflation will also depend on the reason that the exchange rate has weakened. If international demand is low during periods of uncertainty, the krona may depreciate as investors prefer to choose assets in historically safer currencies. Ultimately, the weaker krona may have less of an effect on inflation in Sweden in such a situation, as international inflation will probably be restrained and, at the same time, exports will be unable to increase in the same way. And, if the krona is weakening because growth is deteriorating in Sweden, a krona depreciation may even coincide with a lower rate of inflation if resource utilisation decreases enough.

Other situations may result in clearer positive effects on inflation. For example, a more expansionary monetary policy often entails both a weaker exchange rate and higher demand, which both suggest higher inflation. Even fluctuations in the exchange rate that cannot clearly be linked to other events in the economy can have larger effects on inflation. The Riksbank has previously published scenarios that have pointed to exchange rate fluctuations having clear effects. These estimates have usually been based on a direct shock to the exchange rate.¹³ Different causes for exchange rate fluctuations can thus explain why the impact can vary over time, which is also supported by empirical analyses that the Riksbank and others have made.¹⁴

However, it is often difficult to understand the causes of an exchange rate fluctuation. In the context of forecasting, it is thus common to rely on estimated average effects of exchange rate fluctuations and the influence of these, together with other factors, on the development of inflation over the forecast period.

Estimated inflationary effects of exchange rate fluctuations

On average, a depreciation of the krona will lead to rising inflation. The more direct channels usually lead to inflationary effects of a more transitory nature, while other channels influence inflation over a longer period.

One way of analysing the relationship between the exchange rate and inflation is by using time series models. Such estimates cannot determine why the exchange rate has changed, but can, nevertheless, give an indication of how inflation is typically affected by an exchange rate fluctuation. Such results are shown in Figure 4:16.¹⁵ The estimates show how CPIF inflation is affected by a lasting weakening of the

¹² Among other things, the academic literature suggests that the low-inflation regime may have reduced the impact of the exchange rate. For a discussion, see Taylor (2000), "Low Inflation, Pass-through, and the Pricing Power of Firms", *European Economic Review*, 44(7), pp. 1389-1408.

¹³ See, for instance, the article "Rapid strengthening of the krona" in the Monetary Policy Report, April 2015, and the scenario "Risks inherent in a rapid appreciation of the krona in a low inflation environment" in Monetary Policy Report, February 2016.

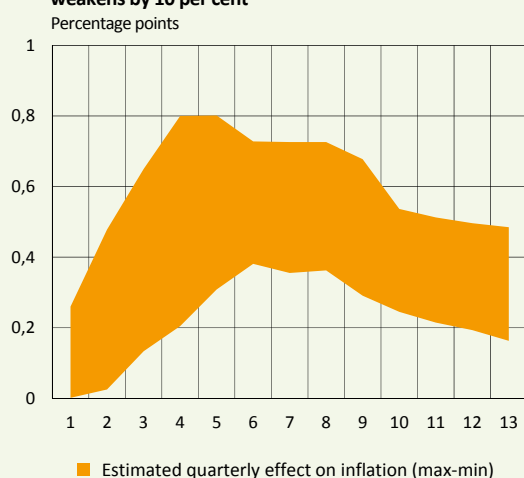
¹⁴ See Forbes, Hjortsoe and Nenova (2015), "The shocks matter: Improving our estimates of exchange rate pass-through", External MPC Unit Discussion Paper No. 43, Bank of England. Similar analyses have been made by the Riksbank using both structural time series models and dynamic general equilibrium models.

¹⁵ In the various estimated models, the development of inflation is explained by exchange rates, inflation expectations, unit labour costs, resource utilisation and other factors.

competitiveness-weighted exchange rate, measured in terms of the krona index (KIX).

The price effects shown are based on a weakening of the exchange rate by 10 per cent in the first period, after which it remains at the new level. The yellow field in the chart shows the effect on the rate of inflation according to various models. The various models show relatively consistent results, indicating that the effect in the first quarter amounts to between zero and about 0.25 percentage points. The effect of inflation then increases to an average of about 0.5 percentage points after about one year before gradually subsiding.

Figure 4:16. Effect on CPIF inflation when the exchange rate weakens by 10 per cent



Note. The figure does not consider uncertainty around the estimated parameters.

Sources: Statistics Sweden and the Riksbank

It takes a variable amount of time for exchange rate fluctuations to impact various consumer prices. Prices are also affected to varying degrees. For example, the winter clothes sold at the end of the year may have been purchased at least six months prior. In contrast, petrol prices, prices for foreign travel and prices for many perishable goods tend to be affected quickly by exchange rate fluctuations.

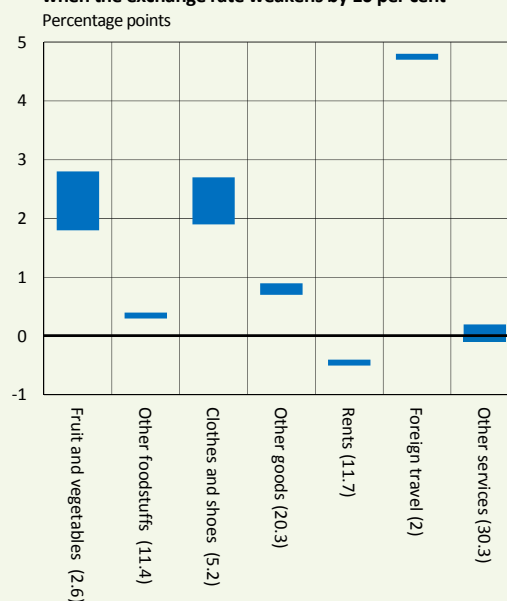
Figure 4:17 shows the maximum effect of the rate of price increase for various components of the CPI when the exchange rate is weakened by 10 per cent. The effect is greatest for foreign travel. The rate of price increase becomes almost 5 percentage points higher after an exchange rate weakening of this magnitude. Prices for clothes and shoes, as well as fruit and vegetables, are also clearly impacted. For other components, the effect is significantly weaker and, in some cases, the result is difficult to interpret.¹⁶

Exchange rate and inflation over the forecast years

So far this year, the development of the krona has been weaker than expected and, at the same time, inflation has been lower than the Riksbank's assessment. The results presented in this article show that the impact is normally positive and that changes of the exchange rate influence inflation after some delay. If historical correlations also continue to apply in the future, the depreciation of the krona since the spring will lead to a higher rate of price increase in the months ahead, particularly among goods and foodstuffs. The result obtained from time series models indicates that inflation will rise by about 0.5 percentage points after one year when there is an exchange rate change of 10 per cent. However, other results, from more advanced macroeconomic models, show that the effect depends on the type of shock that caused the exchange rate movement.

When the Riksbank makes inflation forecasts, an overall assessment is made of the effects of exchange rate change and how these, together with other factors, affect the development of inflation over the forecast period. The current forecast expects the krona to appreciate as international economic activity improves. As resource utilisation will thereby strengthen further and become higher than normal, the moderate appreciation of the krona in the forecast is deemed to be compatible with a rise of inflation to 2 per cent. On the other hand, if the krona should, instead, appreciate more rapidly, inflation could become lower than in the Riksbank's forecast.

Figure 4:17. Maximum effect on the rate of price increase when the exchange rate weakens by 10 per cent



Note. The figures in brackets refer to the weight in the CPI.

Sources: Statistics Sweden and the Riksbank

¹⁶ The effects have been worked out with the models the Riksbank uses as a support for its short-term forecasts for various sub-indices in the CPI. As two different procedures are used for each component, an interval is shown for maximum effect.

Other foodstuffs refers to foodstuffs excluding fruit, vegetables, tobacco and alcohol. Other services refers to services excluding property taxes, rents and overseas travel. Forecasts for the energy price are not generated using models of this type.