

■ Energy prices and Swedish inflation

Energy prices have risen steeply for producers and consumers in recent years. Rising energy prices affect inflation directly via rising prices for fuels, heating oils and electricity in the CPI. Inflation is also affected indirectly via rising costs for companies. The indirect effect is significant when energy prices rise over a long period of time.

Why do energy prices rise?

Energy prices have risen steeply since the October Monetary Policy Report. Oil prices on the world market were approximately 70 per cent higher in January this year, compared with the same month last year. At the beginning of last year the oil price was around USD 50 per barrel and exceeded USD 90 per barrel in January this year (see Figure 19). The rise in Swedish krona has not been as steep however since the US dollar has weakened during the same period. Expressed in Swedish krona the oil price rose by around 55 per cent during the same period. Both demand and supply factors have contributed to the price rise. The political uncertainty in the Middle East is high at the same time as demand for oil has remained high, particularly in emerging markets such as China. High growth in China, India and the Middle East, for instance, offsets the slowdown in the USA, which is the country that uses most oil in the world. Even the fact that the US dollar has weakened has probably contributed to the high level of oil prices. Oil is priced in USD and when the US dollar weakens oil producers often demand a higher dollar price in order to receive the same payment for the oil in their domestic currency.

Electricity prices have also risen and in January 2008 were just over SEK 0.40/kWh on the Nordic Power Exchange, Nord Pool, which is a two-fold increase in the price since the beginning of 2007. One important reason for this is rising prices for carbon dioxide emission rights, which affects Swedish electricity prices despite the fact that a relatively large part of the electric power produced in Sweden comes from renewable sources. Just over half of electricity production in the Nordic countries is made up hydroelectric power, around a fourth is nuclear power, a fifth is thermal power and approximately 2 per cent is wind power. Water levels are therefore of great significance to electricity price developments since they determine the extent to which more expensive electricity production is necessary in order to meet a greater need for electricity. However, the market price of electricity is determined by the cost to produce the last unit of electric power (so-called marginal cost pricing) and the price is, therefore, often determined on the basis of the production costs for other, and more expensive, electricity production than hydroelectric power. In turn, this cost depends on fuel prices as well as the price of carbon dioxide emission rights. A rising oil price on the world market can therefore lead to prices of electricity produced mainly using hydroelectric power in Sweden rising.

How do altered energy prices affect inflation?

A change in energy prices affects Swedish inflation in a number of ways. It is common to differentiate between the direct and indirect, or delayed, effects on inflation. The direct effects are the effects on consumer electricity and oil product prices (see Figure B1). One example of a direct effect is that fuel prices rise when the oil price rises.

Since inflation is often measured as the annual rate of increase in price levels, the direct effect on inflation of a change in energy prices will mainly persist over 12 months. However, a permanent increase of the level of energy prices raises the general price level permanently.

The size of the direct effects is often relatively easy to estimate. For instance, the fuel price comprises around 5 per cent of the CPI and consists, besides the actual product price on oil products, of taxes and trading margins. Taxes reduce the impact of a change in the price of crude oil since the taxes are mainly quantity taxes, expressed as a certain number of krona per litre and are thus not affected by a change in the price of crude oil. Calculations of the direct effect show that approximately 30 per cent of a change in the oil price in Swedish krona impacts as a change in the price of oil products in the CPI. A permanent ten per cent increase of the oil price expressed in Swedish krona will then increase inflation measured with the CPI by some 0.15 percentage points ($=10 \cdot 0.05 \cdot 0.3$) for one year ahead.

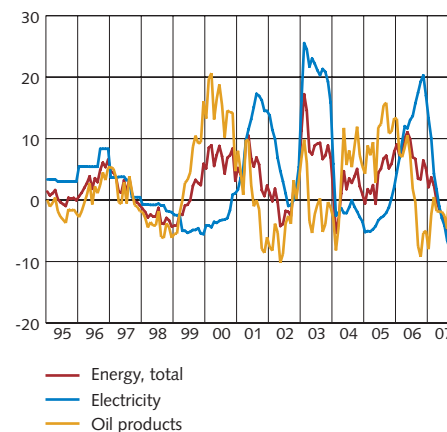
It is possible to reason in a similar way to achieve the direct effect of a changed electricity price. The direct impact of a change in electricity prices on the CPI does, however, occur with a time lag since a large part of the index for electricity prices in the CPI consists of net tariffs, semi-flexible prices and fixed-price contracts for one year, which are not directly affected by a change in the price of electricity on the Nord Pool Power Exchange. A change in the price of a one-year fixed-price contract affects the CPI calculations as a moving average over the past 12 months' fixed-price contract. A change in the price of electricity will, therefore, have an effect on the annual rate of increase in the CPI for a longer period than twelve months. The expenditure weight of electricity in the CPI is just over 4 per cent. According to the Riksbank's calculations, a ten per cent increase in the price of electricity on the Nord Pool Power Exchange will increase CPI inflation directly via rising electricity prices by approximately 0.15 percentage points on average in the first year after the increase and by 0.05 percentage points in the second year.

The direct effect on inflation of an energy price increase will thus remain for around 24 months ahead, with the greatest effect being visible during the first 12 months. After that the energy price increase will no longer affect the twelve-month comparisons.

Indirect effects are difficult to measure

The size of the indirect effects are far harder to quantify. These effects

Figure B1. Energy prices in the CPI adjusted for direct effects of changes in indirect taxes
Annual percentage change



Sources: Statistics Sweden and the Riksbank

arise when companies' costs change as a result of the change in energy prices. One example of an indirect effect is the rising price of bus tickets, which arises when the bus company raises prices as a result of rising fuel prices. Rising energy prices can also affect inflation expectations and thereby affect inflation via higher wage demands, for instance. The Riksbank has tried to estimate the size of the indirect effects of a change in oil prices with the aid of econometric analysis tools that take into account the historical correlations between the variables.¹⁶ This analysis suggests that a change in the price of oil affects the price level roughly as much indirectly as directly, but is spread over a longer period (see Table B1).

A corresponding estimate has been made for the effect of a ten per cent increase in electricity prices for producers. These estimates indicate there is almost as large an indirect effect from a change in electricity prices as a change in oil prices. Studies of so-called input-output tables from the National Accounts indicate that the use of electricity in input production is almost as great as the use of oil. Therefore, it is reasonable to assume that the indirect effect of a change in the electricity price is almost as great as the indirect effect of a change in the oil price. Table B1 shows the results of an econometric estimate of the historical relationship between energy prices and the CPI.

It should be stressed however that this type of estimate is extremely uncertain. For instance, the variables that are included and the choice of estimation period are often decisive to the result. Moreover, the estimated results show the average impact of a change in energy prices on the CPI, which, among other things, means that the results require an average monetary policy response on the change in energy prices. Should monetary policy react in a different way, the impact may be somewhat different to the result shown in Table B1.

Table B1. Estimates of direct and indirect effects of a permanent ten per cent increase of energy prices on the annual rate of increase in the CPI

	Effect of change in oil prices	Effect of change in electricity prices	Total effect
Year 1	0.15	0.17	0.32
Year 2	0.08	0.10	0.18
Year 3	0.14	0.08	0.22
Accumulated effect	0.37	0.35	0.72

Note. The results are the effect on the CPI of a change in the price of oil on the world market and a change in the price of electricity for producers in Sweden (see footnote 16).

Source: The Riksbank

¹⁶ The model that has been estimated is a VAR model, which is a system of equations with lagged explanatory variables. The variables included are the currency weighted TCW-GDP abroad, GDP in Sweden, the currency weighted exchange rate, the dollar price of oil, producer prices for electricity in Sweden, unit labour costs in the business sector and the CPIX excluding energy. All series are logarithmed and expressed in first differences. The time series are quarterly observed 1985-2007. The series for GDP, unit labour costs and the CPIX excluding energy are seasonally-adjusted. The maximum lag length chosen in the model is four quarters. In the model GDP abroad and the oil price are block-exogenous. This means that international variables affect the Swedish variables (GDP, exchange rate, unit labour costs, electricity prices and inflation) but not the opposite. The effects of two different developments in energy prices have been simulated. One development entails a 10 per cent one-off increase in energy prices. The second entails an identical development with the actual development of energy prices 2002-2007. This was done by adding a sequence of shocks to the unexplained part of the equations for energy prices (the residuals).

How far has inflation been affected by energy prices to date?

With the aid of the same analysis tool, it is also possible to estimate how much of the variation in inflation in recent years is attributable to direct and indirect effects of fluctuating energy prices. Figure B2 shows how CPIX inflation has developed during the period 2002 to 2007. The Figure also shows how great the direct and indirect effects of fluctuating energy prices have been according to the estimated model. Observations for the fourth quarter of 2006 can serve as an example. The line shows that CPIX inflation was approximately 1.1 per cent. During the same period the direct effect of a change in energy prices was approximately 0.4 percentage points and the indirect effect some 1.2 percentage points. This means that the rate of inflation, when the impact of the energy price is excluded, was approximately -0.5 per cent ($=1.1-0.4-1.2$). If energy prices had not risen since 2002 CPIX inflation would then have been negative during the fourth quarter of 2006, according to this analysis.

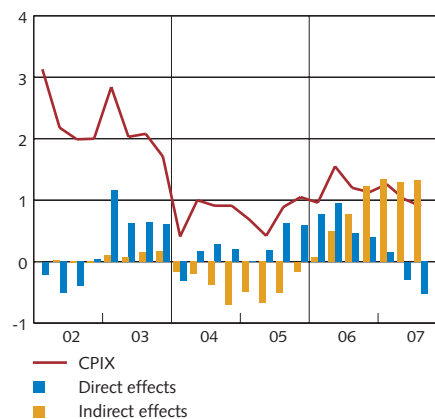
The analysis provides an indication of how the indirect effects often are of the same size as the direct effects. The results also indicate that if energy prices rise sharply over a longer period of time, as has been the case in recent years, the indirect effects also become significant. This is well-illustrated by the third quarter of 2007. The direct effect here is negative as a result of energy prices falling compared with the corresponding quarter the year before (see Figure B2). The indirect effect is however positive as a result of earlier upturns in the price of energy. In addition, the positive indirect effect is greater than the negative direct effect, which means that the total effect is positive.

How do energy prices affect inflation during the forecast period?

During the forecast period energy prices are expected to fall marginally from the current high levels, which there is support for in the pricing on the forward market. This assumption means that the direct effects from energy prices will provide a positive contribution to CPI inflation approximately one year ahead (the rate of price increase for the energy components in the CPI will be high). Thereafter, the recent energy price increases will fall out of the twelve-month comparisons and no longer affect inflation directly. The energy price increases will, however, continue to affect inflation indirectly for a while.

Figure B2. CPIX inflation and direct and indirect effects of changes in energy prices during the period 2002-2007

Annual percentage change and percentage points



Sources: Statistics Sweden and the Riksbank