

The effects of the oil price on inflation in Sweden

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In the 1970s the oil price rose steeply in two stages. This led, for instance, to companies raising their prices at a faster rate and to higher inflation. Over the past five years the oil price has once again increased very rapidly, see Figure 1a. Nevertheless, inflation does not appear to have been affected to any great extent, see Figure 1b. But is this really true?

In this economic commentary we make an attempt to estimate the effects the oil price has on Swedish inflation. We look at the way in which inflation is affected by a 10 per cent rise in the oil price and at the total effects of the oil price on inflation during the period 2002 to 2007.

Entire effect not immediately visible

The effects of the oil price on inflation can be divided into two parts – one with direct effects and one with delayed effects. The direct effect is because the prices of oil-related products such as fuels and heating oils are included in the usual measures of inflation. How the prices of these products develop is commonly strongly linked to the price of oil. This means there is a change in the consumer price index when the oil price changes. This direct effect is relatively easy to estimate.²

It is more difficult to calculate the delayed effect, partly because this depends on the companies' behaviour. One example is that higher fuel costs lead to more expensive transportation and thereby to higher costs for all goods transported by lorry. Another example is that higher oil prices mean that heating costs increase for many companies. This will probably lead to their customers ultimately having to pay higher prices. But how much higher will depend on, for instance, the competition situation in that particular sector.

How much does the oil price affect inflation?

The fact that the oil price affects consumers is clear to all who put petrol in their cars. It is almost the rule rather than the exception when the price has changed since the last visit to the petrol station. The same applies to many companies who use oil or oil-related products in their operations in one way or another. If such products comprise a large part of the companies' purchases, their costs are affected when the oil price is raised or cut. If the costs increase, the companies may need to raise the price they charge their customers. The question is whether they actually do so and if so, by how much.

To try to estimate the delayed effect the oil price has on inflation we have used a statistical model as a base. This of course includes inflation and the oil price, as well as other variables that can, according to economic theory, explain inflation trends (see the box below for a more in-depth description of the model).

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² Around 70 per cent of the consumer price for heating oils and fuels is comprised of taxes, which means that the direct impact of a 10 per cent higher oil price in the producer sector is around 0.15 percentage points higher CPI inflation, given its weight in the CPI basket of around 5 per cent.

In this commentary we attempt to estimate the effects of the oil price on inflation in Sweden. If the price of oil increases by 10 per cent, our calculations show that prices will be 0.25 percentage points higher after 5 years, compared with if the price of oil had remained constant. The estimated effect on inflation of a large and persistent increase in the oil price, which has been the case in recent years, can amount at most to around one percentage point. This effect may seem small in an historical perspective, but is nevertheless even larger when seen in relation to the current inflation target of two per cent.



BOX

The model that has been estimated is what is known as a VAR model. VAR stands for Vector Auto Regression, which is a system of equations with time-lagged explanatory variables (multiple time series). The variables included are trade-weighted international GDP, trade-weighted exchange rate, the oil price in USD, unit labour costs in the business sector, underlying inflation adjusted for oil-related products (the CPIX excluding petroleum products) and the level of a Swedish 3-month interest rate.

All series are logarithmed and expressed in the first differences, apart from the interest rate. The time series are observed quarterly 1990-2005 and seasonally adjusted. The maximum lag length chosen in the model is four quarters. International GDP and the oil price are block-exogenous. This means that international variables affect the Swedish variables (exchange rate, unit labour costs, interest rate and inflation) but not the opposite. Finally, we have assumed an unchanged oil dependency during the period.

We have simulated the oil price changing in two different ways. On the one hand, that the oil price is raised by 10 per cent once, on the other hand that the events are the same as in 2002 to 2007. We have made the simulations by adding sequences of shocks to the unexplained part (the residual) of the oil price equation. Finally, we have investigated whether the reported results are sensitive to the selections we have made regarding time period, lag length and variables included. All in all, these tests show that the results change slightly, but that the main conclusions still apply.

The model calculates how the different variables relate to one another during the period studied. For example, the model describes how increased costs for companies and higher interest affect inflation. As the model describes many correlations, it becomes clearer and easier to understand if the questions are limited and made more specific.

We are most interested in two questions:

- How is inflation affected if the oil price rises by 10 per cent?
- How has inflation during the period 2002-2007 been affected by the oil price having increased substantially and persistently during the same period?

The model can provide answers as to how large the delayed effect will be in the two experiments.

What happens to inflation if the oil price rises by 10 per cent?

If the oil price rises by 10 per cent the delayed effects on inflation are greatest – just over one tenth of a percentage point – after almost two years, see Figure 2. After this the effect begins to wane. The estimate using the model thus implies that if the price of oil rises by 10 per cent, inflation will in two years' time be around 0.1 percentage points higher than if the oil price had remained unchanged.

But we are of course also interested in the total effect on inflation, that is, the total of the direct and the delayed effects. We therefore have to also calculate the direct effect, which is simpler (see footnote 2). Table 1 below shows the total effect, broken down into the direct and the delayed effect, the first five years after the oil price has risen by 10 per cent.

The entire total effect comes in the first two years, with an emphasis on the first year. Inflation will thus be 0.2 percentage points higher in the first year and almost 0.1 percentage points higher in the second year. If one adds together these changes in the rate of inflation one obtains the difference in prices shown in brackets. The total combined effect on prices after 5 years will thus be 0.25 percentage points.

Comparing our results with others is not a simple matter, as we do not know of any similar studies made regarding Sweden. If one compares with international surveys there may be differences in method, sample and country/area. If we disregard such problems and compare the results with five different models in the ECB (2004), our effects are similar to those measures for the euro area. The same conclusion applies if the results are compared, for instance, with the conclusions reached by a number of researchers at the OECD (Brook

et al 2004) with regard to the United States, Japan, the euro area and the OECD countries as a whole.³

Finally, our results are based on the period 1990-2005, which also includes the monetary policy conducted then. A different monetary policy would probably have led to different results.

Table 1. Effects on inflation of the oil price increasing by 10 per cent Q1, year 1

	Direct effect	Delayed effect	Total effect
Year 1	0.15 (0.15)	0.05 (0.05)	0.20 (0.20)
Year 2	0 (0.15)	0.08 (0.13)	0.08 (0.28)
Year 3	0 (0.15)	-0.01 (0.12)	-0.01 (0.27)
Year 4	0 (0.15)	-0.02 (0.10)	0.02 (0.25)
Year 5	0 (0.15)	0.00 (0.10)	0.00 (0.25)

Note. All values refer to the fourth quarter of the respective year. The values in brackets show the cumulative effect on prices.

How was inflation affected by the substantial rise in the oil price 2002-2007?

At the beginning of this commentary we mentioned that inflation has been relatively low in recent years. This is despite a substantial rise in the oil price. How much of the inflation in the years 2002 to 2007 was due to the rise in the oil price?

Figure 3 shows how inflation has changed during this period (red line). The figure also shows our calculations of how much the rising oil prices have contributed. The total effect consists of the direct effect (yellow column) and the delayed effect (blue column) and is seen in the combined height of these columns.

Take the observation for 2006 Q4 as an example. The red line shows that inflation was around 1.5 per cent. At the same time, the blue column is around 0.4 percentage points and the yellow around 0.1 percentage point. The oil price thus accounted for 0.5 percentage points of inflation. During the whole of this period the oil price affected inflation the most during 2005 Q3. The direct and the delayed effects were then around 0.65 and 0.35 percentage points respectively, while inflation was 0.5 per cent. This means that if one adjusts for the effect of the oil price, the inflation rate was -0.5 per cent, that is, the general price level fell.

Our results give an indication that the oil price primarily affects inflation through the direct effect. However, the delayed effect can have a greater effect if the oil price varies over a longer period. We consider that this is illustrated fairly well in the first quarter of 2007. The direct effect was then negative, as the oil price fell. The delayed effect, on the other hand, was positive as a result of the oil price having risen earlier. The positive delayed effect is moreover greater than the negative direct effect. The oil price thus pushed up inflation during this quarter, despite the oil price falling then.

Conclusion

Our calculations show that if the price of oil is raised by 10 per cent, price levels will be 0.25 percentage points higher after 5 years than they would have been if the oil price had remained constant. The inflation rate is approximately 0.2 and 0.1 percentage points higher in the first and the second years respectively. These calculations are based on developments between 1990 and 2005, including the monetary policy conducted then.

However, the estimated effects in recent years are much greater than this, which is because the oil price has risen significantly for a long period of time. It is not entirely clear how great the total effect will be on inflation, as around 40 per cent of the effect comes

³ Our estimated effects lie well within the span between the greatest and least effect for the different areas/countries.

with some time lag. For example, the total effect of the oil price on inflation was positive during the final months of 2006. The fact that the oil price had fallen during the previous months was more than counterbalanced by the fact that prices had been rising since 2002. The delayed effects were thus greater than the direct effects at this point in time.

The general result we wish to draw attention to is the effects of a large and persistent rise in the oil price. These effects can in recent years sometimes be measured as whole percentage points, much more than the few tenths of a percentage point that arise from a temporary ten-per cent increase in the oil price. Effects of around one percentage point may appear small in a historical perspective, but are definitely not small when related to the current inflation target of two per cent.

Although the oil price has risen by an enormous amount in recent years, this has taken place at the same time as underlying inflationary pressures have been low. We believe that in the event of recurring similar, persistent trends in the oil price during a period of higher underlying inflationary pressures, the effects of a rising oil price could attract greater attention.

References

Brook, A-M., Price, R., Sutherland, D., Westerlund, N. and André, C., (2004), "Oil Price Developments: Drivers, Economic Consequences and Policy Responses", OECD Economic Department Working Papers, No. 412.

ECB (2004), "Oil prices and the euro area economy", Monthly Bulletin, November 2004, pp. 51–63.

Figures

Figure 1a. The Oil price 1970–2007
Brent crude, USD/barrel



Figure 1b. Inflation 1970–2007
Annual percentage change in CPI

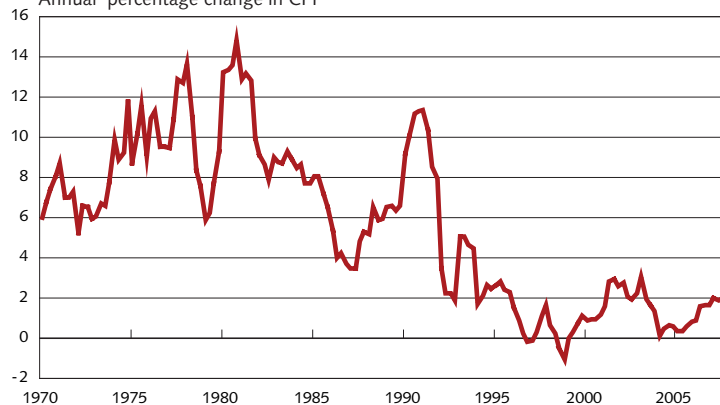




Figure 2. Delayed effect on inflation if the oil price increases 10 per cent in Q1
Percentage points

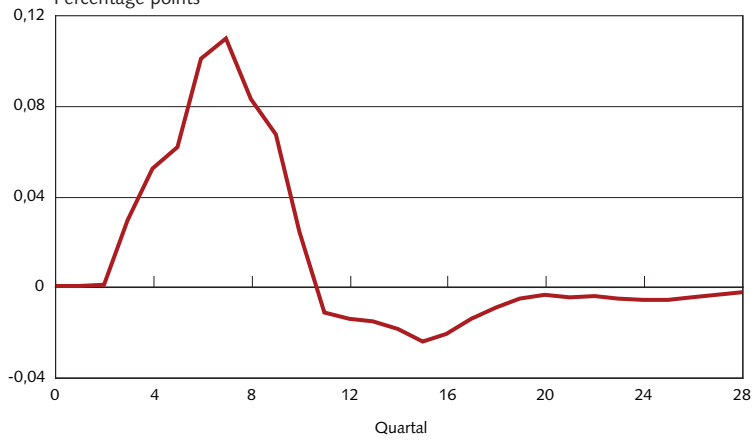


Figure 3. Inflation and calculated effect of oil price increases 2002–2007
Per cent and percentage points respectively

