Higher Import Prices for Oil, Natural Gas and Mineral Oil Products: the Potential Price Effects in Individual Sectors of German Industry

Since reaching their last low level at the beginning of 1999, import prices for oil, natural gas and mineral oil products have been rising constantly. By July of this year prices for crude oil and mineral oil products had more than trebled on January 1999, while the price of natural gas, which usually catches up with the prices of light and heavy heating oil after a six-month delay, had almost doubled. The effects of these price increases vary across the individual production sectors and consumer groups. This report uses a model calculation based on input-output analysis to quantify the price effects of the energy-price rise in the various production sectors of the German economy. According to this calculation, manufacturing costs will rise on average by 1.0%. The spectrum of the additional burden of costs in the individual production sectors ranges from a maximum 60% (mineral oil refining) to only 0.2% (manufacture of office machinery and computers).

Components of the price rise for oil and mineral oil products

The increase in the price of oil in Germany is the result both of trends on the oil markets, where the transaction currency is the US dollar, and of events on the exchange markets. At USD 31 this September, the price of crude oil had almost trebled on the beginning of 1999. Given that the value of the dollar has since risen by a third against the euro, and thus also against the D-Mark, the price of oil in D-Marks was almost four times the lowest price reached in January 1999 (cf. figure 1), though oil was still considerably cheaper than in the first half of the 1980s.¹

Public debate focused on the increase in the price of fuel. German long-distance hauliers demonstrated

against the rise, as had their counterparts in France and Great Britain before them, because the consumers of mineral oil products are affected not only by the price of crude oil, but also by the added component of mineral oil tax.

The share of tax in the price at the pumps in Germany last year was 74% for premium petrol, 62% for diesel fuel,² and 36% for light heating oil (cf. table 1). German taxes on diesel fuel and light heating oil are about average compared with its neighbours, while taxes on premium fuel are higher only in France and Great Britain.

The share of tax in the product price in the countries observed ranges from:

-24% (Belgium) to 72% (Italy) for light heating oil;

 - 36% (Denmark) to 78% (Great Britain) for diesel fuel. The spectrum is narrower for petrol, ranging from 71% in Denmark to 79% in France.

The price of petrol increased in Germany from an annual average of around DM 1.71 in 1999 to DM 2.06 in September 2000, in other words by 35 pfennigs. Around 12 pfennigs of the rise was due to taxes and 23 pfennigs to the oil companies' purchasing, processing and sales costs. The price of diesel fuel increased by 38 pfennigs, over a sixth of which (7 pfennigs) can be attributed to the tax increase.³ The price increases are thus largely the result of the higher import prices for crude oil and on exchange-rate trends.

Macroeconomic effects of the oil-price rise

Three effects can be expected from the increase in oil prices:

- Effects on the overall rate of inflation;
- A notable decrease in net exports due to the higher oil bill, given that Germany is practically entirely dependent on imports for its oil needs. Exports would have to increase by 4% to compensate for the around DM 45 billion increase in the import bill;
- Effects on economic growth.

The Six Institutes dealt with the expected effects on economic growth in their last joint forecast.⁴ They estimated a negative impact of 0.8% of nominal GDP, or of

¹ In 1984 the German import price for crude oil was US-\$ 29.30 or DM 83.40, given an exchange rate of DM 2.8456 to the dollar.

 $^{^2\;}$ Without V.A.T., in other words from the point of view of commercial consumers, who are entitled to deduct turnover tax paid.

 $^{^3}$ Mineral oil tax on diesel fuel rose by 40% (17.6 pfennigs) between 1990 and 1994, while tax on premium petrol rose by 44% (25 pfennigs) during the same period. This was a period when crude oil prices and the exchange rate for the US-dollar were falling, though these savings only partly compensated for the tax increases.

⁴ Cf. 'The World and the Germany Economy in Autumn 2000', *Economic Bulletin* 11/2000.

Figure 1 Import Prices for Crude Oil in Germany January 1999 = 100



Sources: International Energy Agency; Federal Office for Industry; Bundesbank; DIW calculations.

1.1% when the comparably substantial increase in the natural gas bill was also taken into account.

The latest oil-price rise has led to a sharp increase in the overall rate of inflation, measured on the basis of the cost-of-living index. The sharp rise in the price of heating oil and fuel in September 2000 (+29% on the previous year) led to a 2.5% increase in the cost-of-living index over September 1999, as against a 1.8% increase in August (cf. figure 2). Leaving heating oil and fuel prices out of the calculation, the increase in the cost-ofliving index amounts to only a moderate 1.2% for September.

However, the current overall effects of the oil-price increase are much weaker than they were in the early 1970s and in the first half of the 1980s, owing to the marked decrease in the oil intensity of German industry. Moreover, this time the oil-price increase has come at a time when the German economy is experiencing a cyclical upturn and has almost achieved price stability. The increase in the oil bill, which is around twice as high in 2000 as in 1999 (cf. table 2), is exclusively the result of the oil-price increase – the volume of imports of oil and mineral oil products has remained more or less stable since 1995. The effects of the increase in the oil bill vary widely from sector to sector.

Potential effects on manufacturing prices in industry

The direct and indirect effects of the oil-price increase on manufacturing prices in the various production sectors in 2000 are estimated using a model calculation based on the official input-output table for 1995. By basing the model on this table we can analyse in detail the price effects of higher priced energy imports. The input-output structures are unlikely to have changed substantially since 1995, as indicated by the calm price climate up to 1999 and the stable volume of oil imports. The model allows us to quantify the inflation potential - broken down by sector - created by the rise in import prices. Only the price effects resulting from the increase in energy import prices in the narrow sense - and not those resulting from the ecological tax - are calculated. In other words, the analysis does not investigate the extent to which energy price inflation affects other cost factors, such as wages, salaries, interest rates and exchange rates, which in turn also influence manufacturing prices. The model calculation is based on the assumption that the trends for the other cost factors are identical in the scenarios that take account of the energy import price rise and in the alternative scenarios without the price rise. It is also assumed that the higher costs resulting from the higher prices for energy imports are passed on in full by the manufacturers. In other words, the model does not allow us to predict the actual price trend, which also depends on whether the market position of enterprises allows them to pass on the higher costs in full, or perhaps even leaves scope for sharper price increases. Similarly, changes in volumes as a result of substitution processes are not taken into account.

This study focuses on quantifying the potential cost and price effects that can be expected in the various manufacturing sectors in 2000, on the basis of the higher prices for imported energy sources. A subsequent comparison between the actual manufacturing prices and the potential prices calculated here could provide information on the extent to which the transfer of additional costs to sales prices and thus to consumers assumed in the model actually took place. If producers were unable to pass on the additional costs in full, the cost increases calculated here would result in reduced profits.

Summary of the model calculation

The process of passing on the higher manufacturing costs is assumed to take place as follows: Costs rise in the domestic mineral oil refining sector – which buys

Table 1	
Average Prices and Taxes on Heating Oil, Diesel and Premium Petrol in 1999	

	Price per litre in national currency				Price per litre after tax = 100					
Product	Price before tax	Mineral oil tax/ ecologi- cal tax	V.A.T.	Total taxes	Price after tax	Price before tax	Mineral oil tax/ ecologi- cal tax	V.A.T.	Total taxes	Price after tax
	Germany									
Heating oil	0.324	0.110	0.070	0.180	0.504	64.38	21.83	13.79	35.62	100
Diesel ¹	0.412	0.670	-	0.670	1.082	38.08	61.92	-	61.92	100
Premium petrol	0.448	1.025	0.236	1.261	1.709	26.21	59.98	13.81	73.79	100
	Denmark									
Heating oil	1.777	1.970	0.937	2.907	4.684	37.94	42.06	20.00	62.06	100
Diesel ¹	2.859	1.630	_	1.630	4.489	63.69	36.31	_	36.31	100
Premium petrol	2.110	3.770	1.470	5.240	7.350	28.71	51.29	20.00	71.29	100
	Belgium									
Heating oil	6.145	0.550	1.406	1.956	8.101	75.85	6.79	17.36	24.15	100
Diesel ¹	9.222	11.700	_	11.700	20.922	44.08	55.92	-	55.92	100
Premium petrol	10.395	20.460	6.480	26.940	37.335	27.84	54.80	17.36	72.16	100
					Nethe	rlands				
Heating oil	0.463	0.270	0.128	0.398	0.861	53.76	31.35	14.89	46.24	100
Diesel ¹	0.533	0.762	-	0.762	1.295	41.16	58.84	-	58.84	100
Premium petrol	0.644	1.293	0.339	1.632	2.276	28.30	56.81	14.89	71.70	100
	France									
Heating oil	1.232	0.526	0.362	0.888	2.120	58.13	24.79	17.08	41.87	100
Diesel ¹	1.212	2.499	_	2.499	3.711	32.66	67.34	_	67.34	100
Premium petrol	1.354	3.867	1.076	4.943	6.297	21.50	61.41	17.09	78.50	100
					Ita	aly				
Heating oil	405	779	237	1016	1422	28.50	54.83	16.67	71.50	100
Diesel ¹	444	780	_	780	1224	36.27	63.73	_	63.73	100
Premium petrol	496	1048	309	1357	1853	26.77	56.56	16.68	73.23	100
	Great Britain									
Heating oil	0.102	0.030	0.007	0.037	0.139	73.68	21.56	4.76	26.32	100
Diesel ¹	0.139	0.478	-	0.478	0.617	22.53	77.47	-	77.47	100
Premium petrol	0.196	0.510	0.124	0.634	0.830	23.61	61.45	14.94	76.39	100

1 For commercial use.

Sources: International Energy Agency; DIW calculations.

almost all the oil imported to Germany – because of the increase in the price of crude oil. The same applies to the production sectors which import natural gas and mineral oil products. The cost increases – but only these – are passed on in full at all stages of the production process, so that even if the other factors in production remain unchanged, the prices of those goods that are produced either directly or indirectly (via purchases of intermediate goods) on the basis of mineral oil products will also rise.

The following example illustrates the process. When the price of the crude oil needed to manufacture mineral oil products increases, the manufacturing price of mineral oil products also rises. The result is higher input costs for the purchasers of petrol and diesel – for example, those in the road haulage sector – which leads to higher prices for road transport services. In turn, the users of freight services, such as wholesalers and retailers, are then faced with higher charges.

The direct and indirect processes of cost transference outlined here are represented using the input-output price model (cf. box). The calculation is based on the Federal Statistical Office's 1995 input-output table for 71 German production sectors, and on the accompanying table on energy consumption broken down by type of energy source.⁵

Figure 2 Price Trend for the Cost of Living January 1999 = 100



Sources: Federal Statistical Office; DIW calculations

Specifications of the model calculation

The model is based on the import price rises for crude oil, natural gas and mineral oil products – broken down into seven product types – between 1995 and 1999 and in 2000. Last year the import price for crude oil exceeded the 1995 price by 27%, while the price of natural gas was 5% lower than in 1995. The margin of fluctuation of the price increase for the individual products ranged from 19% for medium-heavy and heavy heating oils to 34% for engine petrol, premium petrol and crude petrol. On average, imported mineral oil products were 28% more expensive in 1999 than in 1995.

Indices for the import prices of crude oil and mineral oil products were available up to July 2000 for the model calculation. In order to estimate the inflation rates for the entire year, the statistically demonstrated July increase in the price of crude oil compared with the average 1999 price was taken as the basis for imports both of crude oil and of mineral oil products, because the import price trend for the main product groups runs more or less parallel to the trend for the crude-oil price. The equation results in an import price increase in 2000 compared with the annual average for 1999 of 84% for crude oil and mineral oil products and of 74% for natural gas. This result corresponds to the price trend estimated in the last Six Institute forecast.

The effects – as calculated by the model – of changes in the import prices for oil, natural gas and mineral oil products on manufacturing prices in the various production sectors in 1999 and 2000 were used to inflate the sectoral production values for 1995. A comparison between the total costs thus calculated on the basis of the oil prices in 1999 and those in 2000 then yields the cost or manufacturing price increase which can be attributed exclusively to the higher import prices for oil, natural gas and oil products during this period. The rates of change in percent for the two variants (2000/ 1999 and 1999/1995) are given in table 3, for 58 selected production sectors.

In addition, in calculating the total cost effects for the different sectors, a distinction was made between

The formula used in the input-output price model is as follows:

$$X_{p} = (I-A')^{-1} * A'_{p}$$

where X_p is the price vector for the output values, I is the standard matrix, A' is the transposed matrix of the input coefficients for domestic intermediate inputs, and A'_p is the transposed matrix of the input coefficients for primary input. The components included in A'_p are gross value added, product tax net of subsidies on products, and imported intermediate goods. The analysis presented here covers imports of crude oil, natural gas and mineral oil products.

The share of energy imports included in the output value varies in the model in accordance with the import price rises between 1995 and 1999 and in 2000. The other primary input coefficients remain constant.

⁵ Cf. Federal Statistical Office: Fachserie 18, Reihe 2, 'Input-Output-Rechnung 1995', July 2000, and 'Input-Output-Rechnung: Instrumente zur Politikberatung,' press copy for a press conference on 30 August 2000. The authors of this report would like to thank the director and members of the working group on 'Input-output, national wealth and satellite accounts' in the Federal Statistical Office for providing additional information pertaining to the input-output table.

Table 2 German Imports of Oil, Mineral Oil Products, and Natural Gas

1995 to 2000

Year	Oil and mineral oil products	Natural gas	Total	Oil	Mineral oil products	Natural gas
	Valu	e in DM bil	Volum	e in million	tonnes	
1995	28.4	9.5	37.9	100.9	43.4	51.8
1996	36.8	12.8	49.6	103.6	46.2	66.9
1997	40.1	13.8	53.9	100.5	49.3	64.0
1998	30.1	12.0	42.1	109.4	44.7	61.7
1999	34.4	10.5	44.9	103.9	40.5	63.9
2000	69.9	19.4	89.3	103.9	40.5	63.9

Sources: Federal Statistical Office; Federal Office for Industry; 2000: DIW estimates.

direct and indirect effects. The extent of the direct cost effects is found by comparing the higher input coefficients for oil and natural gas imports resulting from the price increase with their share in the costs during the previous period. The indirect effects, which are calculated as the difference between the direct effects and the total effects, are the result of the process of passing on costs.

Results of the model calculation

The calculation results in an average cost increase across all production sectors of 1% between 1999 and 2000. The increase in import prices for oil and oil products (27%) and the decrease in import prices for natural gas (5%) had led to a potential price increase of 0.22% between 1995 and 1999. The results show clearly that the quite substantial increase in the import prices for oil, natural gas and mineral oil products this year compared with 1999 could result in an average cost increase across all production sectors which is almost five times that in the 1995-1999 period (cf. table 3).

The deviations from the mean and the wide margin of fluctuation of the overall price effects in the individual production sectors can basically be explained by the different intensities of oil and natural gas consumption in the different production areas, in other words by the direct or indirect mineral oil content of the individual product groups. The result is a total price effect of over 1% in 16 of the 58 sectors observed – if the increase in the import prices between 1999 and 2000 for oil, natural gas and mineral oil products is passed on in full, and if the trends for the other cost factors are identical in both years in all the scenarios. In the 1995-1999 period the total burden of costs exceeded the average of 0.22% in ten sectors.

The findings also show that the indirect effects, which are caused by the share of oil and natural gas 'contained' in the intermediate goods purchases of manufacturers, represent a greater burden than the direct effects in most sectors. In the 1995-1999 period there were two sectors (coke, refined petroleum products and nuclear fuel; and air transport) where the direct input costs for oil, natural gas and mineral oil products were higher. Because natural gas imports were cheaper in 1999 than in 1995, manufacturing prices actually decreased slightly in 1999 compared with 1995 in four sectors (crude petroleum and natural gas; pulp and paper; non-ferrous metals; and manufacture and distribution of gas).

The increase in import prices for oil and gas between 1999 and 2000 will lead to higher direct than indirect cost effects in six production sectors because the import prices for natural gas, which usually catch up with heating oil prices after a delay of around six months, have since increased. Five of these sectors belong to the 16 sectors which can expect a price increase of at least 1% in 2000. These 16 sectors are presented in figure 3, ranked according to the severity of the cost effects. The sector topping the list is coke, refined petroleum products and nuclear fuel (58.6%), followed by air transport (10.1%) and water transport (4.0%). The total effects (assuming that costs are passed on in full) represent the cost increases in percent which will be created by the import price rises for oil, natural gas and mineral oil products from 1999 to 2000. Most of this increase can be attributed to the direct cost effects in the cases of coke, refined petroleum products and nuclear fuel and air transport, while the effects induced by intermediate goods have a greater impact in the case of water transport. This also applies to 'other land transport', which includes freight services and road haulage, where the direct effects only account for around an eighth of the total cost increase of 1.9%.

Owing to the lack of up-to-date disaggregated data on final consumption, a precise allocation of the sectoral price effects calculated by the model for 2000 to the components of final consumption (private and government consumption expenditure, fixed capital formation, changes in stocks and exports) is not possible. While the rates of inflation shown for the 58 production sectors are always the same, regardless of the final destination of the product groups, the total price effects also vary because of the different weighting of the product groups in the components of final consumption. However, it can

Table 3

Effects of Higher Import Prices for Oil, Natural Gas, and Mineral Oil Products on Manufacturing Prices in Selected German Production Sectors

% of total costs

Draduation exerter		Price increase: 2000 v. 1999			Price increase: 1999 v. 1995		
Production Sector	direct	indirect	total	direct	indirect	total	
All production sectors	0.50	0.50	1.00	0.11	0.11	0.22	
of which: Agriculture, hunting and related services	0.16	0.93	1.09	0.03	0.22	0.25	
Forestry, logging and related services	0.64	1.01	1.65	0.16	0.25	0.40	
services incidental to fishing	0.34	1.19	1.53	0.08	0.13	0.21	
Coal and lignite: neat	0.05	0.45	0.50	0.01	0.10	0.11	
Crude petroleum and natural gas; services incidental	0.00	0.40	0.00	0.01	0.10	0.11	
to oil and gas extraction excluding surveying	0.89	0.41	1.31	-0.06	0.09	0.03	
Other mining and guarrying	0.00	0.41	0.41	0.00	0.05	0.05	
Food products	0.16	0.64	0.80	0.01	0.14	0.15	
Beverages	0.20	0.71	0.91	0.02	0.15	0.17	
Tobacco products	0.05	0.33	0.38	0.01	0.06	0.07	
lextiles Wearing apparel: furs	0.22	0.63	0.85	0.00	0.12	0.12	
Leather and leather products	0.07	0.46	0.54	0.00	0.10	0.10	
Wood and products of wood and cork, except furniture;	0.00	0.55	0.02	0.01	0.44	0.40	
Pulp and paper	0.08	0.55	1.35	-0.02	0.13	0.13	
Paper products	0.26	0.52	0.78	0.00	0.08	0.08	
Publishing Bristand and the second advectory dia	0.04	0.23	0.27	0.01	0.05	0.05	
Coke, refined petroleum products and nuclear fuel	0.06 46.64	0.35	0.41 58.56	0.00 13.93	0.06	0.06 17.48	
Pharmaceutical products	0.04	0.35	0.39	0.00	0.08	0.08	
Other chemical products	1.06	2.02	3.08	0.19	0.48	0.67	
Plastic products	0.19	0.47	0.66	0.00	0.09	0.08	
Glass and glass products	0.79	0.79	1.58	0.01	0.16	0.17	
Other non-metallic mineral products	0.45	0.77	1.21	0.04	0.17	0.21	
Non-ferrous metals	0.53	0.91	1.44	-0.01	0.19	0.20	
Products of metal casting	0.25	0.61	0.86	0.00	0.11	0.11	
Fabricated metal products,	0.10	0.20	0.40	0.00	0.07	0.07	
Machinery and equipment	0.05	0.39	0.49	0.00	0.07	0.07	
Office machinery and computers	0.02	0.21	0.24	0.00	0.04	0.05	
Electrical machinery and apparatus, etc.	0.06	0.28	0.33	0.00	0.05	0.06	
and apparatus	0.04	0.30	0.34	0.00	0.06	0.06	
Medical, precision and optical instruments, watches and	0.04	0.00	0.00	0.00	0.00	0.00	
CIOCKS Motor vehicles trailers and semi-trailers	0.04	0.28	0.32	0.00	0.06	0.06	
Other transport equipment	0.07	0.31	0.38	0.00	0.05	0.05	
Furniture, other manufactured goods, etc.	0.06	0.41	0.46	0.01	0.08	0.09	
Recovered secondary raw materials	0.25	0.72	0.97	0.03	0.12	0.16	
Electrical energy, steam and hot water Manufacture and distribution of das	1.04	0.99	2.03	0.04	0.24	0.28	
Collection, purification and distribution of water	0.03	0.29	0.32	0.02	0.05	0.02	
Duilding of complete constructions or parts thereof.							
civil engineering	0.06	0.61	0.68	0.02	0.13	0.15	
Building completion	0.05	0.40	0.45	0.01	0.09	0.10	
Sale, maintenance and repair of motor vehicles and							
motorcycles; retail sale of automotive fuel	0.07	0.28	0.35	0.01	0.06	0.07	
vehicles and motorcycles	0.06	0.29	0.36	0.01	0.07	0.08	
Retail trade, except of motor vehicles and motorcycles;	0.00	0120	0100	0.01	0.01	0.00	
repair of personal and household goods	0.11	0.32	0.43	0.01	0.07	0.09	
Transport via railways	0.12	0.84	0.49	0.01	0.08	0.08	
Other land transport	0.24	1.63	1.87	0.06	0.41	0.47	
Water transport services	1.02	2.93	3.95	0.21	0.74	0.95	
Supporting and auxiliary transport activities; activities of	1.13	2.33	10.00	2.17	0.00	2.11	
travel agencies	0.07	0.96	1.03	0.02	0.24	0.25	
Financial intermediation services, except insurance and pension funding services	0.03	0.56	0.58	0.00	0.11	0 11	
Research and development services	0.07	0.25	0.33	0.01	0.05	0.06	
Public administration and defence services	0.13	0.32	0.45	0.02	0.07	0.10	
Compulsory social security services Health and social work services	0.01	0.26	0.27	0.00	0.05	0.05	
Membership organisation services, etc.	0.10	0.18	0.27	0.01	0.04	0.05	

Sources: Federal Statistical Office; DIW calculations.

Figure 3 Higher Import Prices for Oil, Natural Gas, and Mineral Oil Products in Germany: Cost Effects in Selected Production Sectors in 2000



Source: Federal Statistical Office; DIW calculations

be assumed on the basis of previous analyses that the burden will amount to around 1.3% for private consumption expenditure and to around 1.2% for exports. The burden on private consumption expenditure is due in part to direct purchases of imported mineral oil products, while exports are affected by the substantial use of mineral-oil-intensive transport services.

Conclusion

It was considered important to distinguish in the model calculation between the import price increases for the different energy sources of oil, natural gas and mineral oil products, because the significance of these products varies in the cost structure of the various production sectors. There was also good reason to exclude the cost and price effects of the ecological tax reform from the calculation. The effects related to the tax reform differ considerably from those related to the price increase for mineral oil products (based on the price of crude oil), because the burden for energy-intensive sectors of industry is reduced by complex special regulations and because the tax increase is almost entirely offset – in macroeconomic turns – by a reduction in pension insurance contributions. The economic effects of this reform are currently being investigated in detail in a comprehensive DIW study.⁶

The potential overall price increase for the German economy between 1999 and 2000 – based exclusively on the higher import prices for oil, natural gas and mineral oil products – is estimated at 1%. The results of the model calculation show how this additional price increase is distributed across the different sectors of industry. The model not only takes account of the direct cost effects resulting from the immediate consumption of oil and natural gas, but also of the indirect effects yielded in connection with costs being passed on

⁶ 'The macro-economic effects of the ecological tax reform.' Report commissioned by the Federal Ministry of Finance to be prepared by the DIW in cooperation with Prof. B. Meyer, Osnabrück University, and Prof. H. Welsch, Oldenburg University, and published in November 2000.

through intermediate goods. The oil-price increase will lead to a cost burden of over 1% in 16 of the 58 production sectors observed. The effects on costs vary considerably, ranging from 58% in the area of coke, refined petroleum products and nuclear fuel – the main consumer of crude oil imports – to 10% in air transport, where fuel consumption is a significant cost factor, to only insignificant effects – 0.2% to 0.3% – in some sectors, such as office machinery and computers, and publishing. In most production sectors the cost burden is less than 1%.

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