Oil Price, GDP and International Trade. The Case of Germany

by

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1 INTRODUCTION

Oil price shocks have negative impacts on GDP of oil importing countries. There seems to be evidence for this plausible result from the literature of econometric studies with vector autoregressive models conducted by Darby (1982), Hamilton (1983) and others. Since Mork (1989) has shown that oil price decreases have other effects than oil price increases, the discussion in this literature primarily focuses on the question, whether the effects are symmetric or not. Lee et al. (1995), Hamilton (1996) Jimenez-Rodriguez and Sanchez (2005) and others have shown that non linear estimations give a better explanation of the observations.

The literature of studies with big structural econometric models also comes to the result that oil importing countries are negatively hit by rising oil prices. Since these models depict the structures of the economies and the causality between the oil price and GDP in detail, the discussion in this literature is focussed on the differences of the absolute effect that generally is negative for oil importing countries. The International Energy Agency (2004) found out in simulations with its World Energy Model that in all OECD countries a rise of the oil price will reduce GDP and raise inflation. The effects in Asian countries and in developing countries will be stronger since these countries are more energy intensive than the OECD countries. At the request of the International Energy Agency the US Department of Energy Information Administration also carried out an oil price simulation with the "Global Insight Global Scenario Model" which covers 22 major countries including China and India and the rest of developing Asia (International Energy Agency 2006). The country results are near to that of the previous study.

Both studies with structural models calculate for global GDP a negative impact of a rising oil price, which means that the positive impact on oil exporting countries and their thus induced import demand for goods is not able to compensate the negative cost impact on the oil importing countries. Jimenez-Rodriguez and Sanchez (2005) argue that international trade effects have always reinforced the negative effects under the oil importing countries because these countries trade mostly among themselves and on the other side the oil exporting countries may not spend all of the additional money for goods imports (Jimenez-Rodriguez and Sanchez, 2005, p. 7). The International Energy Agency (2006, p. 312) stresses the last point arguing that it is a critical factor how quickly the windfall profits are spent by the oil exporting countries. It can be observed that these countries have accumulated large trade and budget surpluses.

On the other side one may argue that this behaviour belongs to the past, when a rise of the oil price was – sooner or later – followed by a fall. It seems to be plausible that in times of strong growing oil demand from China, India and other Asian countries and restrictions on the supply side due to reduced oil reserves the price expectations in oil exporting countries will change to a long run growth path. This will favour a more continual spending behaviour of oil exporting countries. Insofar our topic is not the impact of oil price **shocks**, but the effect of permanently rising oil prices on oil importing economies.

Based on this hypothesis the paper at hand asks, whether a stabilizing effect via international trade on the GDP of oil importing countries can be observed, if an oil price

increase occurs. We try to examine specifically the effects on Germany, because it is the third biggest economy in the world and insofar one of the important oil importing countries and is (still!) the leading goods exporting economy. So if there are the effects in question, we should have a chance to observe them.

We run simulations with two linked structural econometric models. The first is the model INFORGE, which disaggregates the German economy into 59 sectors. The second one is the global model GINFORS, which depicts the economies of 50 countries and two regions (OPEC and Rest of the World) in structural detail and links them by bilateral trade with 25 commodities and 1 service good. GINFORS is based on international data (IEA, OECD, IMF), which has the advantage of comparability on the other side the data is poorer than that of national sources. This is the reason, why we combine GINFORS and INFORGE. There is also a model for Germany in the system GINFORS, but the model INFORGE is based on national data and allows a richer structure than the model that is part of GINFORS.

The paper is structured as follows. In chapter 2 both models are presented very shortly. In chapter 3 the baseline and the alternative scenario are discussed. In chapter 4 the results of the simulation are presented. Some conclusions in chapter 5 close the paper.

2 THE INSTRUMENTS OF THE ANALYSIS

2.1 THE MODEL INFORGE

INFORGE (**IN**terindustry **FOR**casting **GE**rmany) is based on two principles : bottom up modelling and full integration, which are typical for the INFORUM philosophy (Almon 1991). Bottom up modelling means that each of the 59 sectors is modelled in detail. Macroeconomic variables like GDP, disposable income or the consumer price index are calculated by explicit aggregation. Full integration implies a complex modelling, which simultaneously depicts the interindustry connections, the generation, distribution and redistribution of income, as well as its demand for goods.

The model could be called an econometric input- output- model (West 1995), owing to the econometric estimation of its parameters and the existence of input- output- connections. But a careful interpretation is necessary here. A Leontief- type model with constant structures is not given. The input- output approach only gives a set of definitions and balance equations. All technological coefficients are dealt with as variables, which are changed by relative prices and technological trends.

Another clarification concerns the classification of input- output- models as demand oriented. This is not the case for INFORGE. All demand variables depend from relative prices and other variables. Prices in turn are given by the unit costs of the firms using the mark- up hypothesis, which is typical for oligopolistic markets. In that regard compared with neoclassical models the difference lies in the assumed market structure and not in the accentuation of either side of the market.

The model supplies a complete macroeconomic system with goods markets, labour market, a reduced form of the money market and a complete SNA system, which includes

the endogenization of the government and social security system. A more detailed description of the model can be found in Meyer et al. (2007a)

2.2 THE MODEL GINFORS

The core of the system GINFORS (**G**lobal **IN**terindustry **FOR**ecasting **S**ystem)is a bilateral trade model, which links for 25 commodities and 1 service good 50 countries and the two regions OPEC and rest of the world. The trade share that a country k has for a specific import good i of country l is depending from the relation between the price of the exporting country and the import price of that good in the importing country and a time trend. All 52*52*26= 70304 trade share functions have been estimated econometrically. Every country model gives a vector of imports and a vector of export prices to the bilateral trade model and gets from it a vector of exports and import prices.

The economies of all 50 countries and the region OPEC are depicted by a macro model, consisting of the modules balance of payments, final demand, labour market, monetary market, and an energy model. The most important 23 countries – including China – additionally have an input- output- model that is fully integrated with the macro model and the energy model. The energy models provide energy demand for 11 energy carriers and estimate trade of oil, gas and coal. All goods prices are endogenous, but the international prices of oil, gas and coal are exogenous. The exchange rates are assumed to be constant in real terms.

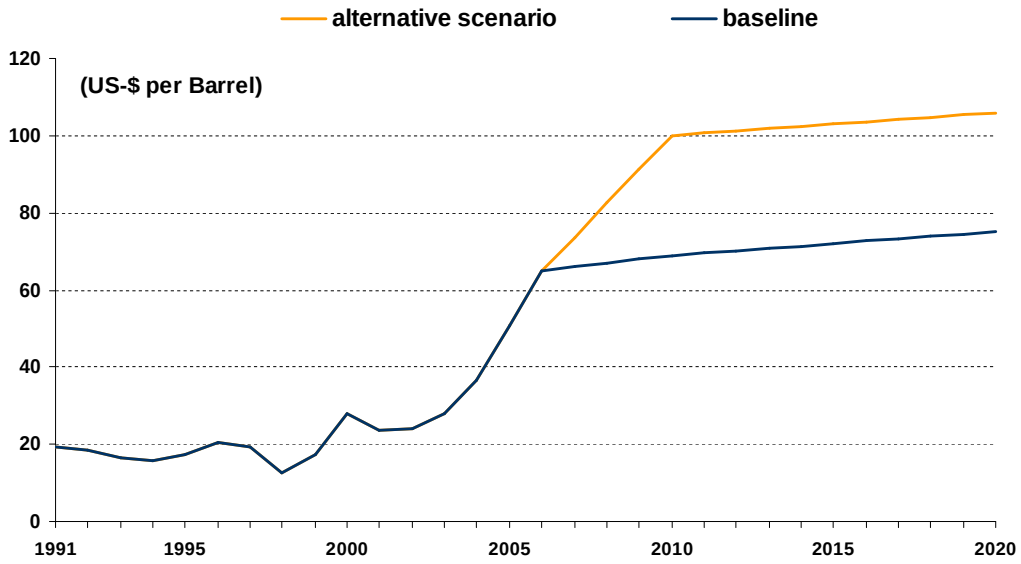
A more detailed presentation of GINFORS give Meyer et al. (2007a), Meyer et. al. (2007b) and Meyer et. al. (2005).

3 THE SCENARIOS

The baseline is a business as usual forecast from 2006 to 2020. The oil price is rising very slowly from 65 US $ to 69 US $ per barrel in 2010 and then needs 10 further years to reach 75 in 2020. In the alternative scenario only the oil- price is changed compared with the baseline. It is assumed that the gas price follows the path of the oil price as it did in the past. Figure 1 shows the assumption of a linear rise till 2010 to reach 100 US $ per barrel. After 2010 the oil price in the alternative scenario has a constant distance of 31 US $ to the base line. So a comparison between the results in 2010 and 2020 will allow for the discrimination of short term and long run effects. This seems to be necessary since the whole system is dynamic and especially the effects via international trade need time since all 50 economies have to react.

For the oil exporting economies linear import- functions have been estimated with GDP as the explaining variable. So the scenario guarantees that – as for every other country – rising exports raise the imports via GDP.

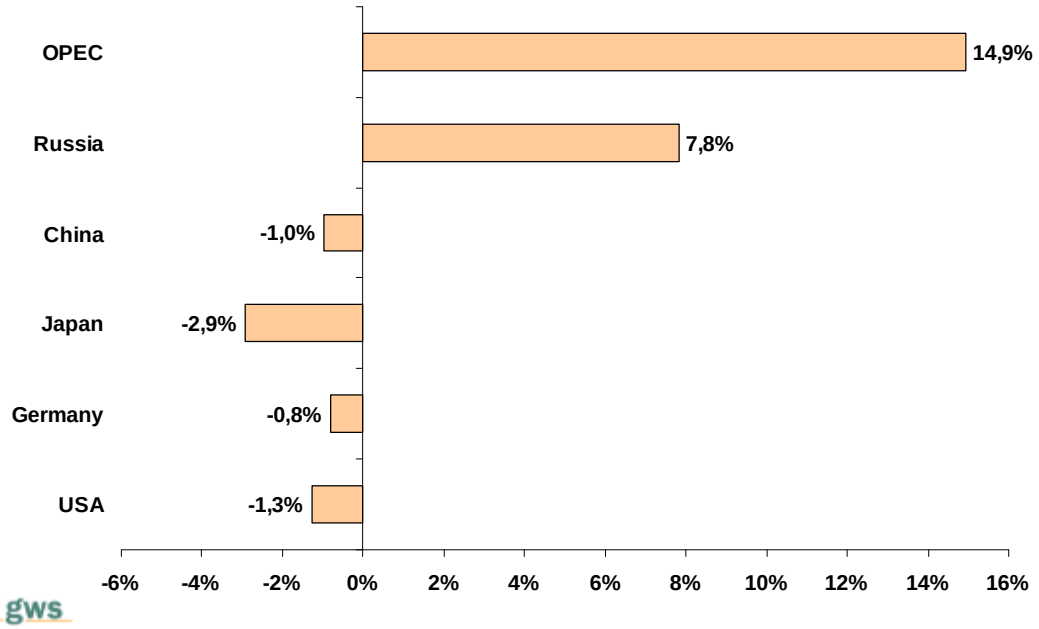
Figure 1: Oil-price development in the baseline and the alternative scenario



4 THE RESULTS OF THE SIMULATION

First we have a look at the results for the short run. In Figure 2 the impact on real GDP for the biggest economies USA, Japan, Germany and China that are also the main oil importing countries is depicted for the year 2010. We get the expected picture: The oil exporting countries/regions Russia and OPEC are winning 14.9 % and 7.8%, whereas the oil importing countries USA, Japan, China and Germany have losses. The differences have many reasons. First the impact depends on the energy intensity and especially on the share that oil and gas have in energy consumption. Secondly the substitution possibilities decide on the cost push that hits the economy and its prices. Thirdly the reaction of domestic demand on the price changes will be important for the total result. And last not least the response of monetary and fiscal policy to stabilize the economy influences the performance of the economy.

Figure 2: **Impact of the rise in oil and gas prices on deflated GDP of selected countries and regions in the year 2010**



These effects are discussed in general in the literature. Our further look is focussed on changes in international demand that are induced by the expanding oil exporting economies. A second international trade effect is induced by changes of the competitiveness of the economies. If an oil importing economy has higher costs and as a consequence higher impacts on its goods prices than its competitors on international markets, it will lose trade shares in export and may suffer from higher import ratios on the goods markets as an indirect consequence of the oil price shock.

Table 1: **Impact of the rise in oil and gas prices on German import prices and deflated exports in the year 2010**

Import price index, all goods	+	5,9%
among these:		
Refined petroleum products	+	22,7%
Motor vehicles	+	1,3%
Machinery	+	1,5%
Furniture	+	2,0%
Deflated Exports, all goods	+	0,7%
among these:		
Motor vehicles	+	2,7%
Machinery	+	1,9%

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Let us have a closer look at Germany, which has the lowest negative impact of the countries mentioned in figure 2. Table 1 shows the effect of the rising oil and gas prices - those variables which link the German economy with the global developments. These are the exports and the import prices. The import prices for mineral oil products rise by 22.7% which is less than the rise of the crude oil price because the mineral oil products price contains also elements of cost for capital and labour inputs. Since all economies in the

world are hit by the oil price shock, the whole import price vector rises, which is documented in table 1 with the examples for motor vehicles, machinery and furniture.

Further the German exports will rise deflated by 0.7%. The absolute effect of + € 8.7 billion is nearly completely achieved with machinery (+ € 2.6 billion) and motor vehicles (+ € 5.9 billion). If we add the related product groups other vehicles (+ € 2.6 billion) and electrical machinery (+ € 0.5 billion) we come to the conclusion that the product groups machinery and vehicles together have a positive deflated impact of + € 11.8 billion. So the export plus for Germany concentrates on these two products, which in deed are a central part of German exports, and the effect on the sum of all other product groups is negative.

Since the export prices for machinery and vehicles rise by the same percentage amount as the import prices – which reflect average world market prices as seen from German imports -, it could be assumed that a change in the trade shares is not responsible for the result. But we have to be careful, since the weights of the international export prices that give the **German** import price of that product groups are not the same as in the different German export markets. This can make a big difference, because imports of machinery und vehicles in Germany are to a large extend intermediate products, whereas Germany sells finished products on its export markets. Another explanation is that these product groups have a relative high share in the imports of oil exporting countries and that Germany is an important bilateral partner of these countries concerning these product groups.

For German households severe problems will arise, since the prices for household energy demand will rise by 13.7% in the average, the user costs for cars will rise by 10.7% and the prices for transportation services will be 9.5% higher than in the baseline (table 2).In the average prices for consumption goods rise by 2.7%.

Table 2: Impact of the rise in oil and gas prices on selected consumer prices in Germany in the year 2010

Consumer price index, all goods	+	2,7%
beneath this:		
Energy (Electricity, gas and other fuels)	+	13,7%
Operation of vehicles	+	10,7%
Transports services	+	9,5%

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Of course households can not reduce their oil and gas consumption so much that the expenditure for the related consumption categories can be kept constant. Price elasticities for energy demand are much less than one in absolute value, so that expenditure for energy has to rise. Since in nominal terms the disposable income of households remains more or less constant, other consumption categories have to be reduced. So the whole vector of private consumption will be shortened. Employment falls, because production is reduced, and wage rates will rise less than prices because unemployment is growing.

Table 3 shows the macroeconomic effects for the year 2010 in the first column: Deflated gross production is reduced by 1.1%. Deflated imports reduce stronger with -1.4% since oil and gas are reduced by rising energy efficiency and substitution. So the impact on deflated GDP is with -0.8% less than the impact on gross production. Since the inflator of GDP is rising by 0.9% we get a small plus of 0.1% in nominal GDP. Because

Table 3: Macroeconomic effects of the rise in oil and gas prices in Germany

	2010	2020
Deflated gross production	-1,1%	-0,6%
Deflated gross domestic product	-0,8%	-0,1%
Components:		
Final consumption expenditure by households	-2,1%	-1,7%
Final consumption expenditure by government	-1,6%	-1,9%
Gross fixed capital formation: machinery and equipment	-0,6%	-0,8%
Gross fixed capital formation: dwellings, other buildings and structures	-0,9%	-1,0%
Exports	0,7%	1,9%
Imports	-1,4%	-0,6%
Economically active population	- 360.000	- 321.000

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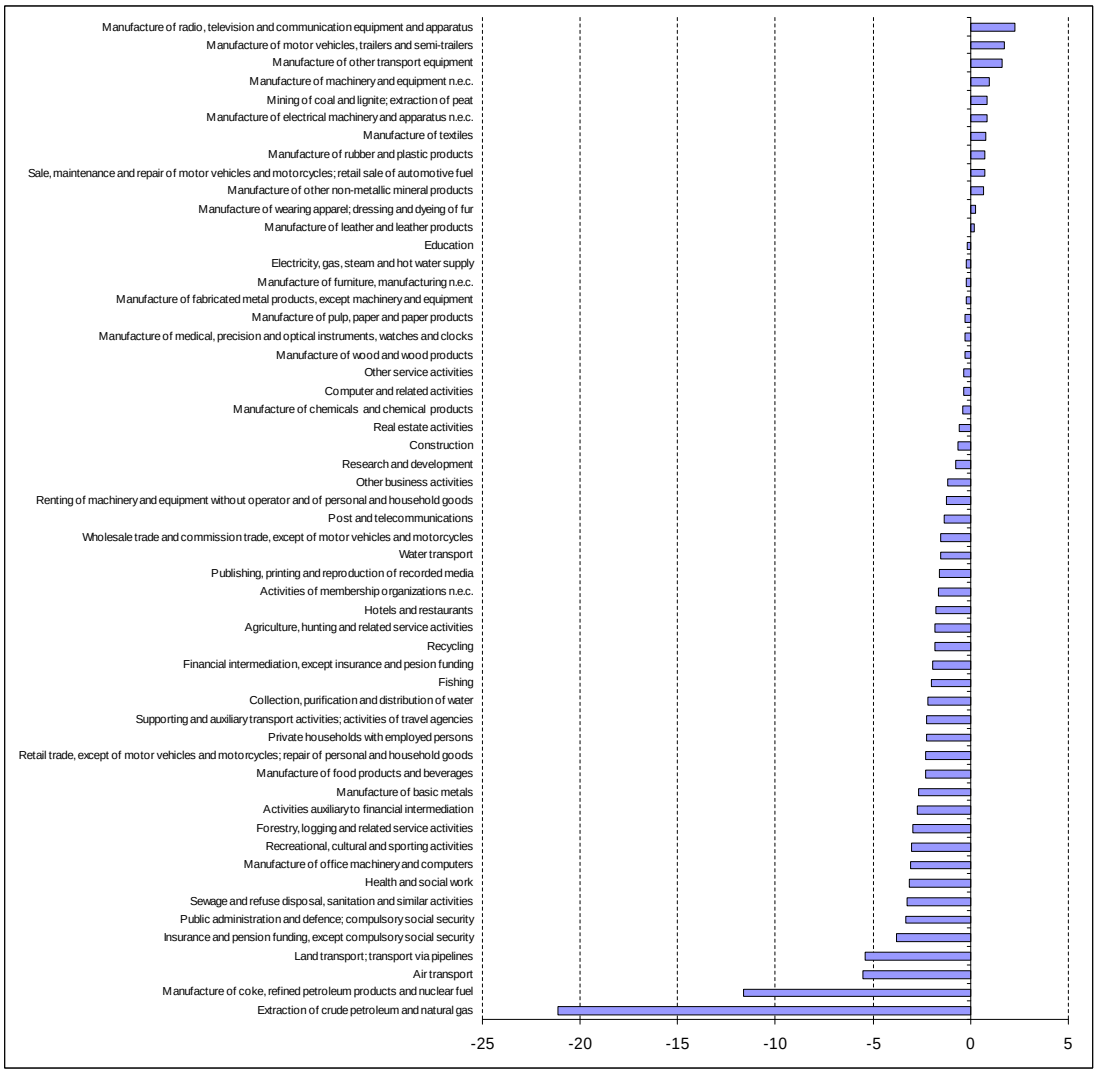
Figure 3: Impact of the rise in oil and gas prices on deflated production in the German sectors in the year 2010



nominal disposable rises by 0.5%, private consumption falls due to the rise of consumer prices of 2.7% with -2.1%. Since the economy in nominal terms is relatively stable, the government also has unchanged tax revenues, which means that the deflated public

expenditure reduces by 1.6%. Investment follows GDP, and exports rise as already discussed deflated by 0.7%. Employment is reduced by 360.000 persons which in relative terms is less than the reduction in gross production. The reason is the already discussed fall of the real wage rate.

As figure 3 shows, losses of production are dominating in most industries. But there is rising production in machinery, motor vehicles and some other sectors that produce investment goods. In these industries rising exports are able to overcompensate losses from domestic investment demand. As can be expected, oil extraction, oil refineries and oil intensive sectors like transportation are on the negative side of figure 3. We further find typical producers of consumption goods and the producers of intermediate products and services.

Let us now have a look at the long run development after 2010, when the oil price in the alternative scenario has a constant distance to its value in the baseline. So there is no further cost pressure from the oil price, but we can observe now the implications of the dynamics of international trade and the dynamics that are happening at the labour market. The results for deflated GDP and its components are given in the second column of table 3. The exports further rise and reach +1.9% in 2020. Compared with the situation in 2010 the reduction of gross production is nearly halved to -0.6%. Imports have now the same deviation from the baseline. This is at the first sight astonishing since the reductions of oil and gas inputs should induce a stronger reduction than that of gross production – as observed in 2010. But this effect is compensated by the rise of exports of investment goods, which have a higher import ratio than the average production. Employment has with -321000 persons a relative reduction of 0.8%. This is a bit more than gross production. Once more the relative high import ratio is the explanation. The real wage rate – which was fallen in 2010 against the baseline – is now the same as in the baseline, because the nominal wage rate rises with 2.5% as producer prices do. This effect as well as the relative persistence of imports explains why employment does not significantly change compared with 2010 and has in 2020 with -321000 persons a reduction of 0.8% against the baseline, which together with the movement of the wage rate gives allows labour income to rise with 1.7%. Since profits fall, disposable income rises only with 1.0%. The rise of consumer prices (+2.7%) urges a reduction of private consumption of 1.7%.

5 CONCLUSIONS

After all reactions have passed, the German economy at all is not hit negatively by the rising oil price. But we observe a strong structural divergence. Since the higher oil prices are a world wide phenomenon, firms are able to raise their goods prices. The losers are the consumers, who have to pay the bill.

Those industries that primarily produce for consumption suffer from reduced demand, higher costs and have to drop employment. On the other side investment industries like motor vehicles and machinery, which have high export ratios, sell more. Two reasons explain this result. First Germany is not hit as strong as its competitors on international markets for investment goods by the rising oil prices, so that the goods prices for German investment goods rise less than in other countries, which will generally raise the German

trade shares. A second reason is that Germany as an international supplier of investment goods is positively affected by rising investment demand of oil exporting countries. Both effects over compensate reductions of imports of investment goods of oil importing countries.

Further research has to clarify these points and to analyze the meaning of international trade for the oil price dependency of other oil importing countries. The results of the paper at hand show that the analysis of the economic meaning of rising oil prices has to be completed by the effects that are induced by international trade. At least for Germany the reaction of the economy can not be understood without a multisector/multicountry analysis of bilateral international trade.

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