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K. CO_2 - Taxes, Growth, Labor Market Effects and Structural Change – An Empirical Analysis

Bernd Meyer

1. Introduction

In 1990 the German government announced the target to reduce the CO_2-emissions by 25% in relation to the historical value of that year till 2005.

At the Berlin-conference in 1995 the target was widened for unified Germany, which meant a reduction of the efforts, because the Eastern German industry had had very big CO_2-emissions in 1990, but with the break-down of these old structures in the following years, nearly half of the target was already reached in 1995. In 1997 a further target was announced by all EU-countries: Reduction of the CO_2-emissions by 15% in relation to the historical value of 1990 till 2010.

The paper at hand discusses the question whether the 25% target can be reached in Germany and which consequences for growth, employment and structural change this may have. Different from the official targeting we take as the base year 1991 - the year of the unification. So the numbers to be compared are measured for the same country. As the year of the target we choose 2010, because in the meantime there is no voice in the open debate, which hopes to reach the target in 2005.

The environmental policy under question will be an increasing carbon-tax, which has to be paid by the producers and the importers of fossile energy-carriers. The government will give the tax-income back to the economy reducing the payments of the firms for social security.

Instrument of the analysis is the economic-environmental model PANTA RHEI (greek philosopher Heraklit: "all things flow"). The name is program: PANTA RHEI is the environmentally extended version of the dynamic fully integrated input-output-model with variable structures INFORGE, which is a member of the international INFORUM-family of models (NYHUS, 1991).

With a first version of the model PANTA RHEI the effects of the introduction of pollution rights were discussed for the Western German economy (MEYER, EWERHART, 1997). With a more extended model - PANTA RHEI II - the possibilities of reaching the 25% target for Western Germany by carbon-tax were analyzed (MEYER, BOCKERMANN, EWERHART, LUTZ, 1997, 1998). At least PANTA RHEI III was created (MEYER, BOCKERMANN, EWERHART, LUTZ, 1999), which covers unified Germany. With this system a comparing analysis of the effects of an eco-tax-scenario and a pollution-right scenario to reach the EU target

of a 15% reduction of CO_2 and different targets for SO_2 and NO_x was prepared (MEYER, BOCKERMANN, EWERHART, LUTZ, 1999). The paper at hand summarizes the results of the eco-tax scenario for the CO_2-reduction target.

We will see, that a slowly increasing eco-tax combined with the compensation of social security payments of the firms will yield the double dividend: The environmental target will be reached simultaneously with growing employment.

2. The Model

2.1 A First Characterization

PANTA RHEI is an ecologically extended version of the 58 sector econometric simulation and forecasting model INFORGE (Interindustry Forecasting Germany) (MEYER, EWERHART, 1997; (MEYER, BOCKERMANN, EWERHART, LUTZ, 1998). Its performance is founded on the INFORUM philosophy (ALMON, 1991), what means to build econometric input-output models *bottom up* and *fully integrated.* The construction principle *bottom up* says that each sector of the economy has to be modelled in great detail and that the macroeconomic aggregates have to be calculated by explicit aggregation within the model. The construction principle *fully integrated* means a model structure that takes into account the input-output structure, the complexity and simultaneity of income creation and distribution in the different sectors, its redistribution among the sectors, and its use for the different goods and services the sectors produce in the context of globalizing markets. In this way one succeeds to describe properly the role of each sector in the interindustry relations, its role in the macroeconomic process as well as its integration into international trade.

These conceptual advantages end up in a consistent and powerful processing of sectoral and macroeconomic information. The about 30.000 equations of INFORGE describe the interindustry flows between the 58 sectors, their deliveries to personal consumption, government, equipment investment, construction, inventory investment exports as well as prices, wages, output, imports, employment, labour compensation, profits, taxes, etc. for each sector as well as for the macro economy. In addition the model describes the income redistribution in full detail. The model frequency is annual, the model updating frequency is semi-annual.

PANTA RHEI additionally is equipped with a deeply disaggregated energy - and air-pollution-model, which distinguishes 29 energy carriers and their inputs in 58 production sectors and households as well as 8 air pollutants (CO_2, SO_2, NO_x, NMVOC, CH_4, CO, N_2O) and their relations to the 29 energy carriers. The energy demand is fully integrated into the intermediate demand of the firms and the consumption demand of the households.

INFORGE is part of the INFORUM International System (NYHUS, 1991) that links 13 national I-O models on the sectoral level via export and import flows as well as the corresponding foreign trade prices. The information gain of this system in comparison to isolated models allows for a reliable analysis of the important contribution of exports for the performance of the German economy. The International System forecasts the economic development of Belgium, Germany, France, Great Britain, Italy, the Netherlands, Austria, Spain, USA, Canada, Mexico, Japan, und South-Korea in full sectoral disaggregation. This world trade model is being developped steadily, in the near future models for China, Taiwan, and Poland will be integrated into the system (MA, 1997; NYHUS, WANG, 1997). Besides the goods markets the INFORUM International System also represents the international financial markets, though in a less detailed way: American interest rates as indicators for the international capital market condition have a weighty influence on German interest rates and by this means once again on the German goods markets.

2.2 The Philosophy of the Model

PANTA RHEI belongs to the class of Econometric Input Output Models, which differ from neoclassical approaches assuming bounded rationality. In this category we find the models of the INFORUM connection (ALMON, 1991) and the European system E3ME (BARKER, GARDINER, 1996). Neoclassical models appear in the literature in two variants. First there are only a few models with econometrically estimated parameters (JORGENSON, WILCOXEN, 1993). The CGE models as the second group use only the data for one year for fixing their parameters. This type of neoclassical modelling is much more popular.

Neoclassical economists emphasize the clearness and generality of their theoretical approach, which derives behavioral functions from an optimization rule and centers them into an equilibrium concept. Econometric Input-Output- models are criticized, because bounded rationality enforces ad-hoc assumptions. On the other hand neoclassical theorizing is based on unrealistic assumptions about the agent's information in complex decision situations. From this perspective, there is more generality in the picture of the interdependency of volumes and prices presented by an Econometric Input Output model than in stories told by neoclassical approaches, because it is not necessary to base the analysis on the restrictive assumptions of general equilibrium (BARKER, 1997).

In Econometric Input- Output models, the release of a closed modelling concept is compensated by the emphasis of the empirical data base. We agree with Selten (SELTEN, 1991, p.19), who comes to the point, that it is better to use empirically tested ad-hoc assumptions than unrealistic principals of high generality and elegance. Our agents follow empirically tested routines (NELSON, WINTER, 1982). So for example instead of equilibrium prices we use the mark-up hypothesis.

The model has a high degree of interdependency. Additional to the common interdependencies of income generation the interdependencies of volumes and prices and the wage-price-interdependency are depicted. Further the model is marked by nonlinearities, which appear by multiplicative combinations of variables in definitions and estimated equations and double-log specifications. The consequence of the overall interdependency and the nonlinearity is the necessity to solve the model as one simultaneous block. Of course such a structure produces difficulties in handling the system, but on the other side each run of the model is a strong test: A bad hypothesis will produce instabilities and the solution will not converge.

The model has a high degree of endogenization. Exogenously given are only some tax rates, labour supply and the world market variables of the international INFORUM system. Since PANTA RHEI itself is part of the international system, the world market variables are also endogenous in a linked run of all models. The high degree of endogenization has the advantage, that in simulations the effects are depicted completly. If in an application the exogenity of certain variables is wanted, this can be done of course easily. Furthermore all variables, which are not calculated by definitions, can be influenced by additive and multiplicative factors, so that they remain endogenous, but nevertheless can be object of the formulation of scenarios.

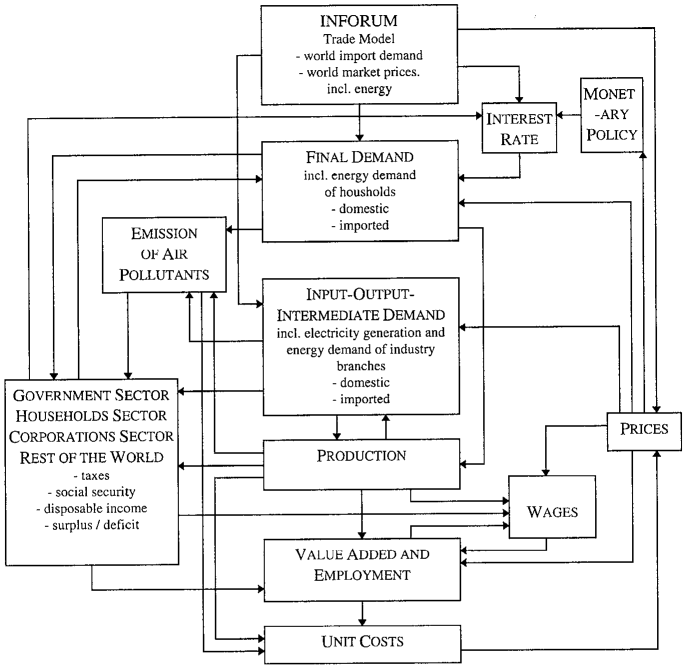
The model was estimated econometrically over the period 1978 - 1994. The transition from West Germany to Germany in 1991 was managed using additive and multiplicative dummyvariables. Our experience with this approach is very positiv. We do not share the fears of some colleages, that this structural break prohibits econometric modelling for Germany for many years.

Selecting the specification from different alternatives we first used a priori information about sign and magnitudes of the parameters. Or in other words: Estimation results without any evidence were eliminated. The by this criterion accepted estimations were tested statistically for autocorrelation of the residuals with the Durbin - Watson statistic and the t-test for the significance of the estimated parameters. If so far a discrimination was not possible, the coefficient of determination was used in the last stage.

2.3 The Structure of the Model

Figure K1 gives a rough impression of the structure of the model. The INFORUM international system delivers the vector of world import demand for product groups, the vector of world market prices for product groups and the US rates of interest. The vector of world market prices includes energy prices.

Fig. K1: Structure of the Model PANTA RHEI



Final demand has the components private consumption, public consumption, equipment, construction, exports, inventories and imports of finished products in the disaggregation of 58 product groups. The consumption of private households includes their demand of energy disaggregated into 29 energy carriers.

The most important determinants of final demand are the world trade variables (explaining exports), disposable income of private and public households (explaining private and public consumption), the interest rates and profits (investment) and the relative prices for all components and product groups of final demand. Via energy consumption private consumption influences air pollutants emissions.

Intermediate demand of the firms is depicted including energy demand and energy conversion. Five (coal, gas, raw oil, electricity and mineral oil) of the 58

product groups of the German input-output account are energy sectors. Their deliveries to each of the 58 product groups are disaggregated into 29 energy carriers. For all intermediate inputs we distinguish deliveries from domestic production and imports. In general the inputcoefficients are variable and depend from relative prices and time trends.

The energetic air pollutants emissions for CO_2, NO_x and SO_2 are combined by constant (CO_2) resp. variable (NO_x and SO_2) emissioncoefficients with the demand of private households and 58 production sectors in the disaggregation of the 29 energy carriers. Depending on the particular environmental policy these emissions influence the unit costs of the firms and the tax income of the government.

The most important determinants of employment are production and the real wage rate of the sector. Wage rates are estimated by productivity and prices. Profits and unit costs are given by definition. Unit costs of the product group and the prices of competing imports are the most important determinants of sectoral prices.

Besides the deeply disaggregated input- output account the model contains the SNA for Germany with the institutional transactors public households, private households, corporations and rest of the world and the functional transactors production, generation of income, distribution of income, redistribution of income, capital account and financial account. This system contains the whole income redistribution of social security and taxation between the government, private households and corporations and thus allows to calculate disposable income figures of public and private households, which are central determinants of final demand. Another important outcome of the SNA part of the model are the net lendings/borrowings of the institutional transactors, which have influence on the interest rates.

Interest rates are further determined by the US rate of government bonds and monetary policy variables, which react on price signals.

3. The Scenarios

In this chapter we give a short description of the assumptions, which define our Business-as-usual (Bau) and the eco-tax-scenario and the short overview of the results of the Bau-scenario.

3.1 The Business-As-Usual-Scenario and Its Results

We assume, that the exchange rates and the American interest rate remain on the level, which they just have. The world-market prices and the world import demand of the different product groups are taken from a linked run of the international INFORUM-system. The German fiscal and monetary policy are endogenous parts of

INFORGE. The environmental and energy policy remain unchanged till 2010. This means especially, that the market shares of nuclear energy and alternative energy carriers like wind and solar energy do not change. We further assume, that the subsidies for coal will be paid further on.

Table K1 gives the averages of the growth rates for important macrovariables over the whole period till 2010. Real gdp will grow with 1,7% a little bit slowlier than in the eighties (2,2%). Most dynamic variables will be the exports with an average growth rate of 4,0%, whereas private consumption limps with only 1,4%.

The rate of unemployment in 2010 (9,0%) will be lower than today, but remain to be unacceptable. The CO_2-emissions in 2010 (855 Mio t) will be a little bit higher than today and miss the target by 140 Mio t.

Tab. K1: The Base Solution (average growth rates p. a. between 1998 and 2010 in prices of 1991)

Gross domestic product	1.7
Personal consumption expenditures	1.4
Public consumption expenditures	1.6
Investment in equipment	2.3
Construction	0.7
Exports	4.0
Imports	3.2
Producer Prices	1.8
CO_2 emissions in 2010 in Mt	855
Unemployment rate in 2010	9.0

3.2 The Eco-Tax-Scenario

We now add to the just mentioned assumptions of the Bau-scenario the following points:

- Every producer and importer of fossile energy carriers has to pay taxes in relation to the CO_2-emissions, which are set free when the specific energy carrier is burned.

- Producers and importers of fossile energy carriers raise their prices due to the tax-payment.
- The government starts with a tax rate of 10 DM/t CO_2 in 1999 and raises the tax rate to 277 DM/t CO_2 in 2010.
- We will discuss different alternatives for the use of the tax revenue by the government.
- The import price for electricity follows the domestic price.

The last assumption allows two interpretations. The first is, that there is a parallel eco-tax-policy in the other countries of the EU. This is resonable, since all EU countries have formulated the target of a 15% reduction of CO_2-emissions based on the 1991 figure till 2010. A second interpretation is, that Germany tries a separate eco-tax-policy and raises a tarif on imported electricity. Of course this is a more theoretical interpretation, because this would violate the existing EU-law.

4. Results of Carbon Tax Simulations: The Meaning of Different Compensation Strategies

We now want to give a short report of the macroeconomic results of some carbon tax simulations focussing the usage of the tax revenue by the government. We will see, that PANTA RHEI gives a very complete picture of the interdependencies, that have to be considered.

We distinguish five alternatives for use of the tax revenue:

(1) The government accumulates the tax in a thesaurus.

(2) The government reduces the debt with the tax income.

(3) The employers' social contributions are reduced.

(4) The employees' social contributions are reduced.

(5) 50 % of the tax are used for reducing the governments debt, 25% are used for reducing employers' social contribution and the same amount diminishes employees' social contributions.

We exogenized employment of the government in order to get employment reactions only from the private sectors.

In table K2 we find the results of these scenarios and a base solution for some macroeconomic variables and the emissions for the air pollutants CO_2, NO_x and SO_2. in absolute figures for the year 2010.

First of all we can see, that gdp is in all policy scenarios lower than in the base solution. Of course the strongest reduction appears, if no compensation is given (no.1). If the tax is used by the government for the reduction of its debt (no.2), the direct effects on economic activity are the same as in simulation no.1, but now additionally the governments credit demand is reduced, which lowers the

interest rate for government bonds and raises investment demand. This effect explains, why gdp in scenario 2 is a little bit higher than in scenario 1.

Tab. K2: Results for the Main Macro-Economic Aggregates in 2010

base solution	without compensation (No. 1)	Reduction of national debt (No. 2)	Reduction of employers' social contribution (No. 3)	Reduction of employees' social contribution (No. 4)	Reduction of national debt, employers' and employees' social
Gross domestic product in prices of 1991					
3885,9	3436,0	3448,5	3660,1	3599,2	3537,2
Rate of inflation					
2,5	3,2	3,2	3,0	3,2	3,2
Rate of umemployment					
9,0	11,4	11,4	6,9	10,5	10,14
Ratio of general government activity					
47,3	47,7	47,7	46,5	47,4	47,4
Net lending of general government (in Mrd. DM)					
-116,3	-194,3	-13,9	-20,9	-136,0	-45,3
Ratio of compensation of employees to net domestic product					
72,0	75,0	74,9	71,3	74,5	73,9
Carbon dioxid (in million tons)					
855,2	670,3	671,3	710,5	699,7	687,8
Nitrogen oxid (in thousand tons)					
1945,6	1611,0	1614,5	1716,7	1685,7	1656,7
Sulphur dioxid (in thousand tons)					
719,5	505,2	506,0	542,8	525,1	519,5

If the government gives the tax income back to reduce the social contributions, the negative effect on gdp is much lower than in scenario 2. Scenario 4 reduces the employees' social contribution, which gives higher disposable income and consumption for private households. A better result can be achieved by a reduction of the employers' social contributions: In this case labour costs diminish and this gives more employment and on this way also more final demand. Scenario 5 is a mix of 2, 3 and 4 and clearly has results in between.

The reduction of the employers' social contributions is the dominant policy. The rate of inflation is with 3% only a little bit higher than in the base solution (2.5%) and the rate of unemployment is even lower than in the base solution, whereas this figure has a bad performance in all other policy scenarios. The „double

dividend" is realized in spite of the negative effects on gdp, because the lower labour costs reduces the growth of labour productivity.

Also the ratio of government activity is in scenario 3 lower than in the base solution and in all policy scenarios.

It is clear, that net lending of the government improves in scenario 2 in comparison with the thesaurus scenario 1. But why do we get a nearly as high improvement, if the government gives the tax income back to reduce the employers' social contributions? The answer is, that with exogenous employment at the government and falling (relative to the base solution and the other scenarios) labour costs public demand falls and net lending rises. This effect also explains, why in the case of the reduction of emloyees' social contributions net lending of the government is worse than in the base solution: In this case there is no reduction of labour costs and the in comparison with the base solution lower gdp yields lower taxes than in the base solution.

The share of wage income rises in the scenario without compensation (no. 1) in comparison to the base solution. The carbon tax compresses profits relative to wage income. The compensation via employers' social contribution corrects this detoriation of thc income distribution. We have in scenario 3 nearly the same income distribution as in the base solution.

In every simulation the emissions are heavily reduced: Compared to the standard in the year 1990 (about 1000 million tons), which is often used for discribing targets of CO_2-emissions, emissions of carbon dioxid decrease from 29% up to 33%. Nearly the same reduction is achived for NO_x and SO_2 by only imposing a tax on CO_2. Obviously the smallest effect is reached for the policy scenario with the best economic outlook.

5. Eco Taxes and the Reduction of Employers' Social Contribution

We now will have a deeper look into simulation no. 3, in which it is assumed, that the government uses the eco-tax revenue to reduce the employers' social contributions. We are especially interested in this scenario, because the environmental target of a 25% reduction of CO_2 - emissions is realized with a relatively good economic performance.

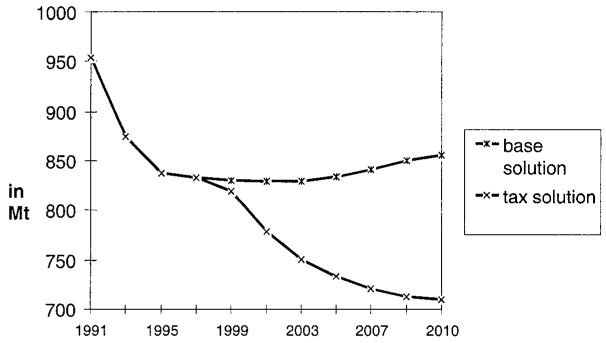
5.1 The Macroeconomic Results

Let us first have a look at the CO_2-emissions in figure K2. We see, that the historical development at the beginning of the nineties is characterized by the slow-down of the old industrystructures in East-Germany, which strongly reduced CO_2-emissions. Till the year 2000 there will be a further slow reduction, because eco-

nomic growth will still be relatively weak. After 2000 we expect for the Bau-scenario growth rates, which lie above the productivity gains of energy consumption. This will raise CO_2-emissions after 2000.

Let us now look in more detail at the results for the compensation strategy „Reduction of the employers' social contribution".

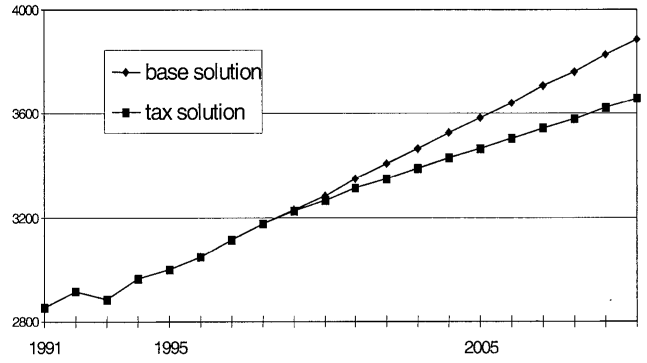
Fig. K2: CO_2 Emissions



In the eco-tax-scenario we will have strong reductions of CO_2-emissions so that the figure for 2010 (710 Mio t) will be 25% below the historical value of 1991. This means, that the target of the German government would be reached.

Figure K3 compares the development of the real gdp in both scenarios: The growth-path of the economy will be a little bit steeper in the Bau-scenario than in the eco-tax-scenario.

Fig. K3: GDP in Prices of 1991 in the Base- and in the Tax Solution



In table K3 we look at the results for the target year 2010. We find deviations between the Bau-scenario and the eco-tax-scenario in percent for important macroeconomic variables. The domestic demand variables investment and consumption are hit stronger than the exports, which nearly do not react at all. Prices will be about 3% higher in the tax-scenario than in the Bau scenario.

The slight reduction of final demand does not penetrate employment. The rate of unemployment will be 6,9% in the eco-tax-scenario against 9,0% in the Bau-scenario. This means, that the number of employment in the eco-tax-scenario will be 867 thousand (2,4%) above that figure in the Bau-scenario.

Tab. K3: Effects of CO_2 Reduction Strategies (percentage differences relative to the base solution in 2010 in percent)

	Tax solution
Gross domestic product	- 5.8
Private consumption expenditures	- 7.7
Public consumption expenditures	- 8.6
Investment in equipment	- 9.2
Construction	- 1.1
Exports	- 1.2
Imports	- 4.4
Producer Prices	+ 3.4
CO_2	-16.9
Price of CO_2 in DM/t in 2010	277.2
Unemployment rate in 2010	6.92

5.2 The Effects on Prices and Energy Demand

The tax burden for the energy carriers is very different, because their contents of CO_2-varies very much. Figure K4 shows, that the price for crude brown coal will be in 2010 500% above its value of the Bau-scenario, whereas gas will be only 150% more expensive.

Secondary energy like electricity and mineral oils are not taxed. They get higher prices because their production costs rise with the prices of the fossile energy-carriers. Of course then we have a lower increase of prices, because the other factors of production have relatively stable prices and labour will be cheaper because the social security costs for the firms fall.

The effects on some selected output prices are shown in figure K5. The strongest effects are of course to be found in the energy-intensive sectors like steel and nonferrous metals. But we have to take in account, that a deviation of + 8,9% in 2010 means, the growth rate of the price for steel is 0,7% higher per year if there is an eco-tax-policy. In the average of all sectors the deviation in 2010 is only 4,8% or in other words: The rate of inflation will be 0,35% higher in the eco-tax-scenario than in the Bau-scenario.

It is remarkable, that the sectors chemical products, electrical machinery, machinery and road vehicles, which together represent more than 60% of the German exports, we have nearly no rising prices but in two cases falling prices. Here the higher energy-costs are more than compensated by falling labour costs.

In figure K6 the effects of the eco-taxes on some important energy-carriers are summarized. According to our expectations the demand for crude brown coal reduces most and the demand for gas has the lowest losses.

In figure K7 we look at the inputs of different energy-carriers in the production of electricity. In this very important energy-sector we watch on the one side growing efficiency: All energy-inputs reduce by 6,8%. On the other side we recognize substitution of the „dirty" crude brown coal by the „clean" energy carriers gas and light mineral oil. Nuclear energy and water do not change.

5.3 The Effects on Production and Employment

Figure K8 shows, that the production effects concentrate on the energy-sector and - in a weaker form - the energy-intensive sectors steel and nonferrous metals. Coal mining would lose the half of its production, which hits this sector in his existence.

All the other sectors are nearly inaffected: Over all sectors (the energy-sectors are included) the reduction of the outputs in 2010 against the Bau-scenario would be only 5,4%. The average growth rate per year would be only 0,4% lower than in the Bau-scenario. Really neglectable are the effects in the industrial heart of Germany, which consists of the sectors road vehicles, machinery, electrical machinery and chemical products.

In figure K9 we look at the relative change of working hours in selected sectors on 2010. The break down of employment in coal mining and the losses of working hours in steel and in nonferrous metals have to be compared with the gains in all other mentioned sectors. Summarizing over all sectors employment grows by 3,3%. So the fall of the wage rate overcompensates the negative effects resulting from the reduction of production.

What does this mean in absolute terms? Figure K10 gives the answer: The labour intensive sector other market services has the strongest expansion of employment, which is nearly six times the fall of employment in coal mining. But we have also growing employment in many manufacturing sectors.

Fig. K4: Relative Change of Selected Prices for Fuels in 2010: Tax Solution Against Base Solution

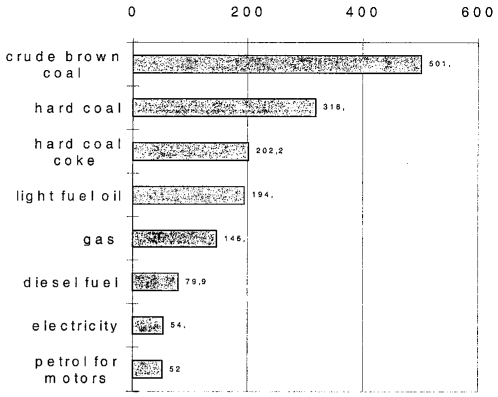


Fig. K5: Relative Change of Selected Prices for Gross Production in 2010: Tax Solution Against Base Solution

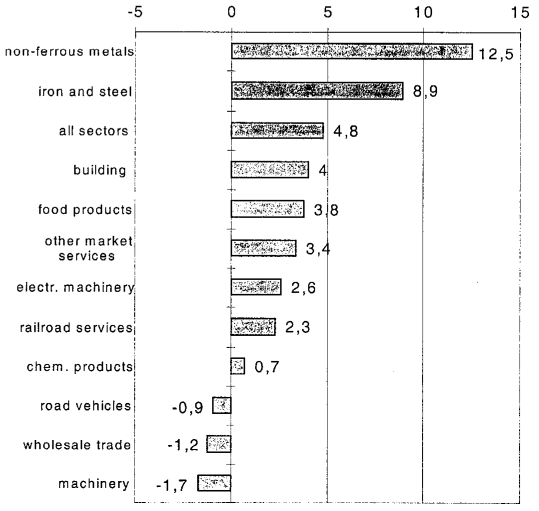


Fig. K6: Relative Change of Energy-Inputs in Petajoule for Different Fuels in 2010: Tax Solution Against Base

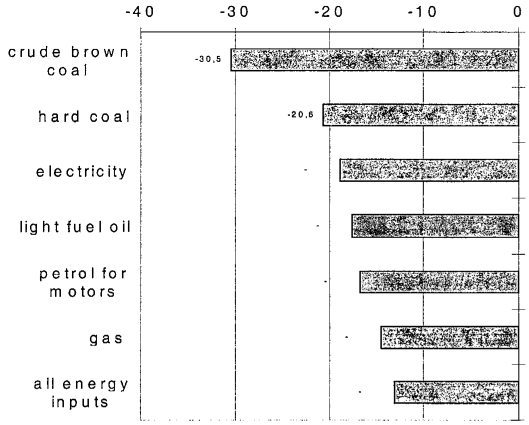


Fig. K7: Relative Change of Energy-Inputs in Petajoule in the Sector Electricity in 2010: Tax Solution Against Base Solution

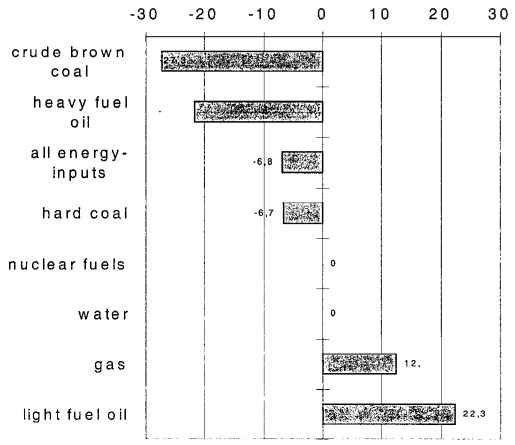


Fig. K8: Relative Change of Real Gross Production in Selected Sectors in 2010: Tax Solution Against Base Solution

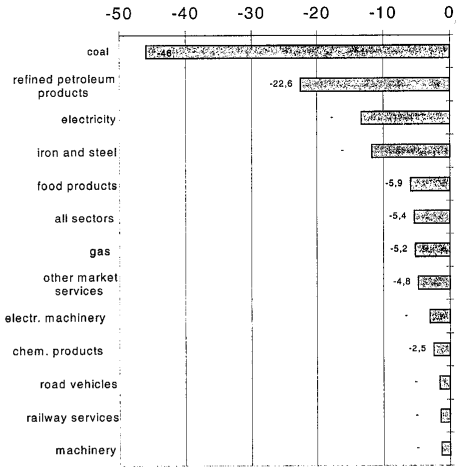


Fig. K9: Relative Change of Working Hours in Selected Sectors in 2010: Tax Solution Against Base Solution

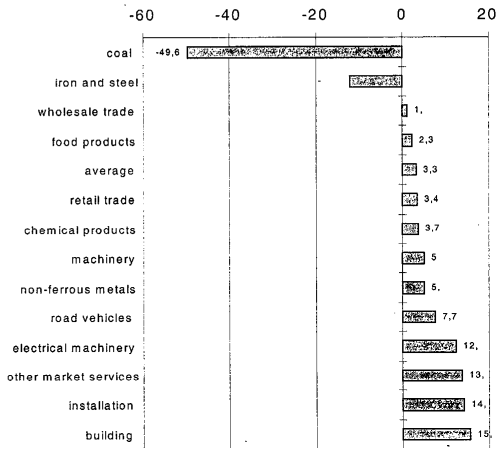
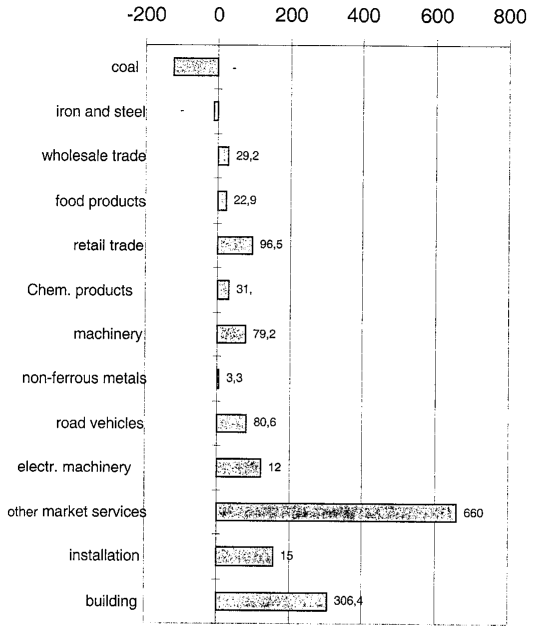


Fig. K10: Change of Million Working Hours in Selected Sectors in 2010: Tax Solution Against Base Solution



5.4 The Burden for Private Households

Without an eco-tax the price for gasoline would rise up to 2,15 DM/l in 2010 (see table K4).

If we choose the eco-tax-scenario, we would get a price for gasoline of 3,27 DM/l in 2010, which gives a deviation of 52,1%. The effect on the consumer-price for electricity would be like that, whereas the energy-carriers, which are used for heating-light mineral oil and gas - would rise with 203% and 140% much stronger.

Tab. K4: The Effects of the Tax Solution on Selected Energy Prices of Private Consumption in 2010

	base solution	tax solution	relative deviation
prices of gasoline	2,15 DM/l	3,27 DM/l	+ 52,1 %
price of light fuel oil	0,82 DM/l	2,49 DM/l	+ 203,6 %
price of electricity	29,9 Pf/kWh	46,2 Pf/kWh	+ 54,2 %
price of gas	7,5 Pf/kWh	18,0 Pf/kWh	+ 140,5 %

The nominal share of the three energy-consumption-categories gasoline heating and electricity on whole consumption was 6,1% in 1991 (table K5). In the Bau-scenario we will have a short reduction of this figure till 2010 to 5,8%, because there will be technical progress especially in the consumption of gasoline.

After the introduction of the eco-tax households will not be able to compensate the rising energy prices by reduction of the demand volumes completely. So the nominal share of energy consumption will rise to 9,1% in 2010. This refers especially to rising expenditures for heating. Nevertheless we should not be afraid, that the end of all times is coming. The expenditures for energy remain in an acceptable area.

Tab. K5: Share of Different Consumption Categories in Total Expenditures of Private Households

	1991 (for comparison)	base solution in 2010	CO_2-Tax in 2010
gasoline	2,8	2,7	3,6
heating	1,4	1,4	3,3
electricity	1,9	1,9	2,2
Σ	6,1	5,8	9,1

6. Conclusions

The last simulations show, that an eco-tax is not necessarily combined with a break down of the economy. But other model runs, with different compensation strategies, have made clear, that this really can be the case. If the compensation would be paid to the households, employment would fall and gdp would reduce three times stronger than in the last scenario. Households would have to reduce their consump-

tion by 4,5%. So the on the first view „better" position in the distribution of income would generate a lower level of income and consumption than in our scenario.

The special kind of our eco-tax proposal, which is directed to the producers and importers of fossile energy carriers is to be recommended also in respect to its practicability: The administrative costs will be very low, because there are only some firms, which have to bc taxed. The dynamic character of the eco-tax will need the installation of an autonomous institution like the „Bundesbank", which would have to rise the tax-rates from year to year following the target of sustainability.

The presented results are not too optimistic, because the further development of alternative energies is not considered. But we can be shure, that with rising prices of fossile energy-carriers the production of solar-energy will be profitable, so that after „half of the way" the full result of CO_2-reduction may be realized. The most important point is, that a political sign in the right direction will be given. In this case investment in alternative energies will be induced.

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