

The effect of special provisions in the framework of energy taxes on the environmental effectiveness – The case of Germany

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Abstract

Many countries nowadays apply energy taxation to give an incentive to reduce energy use and energy-related emissions. Most of them, however, grant special provisions to energy-intensive production in order to meet concerns about negative economic effects and to mitigate carbon leakage. In Germany's "ecological tax reform" special provisions were introduced in the form of reduced tax rates and tax rebates in 1999. In 2003, the tax law was revised in order to increase the incentive for energy and emission reduction for companies that profit from those tax privileges. This paper analyses the effect of those changes on energy use and CO₂ emissions. It argues that the increase of the marginal tax in combination with a "ceiling" of the tax burden has an ambiguous effects on total emissions. A CGE analysis is undertaken with the recursive-dynamic model of Germany, LEAN, in order to quantify the effects.

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1 Introduction

Many countries nowadays apply energy taxation to give an incentive to reduce energy use and energy-related emissions. Most of them, however, grant special provisions to energy-intensive production in order to meet concerns about negative economic effects and to mitigate carbon leakage. In Germany's "ecological tax reform" special provisions were introduced in the form of reduced tax rates and tax rebates in 1999. In 2003, the tax law was revised in order to increase the incentive for energy and emission reduction for companies that profit from those tax privileges. This paper analyses the effect of those changes on energy use and CO₂ emissions. It argues that the increase of the marginal tax in combination with a "ceiling" of the tax burden has an ambiguous effects on total emissions. A CGE analysis is undertaken with the recursive-dynamic model of Germany, LEAN, in order to quantify the effects.

2 The Role of Special Provisions in the Ecological Tax Reform in Germany

In 1999, Germany introduced "eco-taxes" on fossil fuels and electricity (on top of existing energy taxes) aiming at a reduction of energy-related emissions. Eco-taxes are levied on final energy consumption. The tax rates have been gradually increased in five steps between 1999 and 2003. The increase was 3.07 Euro cents per liter gasoline and diesel fuel per year, adding up to 15.35 ct within five years. The increase of 2.05 ct per liter heating oil is executed in the first step only. The tax on natural gas was raised by 0.164 ct per kilowatt hour (kWh) in 1999 and another 0.202 ct at the beginning of 2003. Furthermore, a tax on electricity of 1.02 ct per kWh was introduced in the first step and raised by 0.26 ct in the following four steps.¹

The additional revenue from these taxes is recycled to the economy mainly by reducing social security contributions (SSC), more precisely contributions to the statutory pension system. In Germany, statutory social security contributions for health, pension and unemployment insurance are raised proportionally to the payroll up to a ceiling of 5,150 Euro monthly gross wage (2005). Amounting to 42,0 % (2005), they are considered to be an important impediment to the creation of more employment in Germany. The additional eco-taxes in 2003 are estimated at 18.7 billion euro, which amounts to 0.9 % of GDP.² This allows to

¹ On top of energy taxes, the value added tax (VAT) of 16 percent will be levied, so that the total price increase will be larger than indicated by these tax rates.

² Cf. BMU(2003).

reduce pension insurance rates on payroll by 1.7 percent compared to a situation without ETR.³

In order to meet concerns about negative effects on the competitiveness of German industries, special provisions were made. Up to 2002 the following provisions were in force:

- The goods and materials sector (i.e., manufacturing industry, energy/water, mining and construction sector) as well as agriculture, forestry and fishing paid only twenty percent of the regular eco-tax described above (except for motor fuels for which the full tax rate is applicable) if their energy consumption exceeded a certain threshold.⁴ Small enterprises with an energy consumption below this threshold and other business sectors – retail and private road transport, service companies – as well as public institutions and private households pay the full tax rate.
- Moreover, some enterprises are eligible for tax rebates. Up to 2002, all eco-tax payments of an enterprise in the goods and materials sector which exceeded the savings of social security contributions by more than twenty percent were refunded.

With the beginning of 2003, this system has been revised: the reduced rates now amount to 60% rather than 20%. Moreover, only 95% of the tax payments exceeding the (simple) savings of pension contributions will be refunded. With these changes, the German government intended to spread the burden of the eco-taxes more evenly and improve their ecological effectiveness. It expressed the opinion that four years after the introduction of the ETR, the incentive to use energy more efficiently could be increased without impairing the international competitiveness of energy-intensive industries.⁵

However, in a statement for a parliamentary hearing, DIW (2002) expressed doubts that the described changes achieve these targets. Figure 1 shows the tax schedules of an (arbitrary) enterprise for different quantities of energy consumption before and after the revision and a certain amount of reduced social security contributions SSC. The level of the curves in Figure 1 represents the tax burden (net of tax rebates), the slopes represent the marginal tax burden, i.e. the tax increase associated with a higher energy consumption.

³ The reduction is split equally between employers and employees. It thus reduces the non-wage costs of employers; employees in turn receive higher net wages.

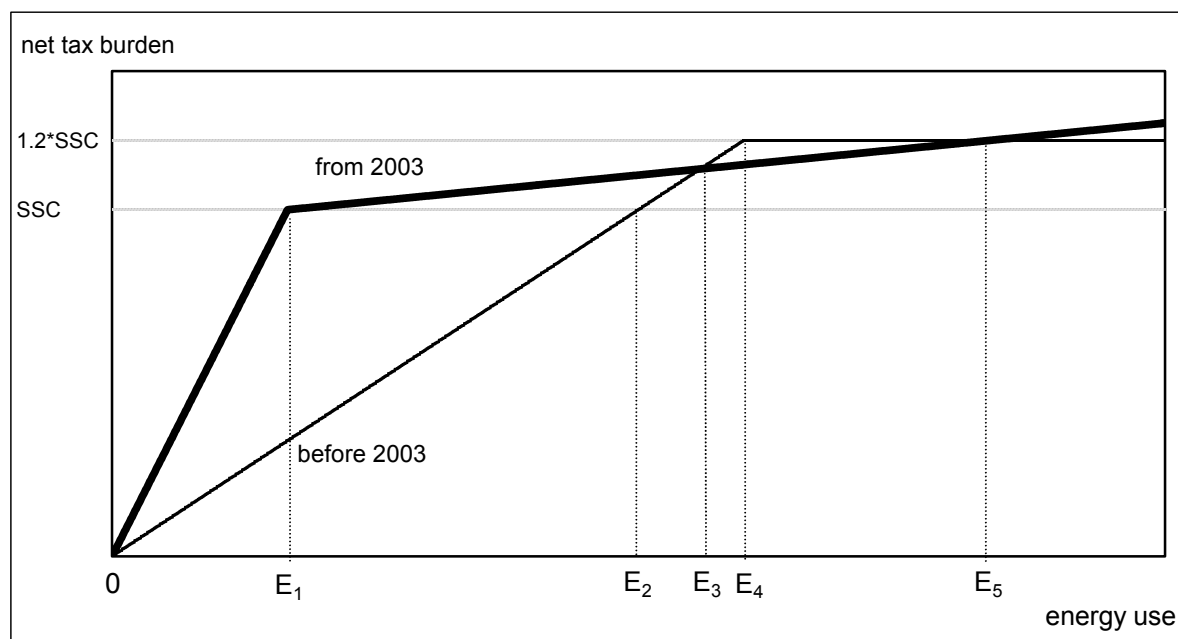
⁴ The threshold is a tax payment of 512,50 Euro for electricity and 512,50 Euro for petroleum products per enterprise and year.

⁵ Cf. Draft law: Entwurf eines Gesetzes zur Fortentwicklung der ökologischen Steuerreform, BT- Drucksache 15/21, 05 November 2002.

The overall tax burden is higher in the new tax schedule in all segments except between E_3 and E_5 . The slope is steeper between 0 and E_1 (60% as compared to 20%) as well as above E_4 (3% as compared to 0%). Between E_1 and E_4 the marginal tax rate and thus the incentive to economize on energy is lower than previously.

The net effect is ambiguous. Data about the number of companies in the different segments, their energy use and their sensitivity to price changes are necessary to estimate the net effect. None of these data were available when the new law was passed in December 2002.

Figure 1: Net tax burden before and after 2003



In this paper, a quantitative analysis of the described changes of the special provisions is undertaken with a CGE model of the German economy. In the following section 2, we will discuss the data which are necessary to model the ETR in Germany and calculate the average effective tax rates for each sector of the economy. In section 3, the framework of the analysis and the simulation results will be presented. Section 4 summarizes and draws conclusions from the findings.

3 Simulation Study

3.1 *The model*

In this paper, the effects of the environmental fiscal reform will be examined using a computable general equilibrium model. LEAN2000 is a two-region empirical general equilibrium model for Germany and the rest of the European Union with a particular emphasis on the representation of the energy markets and the simulation of policies to reduce CO₂ emissions (Welsch and Hoster 1995). Each region is represented in 13 sectors, 5 of which are energy sectors. LEAN is recursively-dynamic and makes the assumption of myopic expectations. This permits to solve the model for a sequence of temporary equilibria.

The model incorporates disembodied factor-augmenting technical progress for labor and energy and embodied technical progress for capital. Aggregate labor supply is described by a dynamic wage equation which explains wage formation by the dynamics of labor productivity in conjunction with a Philips curve mechanism. Labor is assumed to be mobile across the domestic sectors but immobile across borders. Foreign trade is modeled by means of a world trade pool with exogenous import volumes and export prices of the rest of the world. The model is “calibrated”, that means parameter values are determined in such a way as to reproduce the data of the base period.

3.2 *Policy Scenario: Modelling the ETR*

3.2.1 Calculation of effective tax rates

Several provisions of the tax law granted to industry and agriculture entail that the effective (average and marginal) tax rates will differ between enterprises of the same business sector due to difference in size, employment, payroll and the composition of output:

- Small firms below the minimum threshold bear the full burden of the increased energy taxes.
- Companies with higher energy consumption are favored by the general reduction of the increased energy taxes, which implies marginal rates of 20 % (up to 2002) resp. 60 % (2003 onwards).

- Firms in the manufacturing industry (not in agriculture) with tax rebates due to energy tax burden exceeding the reduction of SSC face a marginal tax rate of 0 % (up to 2002) resp. 3 % (2003 onwards).

Therefore, calculations of the (average) marginal tax rate and average tax rate for business sectors have to take into account accurately the distribution of these characteristics. Ideally, micro data from those entities should enter the model. Since the economy is represented as a relatively small number of sectors only in the model, different input data has to be aggregated to match those categories and the average effective tax rate was applied to each sector.⁶

In view of the differentiation of effective tax rates by energy carriers and sectors of use, and the variety of exemptions, threshold values and special clauses, we used the most detailed available information on energy and labor intensities and the distribution of firm size in order to approximate the average effective tax rates. Based on a group simulation model, we calculate the detailed provisions of energy tax law for representative firms of each sector disaggregated by firm size.

As a result, we observe significantly lower effective tax rates in agriculture and industry compared to the normal rates on energy consumption in the service sector or private households (Table 1). In particular, the marginal tax rates are rather low in the mining and quarrying sector or in the energy-intensive basic industries. Nearly all of the firms of these sectors are eligible for a tax rebate, correspondingly their tax rate is solely 3 % of the normal rate at the margin. Higher effective tax rates apply to the less energy-intensive sectors of machinery and equipment or consumer goods, in particular if they are dominated by small and medium-sized firms, e.g. wearing apparel, dressing, leather and leather products or office machinery.

As measured by production values or value added the net burden of the ETR (energy taxes less reduction of SSC) is rather low (Table 2). The above mentioned less energy-intensive sectors are even relieved per saldo by the ETR. The more energy-intensive branches in mining and basic industry face a quite low overall burden, only a few branches such as the agricultural sector (where no tax rebate applies) and the recycling industry are worse off to a significant extend. As is also shown in Table 2, without special provisions the net tax burden would have a much higher impact and might endanger the competitiveness of energy-intensive firms competing on international markets.

Table 1: Effective Tax Rates of ETR in Agriculture, Industry, Energy and Construction in 2003

No. NACE Rev.3	Economic Activity	Effective tax rates of increased energy taxes					
		Tax on electricity ¹⁾		Tax on natural gas ²⁾		Tax on heating oil ³⁾	
		Average tax rate	Marginal tax rate ⁴⁾	Average tax rate	Marginal tax rate ⁴⁾	Average tax rate	Marginal tax rate ⁴⁾
		Euro/MWh		Euro/MWh		Euro/1000 l	
01-45	Agriculture, industry, energy and construction	4,94	2,31	1,71	0,79	12,08	7,85
01-05	Agriculture, forestry and fishing	18,02	17,29	3,32	2,07	12,00	11,03
10-14	Mining and quarrying	2,31	0,65	2,07	1,17	11,23	4,24
10,11,12	Mining of coal etc., crude oil and natural gas	2,13	0,62	2,21	2,20	12,34	12,29
13,14	Mining of metal ores, other mining and quarrying	3,10	0,81	1,97	0,44	10,99	2,48
15-37	Manufacturing	4,60	1,88	1,72	0,77	11,54	5,89
15	Food products and beverages	4,91	1,44	2,01	0,45	11,24	2,50
16	Tobacco products	7,51	0,63	2,21	2,20	12,34	12,28
17	Textiles	5,79	2,18	2,35	2,28	13,10	12,74
18	Wearing apparel, dressing and dyeing of fur	14,55	14,19	2,69	2,45	15,05	13,68
19	Leather and leather products	13,36	11,35	2,59	2,42	14,48	13,50
20	Wood and wood products	5,73	1,96	2,64	2,54	14,75	14,21
21	Pulp, paper and paper products	1,79	0,69	1,64	0,32	9,18	1,78
22	Publishing, printing, reproduction of record. media	11,46	2,71	2,53	2,42	14,16	13,52
23	Coke, refined petroleum, nuclear fuel	1,20	0,62	1,46	0,14	8,18	0,77
24	Chemicals, chemical products	2,03	0,63	1,45	0,16	8,08	0,90
25	Rubber and plastic products	4,43	0,75	2,34	2,23	13,07	12,43
26	Other non-metallic mineral products	3,33	0,89	1,38	0,18	7,71	1,02
27	Basic metals	1,54	0,62	1,04	0,18	5,83	1,02
28	Fabricated metal products	9,81	1,96	2,54	2,32	14,20	12,98
29	Machinery and equipment n.e.c.	12,69	12,52	2,41	2,28	13,49	12,75
30	Office machinery and computers	14,31	13,49	3,19	3,15	17,81	17,60
31	Electrical machinery and apparatus n.e.c.	11,84	7,87	2,34	2,25	13,10	12,56
32	Radio, television and communication equipment	8,62	0,84	2,41	2,26	13,45	12,65
33	Medical and precision instruments, watches, clocks	13,54	13,17	2,74	2,61	15,33	14,60
34	Motor vehicles, trailers	8,12	0,65	2,22	2,21	12,41	12,32
35	Other transport equipment	11,96	8,09	2,26	2,21	12,64	12,37
36	Furniture, manufacturing n.e.c.	13,30	11,75	2,58	2,46	14,42	13,73
37	Recycling	3,91	1,04	2,63	2,38	14,68	13,31
40,41	Electricity, gas, steam and hot water supply	4,77	0,86	0,64	0,35	11,74	11,34
40.1	Production and distribution of electricity ⁵⁾	5,40	0,64	2,24	2,21	12,54	12,34
40.2	Manufacture of gas, distribution of gaseous fuels ⁵⁾	8,90	0,86	0,42	0,11	2,37	0,61
40.3	Steam and hot water supply ⁵⁾	12,50	11,56	2,34	2,27	13,06	12,70
41	Collection, purification and distribution of water	2,55	0,82	2,74	2,48	15,31	13,88
45	Construction	16,82	16,58	3,48	3,40	19,44	19,00
45.1,45.2	Site preparation, building	16,72	16,45	3,45	3,36	19,27	18,79
45.3-45.5	Building installation and other construction	17,00	16,83	3,53	3,47	19,74	19,39
1) Normal rate 20,5 Euro/MWh, reduced rate 12,3 Euro/MWh.- 2) Increased normal rate by 3,66 Euro/MWh, reduced by 2,196 Euro/MWh.- 3) Increased normal rate by 20,45 Euro/1000 l, reduced by 12,27 Euro/1000 l.- 4) Average of business sector, weighted by energy consumption.- 5) Energy tax burden on taxable energy consumption (less exempted consumption for energy conversion). Sources: Statistical Federal Office, own calculations.							

⁶ Applying the average effective tax rate produces exact results only if every enterprise reacts linearly to changes of energy taxes.

Table 2: Net burden of ETR and Tax Relief of Special Provisions in Agriculture, Industry Energy and Construction 2003

No. NACE Rev.3	Economic Activity	Net burden of ETR (energy taxes less reduction of SSC)		Tax relief of special provisions	
		as % of		as % of	
		Gross produc-tion value	Net value added (input cost)	Gross produc-tion value	Net value added (input cost)
01-45	Agriculture, industry, energy and construction	+ 0,01	+ 0,03	0,25	0,95
01-05	Agriculture, forestry and fishing	+ 0,83	+ 2,49	0,04	0,11
10-14	Mining and quarrying	- 0,00	- 0,00	1,37	2,94
10,11,12	Mining of coal etc., crude oil and natural gas	- 0,06	- 0,12	1,91	3,60
13,14	Mining of metal ores, other mining and quarrying	+ 0,08	+ 0,22	0,62	1,67
15-37	Manufacturing	- 0,02	- 0,08	0,27	1,17
15	Food products and beverages	+ 0,06	+ 0,30	0,26	1,36
16	Tobacco products	+ 0,00	+ 0,00	0,02	0,27
17	Textiles	+ 0,03	+ 0,14	0,34	1,41
18	Wearing apparel, dressing and dyeing of fur	- 0,07	- 0,34	0,01	0,07
19	Leather and leather products	- 0,04	- 0,19	0,03	0,18
20	Wood and wood products	+ 0,05	+ 0,19	0,29	1,16
21	Pulp, paper and paper products	+ 0,04	+ 0,17	1,15	4,88
22	Publishing, printing, reproduction of record. media	+ 0,01	+ 0,02	0,08	0,26
23	Coke, refined petroleum, nuclear fuel	+ 0,00	+ 0,12	0,16	4,20
24	Chemicals, chemical products	+ 0,02	+ 0,07	0,77	3,00
25	Rubber and plastic products	- 0,05	- 0,16	0,35	1,14
26	Other non-metallic mineral products	+ 0,07	+ 0,27	0,71	2,63
27	Basic metals	+ 0,05	+ 0,25	1,45	6,50
28	Fabricated metal products	- 0,04	- 0,11	0,13	0,39
29	Machinery and equipment n.e.c.	- 0,10	- 0,30	0,05	0,15
30	Office machinery and computers	- 0,04	- 0,44	0,03	0,33
31	Electrical machinery and apparatus n.e.c.	- 0,07	- 0,24	0,06	0,21
32	Radio, television and communication equipment	- 0,04	- 0,23	0,08	0,47
33	Medical and precision instruments, watches, clocks	- 0,11	- 0,32	0,03	0,10
34	Motor vehicles, trailers	- 0,04	- 0,24	0,09	0,49
35	Other transport equipment	- 0,08	- 0,28	0,06	0,19
36	Furniture, manufacturing n.e.c.	- 0,03	- 0,11	0,06	0,22
37	Recycling	+ 0,45	+ 1,54	0,25	0,87
40,41	Electricity, gas, steam and hot water supply	- 0,01	- 0,05	0,13	0,83
40.1	Production and distribution of electricity ¹⁾	- 0,01	- 0,08	0,10	0,67
40.2	Manufacture of gas, distribution of gaseous fuels ¹⁾	+ 0,01	+ 0,11	0,09	1,16
40.3	Steam and hot water supply ¹⁾	- 0,02	- 0,12	0,03	0,13
41	Collection, purification and distribution of water	- 0,02	- 0,04	0,65	1,32
45	Construction	+ 0,03	+ 0,05	0,01	0,02
45.1,45.2	Site preparation, building	+ 0,01	+ 0,02	0,01	0,02
45.3-45.5	Building installation and other contruction	+ 0,07	+ 0,12	0,01	0,02
1) Energy tax burden on taxable energy consumption (less exempted consumption for energy conversion). Sources: Statistical Federal Office, own calculations.					

A calculation of the effects of the last reform of special provisions enacted in 2003 shows that in most of the sectors marginal rates rose much less than the average tax burden. Due to the increase of the reduced tax rates (nowadays 60 % of the regular tax rates compared to 20 % until 2002) many firms now are eligible for the tax rebate since their additional energy taxes exceed the reduction in SSC. According to information from fiscal authorities, the number of firms with tax rebates rose from 1 600 up to 12 000. Taking into account the tax schedules presented in figure 1, this means that a remarkable part of taxable energy consumption falls into the range from the new threshold eligible for tax rebate (E_1) to the corresponding

threshold of the old regime (E_4). Solely in low energy-intensive sectors, as wearing apparel, dressing, leather and leather products or office machinery, marginal tax rates rose significantly. Moreover, the marginal tax burden on electricity rose in the very energy-intensive sectors of basic industry and coal mining where the marginal tax burden was 0 up to 2002.

Table 3: Changes in Effective Tax Rates by the Reform of Special Provisions in Agriculture, Industry Energy and Construction in 2003

No. NACE Rev.3	Economic Activity	Change in effective tax rates of increased energy taxes					
		Tax on electricity ¹⁾		Tax on natural gas ²⁾		Tax on heating oil ³⁾	
		Average tax rate	Marginal tax rate ⁴⁾	Average tax rate	Marginal tax rate ⁴⁾	Average tax rate	Marginal tax rate ⁴⁾
		Euro/MWh		Euro/MWh		Euro/1000 l	
01-45	Agriculture, industry, energy and construction	+ 1,53	+ 0,17	+ 0,75	- 0,02	+ 4,92	+ 1,94
01-05	Agriculture, forestry and fishing	+ 2,48	+ 3,21	+ 0,34	+ 0,49	+ 2,83	+ 3,28
10-14	Mining and quarrying	+ 0,19	+ 0,61	+ 1,19	+ 0,39	+ 6,08	- 0,24
10,11,12	Mining of coal etc., crude oil and natural gas	+ 0,22	+ 0,61	+ 1,45	+ 1,46	+ 8,11	+ 8,16
13,14	Mining of metal ores, other mining and quarrying	+ 0,05	+ 0,61	+ 1,01	- 0,37	+ 5,64	- 2,07
15-37	Manufacturing	+ 1,54	+ 0,11	+ 0,78	- 0,04	+ 5,33	+ 1,03
15	Food products and beverages	- 0,03	- 1,01	+ 0,89	- 0,38	+ 4,95	- 2,13
16	Tobacco products	+ 3,36	- 3,48	+ 1,45	+ 1,46	+ 8,11	+ 8,17
17	Textiles	+ 0,25	- 3,21	+ 1,31	+ 1,38	+ 7,35	+ 7,71
18	Wearing apparel, dressing and dyeing of fur	+ 5,95	+ 6,31	+ 0,97	+ 1,21	+ 5,40	+ 6,77
19	Leather and leather products	+ 7,07	+ 5,75	+ 1,07	+ 1,24	+ 5,97	+ 6,95
20	Wood and wood products	+ 0,37	- 1,27	+ 1,02	+ 1,12	+ 5,70	+ 6,24
21	Pulp, paper and paper products	+ 0,34	+ 0,61	+ 0,81	- 0,46	+ 4,51	- 2,57
22	Publishing, printing, reproduction of record. media	+ 5,76	- 2,73	+ 1,13	+ 1,24	+ 6,29	+ 6,93
23	Coke, refined petroleum, nuclear fuel	+ 0,46	+ 0,61	+ 0,73	- 0,47	+ 4,10	- 2,65
24	Chemicals, chemical products	+ 0,25	+ 0,61	+ 0,69	- 0,57	+ 3,87	- 3,21
25	Rubber and plastic products	+ 0,12	- 2,92	+ 1,32	+ 1,43	+ 7,38	+ 8,02
26	Other non-metallic mineral products	- 0,00	+ 0,61	+ 0,50	- 0,61	+ 2,80	- 3,41
27	Basic metals	+ 0,38	+ 0,61	+ 0,29	- 0,55	+ 1,65	- 3,08
28	Fabricated metal products	+ 4,25	- 3,25	+ 1,12	+ 1,34	+ 6,25	+ 7,47
29	Machinery and equipment n.e.c.	+ 7,81	+ 7,98	+ 1,25	+ 1,38	+ 6,96	+ 7,70
30	Office machinery and computers	+ 5,99	+ 5,80	+ 0,47	+ 0,51	+ 2,64	+ 2,85
31	Electrical machinery and apparatus n.e.c.	+ 7,33	+ 3,49	+ 1,32	+ 1,41	+ 7,35	+ 7,89
32	Radio, television and communication equipment	+ 4,19	- 3,45	+ 1,25	+ 1,40	+ 7,00	+ 7,80
33	Medical and precision instruments, watches, clocks	+ 6,96	+ 7,33	+ 0,92	+ 1,05	+ 5,12	+ 5,85
34	Motor vehicles, trailers	+ 3,96	- 3,48	+ 1,44	+ 1,45	+ 8,04	+ 8,13
35	Other transport equipment	+ 7,60	+ 3,83	+ 1,40	+ 1,45	+ 7,81	+ 8,08
36	Furniture, manufacturing n.e.c.	+ 7,12	+ 5,94	+ 1,08	+ 1,20	+ 6,03	+ 6,72
37	Recycling	- 0,06	+ 0,46	+ 1,03	+ 1,28	+ 5,77	+ 7,14
40,41	Electricity, gas, steam and hot water supply	+ 1,14	- 2,07	+ 0,18	+ 0,26	+ 7,07	+ 7,35
40.1	Production and distribution of electricity ⁵⁾	+ 1,24	- 3,48	+ 1,42	+ 1,45	+ 7,91	+ 8,11
40.2	Manufacture of gas, distribution of gaseous fuels ⁵⁾	+ 4,51	- 3,34	+ 0,03	+ 0,11	+ 0,17	+ 0,61
40.3	Steam and hot water supply ⁵⁾	+ 7,82	+ 7,14	+ 1,32	+ 1,39	+ 7,39	+ 7,75
41	Collection, purification and distribution of water	+ 0,18	+ 0,61	+ 0,92	+ 1,18	+ 5,14	+ 6,57
45	Construction	+ 3,68	+ 3,92	+ 0,18	+ 0,26	+ 1,01	+ 1,45
45.1,45.2	Site preparation, building	+ 3,78	+ 4,05	+ 0,21	+ 0,30	+ 1,18	+ 1,66
45.3-45.5	Building installation and other construction	+ 3,50	+ 3,67	+ 0,13	+ 0,19	+ 0,71	+ 1,06

1) Energy tax burden on taxable energy consumption (less exempted consumption for energy conversion).
Sources: Statistical Federal Office, own calculations.

Thus, from the ecological perspective, the reform of special provisions seems to fail widely in enhancing incentives on energy-saving in the industrial sector, which is triggered by marginal tax rates. Moreover, the strong increase in firms eligible for the tax rebate would lead to

higher administrative and compliance cost of the tax system, because the assessment procedure of the provisions is quite complex.

3.2.2 Reduction of social security contributions

The second element of the policy scenario consists of a reduction of the contributions to the old-age pension funds. This reduction takes the form of a decrease of the contribution rate (a percentage of gross wages and salaries). The reduction amounted to 0.8 percentage points in 1999 and increased almost linearly to 1.7 percentage points in 2003. The reduction is split equally among employers and employees, implying (*ceteris paribus*) lower labor costs for the former and higher disposable income for the latter. Here, too, the effective reduction of pension contributions had to be calculated for each sector individually on the basis of disaggregated statistics for several reasons: Firstly, not all employees have to pay contributions. Especially civil servants, self-employed persons and parts of the management are exempted. Moreover, there is a cap on the contributions to be paid. For incomes above a certain threshold, the contributions do not increase with income any more.

Though the environmental fiscal reform has as yet been formulated only for the period 1999-2003, the simulations extend until 2010. For the period 2004-2010 the assumption is made that the tax rates and social security contributions as of 2003 continue to be valid. In modeling the initial year, it should be recalled that the reform entered into force by April 1, 1999, hence was valid only for nine months. To accommodate this, the tax rates and reduction rates of the social security contributions were fixed at 75 percent of their legal value for the entire year 1999.

3.3 *Simulation results*

The effects of the modification of the special provisions are calculated by comparing a policy scenario of the ETR in Germany in line with the most recent tax code to a base scenario representing the former special provisions.

Table Table 3-1 shows the effects of the modifications of the special provisions on the German economy from 2003 to 2010.⁷ Overall, the effects are miniscule. This is not surprising, since the impulse of about 600 million Euro is not very significant at less than 0.03 % of GDP. It is more important to look at the reaction of the economy over time. The effect

⁷ Simulation results up to the years 2002 are not shown because the new special provisions enter into force in 2003 and there no differences between the two scenarios before that year.

on GDP and employment is negative in the first years, but positive in later years. The CO₂ reduction is largest in the first year. The gap shrinks later on as the GDP grows faster than in the base run. At the end of the simulated period the reduction of CO₂ emissions amounts to 0.04 % or about 350,000 (metric) tons of CO₂.

Table 3-1: Macroeconomic effects of the modification of the special provisions
Deviation from base run in percent

	2003	2004	2005	2006	2007	2008	2009	2010
CO ₂ emissions	-0.07	-0.05	-0.05	-0.04	-0.04	-0.04	-0.04	-0.04
Employment	-0.05	-0.03	-0.01	0.02	0.01	0.01	0.01	0.01
GDP	-0.05	-0.03	-0.01	0.02	0.01	0.01	0.01	0.01
Private spending	-0.03	-0.01	0.00	0.02	0.02	0.01	0.01	0.01
Public spending	-0.10	-0.08	-0.07	-0.06	-0.05	-0.05	-0.05	-0.05
Investment	0.03	-0.02	-0.02	-0.02	0.01	0.00	0.00	0.00
Exports	0.05	0.01	-0.05	0.02	-0.03	-0.02	-0.01	-0.02
Imports	0.03	0.07	0.09	0.08	0.08	0.08	0.07	0.07

Tabelle 3-2 describes the effects on the output of the sectors of production. These values display the same pattern as the change of GDP: an initial decrease, then a slight increase up to 2007 and finally a slight decrease again.

Tabelle 3-2: The effects of the modification of the special provisions on output
Deviation from base run in percent

	2003	2004	2005	2006	2007	2008	2009	2010
Agriculture	-0.07	0.00	0.01	0.01	0.01	0.00	0.00	-0.01
Energy sector	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08
Basic/chemical goods	0.00	0.06	0.08	0.08	0.08	0.07	0.07	0.06
Investment goods	0.03	0.08	0.09	0.11	0.10	0.09	0.09	0.08
Consumer goods	0.04	0.04	0.06	0.07	0.06	0.06	0.06	0.05
Construction	-0.06	-0.04	-0.04	-0.01	-0.02	-0.02	-0.01	-0.02
Transport	-0.03	-0.01	0.00	0.01	0.01	0.01	0.01	0.01
Services	-0.06	-0.04	-0.03	-0.02	-0.02	-0.02	-0.02	-0.02
State	-0.02	-0.04	-0.03	-0.02	-0.01	-0.01	-0.01	-0.01

More detailed information about the sectoral effects are given in Table 3-3. The primary impulse comes from a change in unit energy costs.⁸ The modification of the special provision affects only the goods and materials sector (i.e., manufacturing industry, energy/water, mining and the construction sector) as well as agriculture, because the other sectors do not profit from reduced tax rates or tax rebates. Within the goods and materials sector, three groups of enterprises can be distinguished:

- First, enterprises with a low energy intensity, which have to pay 60% instead of 20% of the regular tax rates since 2003. All farms fall into this category regardless of their energy intensity, because the agricultural sector is not eligible for tax rebates.

⁸ The reduction of social security contributions is identical in both scenarios.

- Second, energy users with a “medium” energy intensity which did not qualify for tax rebates in the old system, but do so due to the modification. For them, the marginal tax rate amounts to 3%, down from previously 20%.
- Third, enterprises which had obtained tax rebates already before 2003. For them, the marginal tax rates increases from 0% to 3% of the regular tax rate.

The simulation results reflect the interaction of the primary effect of the change of tax rebates and the induced reduction of net energy prices. Therefore, sectors which are not directly affected by the modifications (transport, private and public services) experience a reduction on unit energy costs.

The effect on producer prices depends on share of energy in total production costs as well as the change of the price of intermediate goods.

The increase in unit energy costs induces a substitution of energy by labor and - in the longer run - by capital. Therefore, the effect on employment is in general somewhat more favorable than the effect on output.

Since reduced tax rates and tax rebates are applied to electricity, natural gas and heating oil, only, the modification influences the relative price of hard coal and lignite and thus the energy mix. This may explain why the emissions of basic materials and chemicals increase even though the output is unchanged and unit energy costs increase.

Table 3-3: The effects of the modification of the special provisions on production sectors in 2003

Deviation from base run in percent

	Unit energy costs	Producer price	Output	Employment	CO2 emissions
Agriculture	1.18	0.05	-0.07	0.03	-0.06
Energy sector	-0.30	-0.25	-0.08	-0.13	-0.30
Basic/chemical goods	0.15	0.00	0.00	0.01	0.00
Investment goods	-0.64	-0.81	-0.08	-0.60	0.00
Consumer goods	-0.04	-0.03	0.01	0.04	0.00
Construction	0.06	-0.28	-0.16	-0.45	0.00
Transport	-0.70	-0.24	-0.11	-0.11	0.00
Services	0.42	-0.01	0.00	0.04	0.34
State	1.32	-0.01	0.03	0.05	-1.13

4 Summary and conclusions

In 2003, the German government modified the special provisions granted to part of the commercial energy users in the framework of the ecological tax reform. This was intended to

increase the incentive for companies that profit from those tax privileges to reduce energy consumption and related emissions. DIW (2002) had pointed out that the effect was ambiguous, because the modifications increased the incentive for some enterprises while it reduced it for others.

In this paper, the effective marginal and average tax rates are calculated based on detailed statistical information. Those effective tax rates are used to simulate the effects on CO₂ emissions as well as on the economy performance. According to the simulation results the modifications induce a net reduction of CO₂ emissions, although a very small one. The impact on GDP and employment is negative in the at the beginning, but gradually improves and becomes positive after 4 years.

References

DIW (Deutsches Institut für Wirtschaftsforschung Berlin) (2002): Stellungnahme zum Entwurf eines Gesetzes zur Fortentwicklung der ökologischen Steuerreform vom 5.11.2002 anlässlich der Anhörung des Finanzausschusses des Deutschen Bundestages am 12. November 2002. Bearbeitet von Stefan Bach und Michael Kohlhaas. Berlin, 11. November 2002.
http://www.diw.de/deutsch/produkte/publikationen/diwkompakt/stellungnahmen/docs/hearing_oekstreform4.pdf