EMPIRICAL ASSESSMENT OF AN ENERGY TAX PROPOSAL FOR AUSTRIA

ANGELA KÖPPL

75/1997

EMPIRICAL ASSESSMENT OF AN ENERGY TAX PROPOSAL FOR AUSTRIA

ANGELA KÖPPL

Paper presented at the Conference "Green Budget Reform. Prospects in Central and Eastern Europe", Lake Bled, Slovenia, April 9-11, 1997

WIFO-Lectures, No 75

97/265/V/

1 Introduction[1]

This paper analyses the potential economic effects of an energy tax in Austria. The macroeconomic effects of such a tax as changes in economic growth and employment, in the rate of inflation, in the budget deficit, and in the current account will be explained. Apart from the macroeconomic effects, the sectoral impact on different industries will be examined. Indeed, structural consequences are to be expected from such a policy as energy-intensive activities will be subject to higher taxation than activities consuming less energy (other things being equal). Since this objective of inducing environmentally responsible behaviour may conflict with other economic policy goals (for example employment and industrial goals) it is important to assess the macroeconomic and sectoral consequences of this envisaged measure[2].

The rather complex set of reactions to and effects of an energy tax may be reliably assessed only within a framework that is supported by a model. Our model is an input-output model linked to a macroeconomic model. To this end, the Austrian Institute of Economic Research (WIFO) macromodel has been adapted to the purpose of the study, and to a large extent combined with an input-output model.

2 The energy tax proposals simulated

The study concentrates on assessing the effects of major features of alternative energy tax concepts - such as tax base, tax schedule, tax revenue and options for compensation.

Starting from a so-called "Central scenario I", we simulated scenarios which differ in specific design features. A comparison between the various scenarios allows an evaluation of the differential impact of alternative tax proposals.[3]

Table 1 shows the various scenarios (vertical axis) and their major design features (horizontal axis).

---

[1] A more detailed analysis can be found in Koeppl et al., 1995. In this study a comparison of various modelling approaches as well as simulation results of empirical studies is included. See also „Macroeconomic and Sectoral Effects of Energ Taxation in Austria" by Koeppl, A., K. Kratena, C. Pichl, F. Schebeck, St. Schleicher and M. Wueger published in: Environmental and Resource Economics 8(1996), 417-430.

[2] The impact on environmental quality, which is the ultimate goal of environmental taxation, has also been explored. A detailed modelling of the consumption sector enables us to capture the changes in CO_2-emissions following the imposition of an energy tax, whereas similar effects for the manufacturing sector are not captured in the model.

[3] The simulation period extends from 1988 to 1992, with actual developments over this time period serving as a baseline scenario.

Scenario I ("Labour cost reduction and technology promotion") is the central scenario. It provides for the taxation of final use of energy with rising tax rates and exemptions for all production sectors for an initial period of several years. Compensation takes place partly via a reduction in non-wage labour costs (payroll taxes), and partly via special funds[4] established for the development and diffusion of energy efficient technologies in the production sector as well as in private households. Over time, these funds lose importance in favour of revenue-neutral compensation. As regards the international context, the simulations assume an autonomous national strategy. The initial tax rates are given in Table 2 (in Austrian Shillings per kWh).

[4] A similar modelling approach using part of the tax revenues for a fund to improve energy efficiency was chosen by Detemmerman, Donni and Zagamé, 1996.

Overview of energy tax simulation scenarios and sensitivity analysis

Design Features

	Scenarios	Tax base	Level of taxation	Compensation			Exemptions for industry	International harmonization	Employment function	
		Energy[a]	Final energy use	None	Payroll taxes	Partial earmarking via funds	Transitory, low	No	Capacity utilization A	Producer real wage B
I	Central scenario: Labour cost reduction and technology promotion	X	X		X	X	X	X	X	
Ib	Employment function B	X	X		X	X	X	X		☒[b]
II	Budget consolidation	X	X	☒			X	X	X	
III	Labour cost reduction	X	X		☒		X	X	X	

[a] No explicit CO_2 component.

[b] Squares denote those features which have been changed compared to the central scenario.

Table: 2

Initial energy tax rates

ATS / kWh

Fuels:		*Electricity*	
gasoline	0,096	(secondary energy level,	
diesel	0,06	independent from primary	
		energy source used)	0,1
Fossil fuels:			
(gas, heating oil,			
coal/coke)	0,05		

As a result of taxation prices increase by the amount presented in Table 3 (in percent).

Table 3

Price increase due to energy taxation

in percent

	first year	*fifth year*
Electricity	5.3	17.4
Gas	9.7	31.2
Heating oil	15.7	47.2
Coal/coke	10.3	31.4
Gasoline	9.7	27.6

Renewable energy sources like bio-mass, solar energy etc. are exempt from the tax. Hydro-energy is included indirectly via the uniform electricity tax. Exemptions are allowed also for district heating produced via co-generation.

For the production sector it is assumed that a tax rebate (according to a degressive schedule) will be granted if energy taxes as a percentage of value added exceed a certain level: the aim is to lower adjustment costs for particularly energy-intensive production processes even if the environmental effect is thereby somewhat reduced. This discrimination in favour of energy-intensive enterprises is temporary and phases out in the final year of the simulation period.

Energy tax revenues (from a static perspective) are estimated at around Austrian Shillings (ATS) 12 billion for the first year; the increase in tax rates along with the phasing out of exemptions, will cause tax revenues to rise to about ATS 49 billion by the fifth year. The compensation envisaged in scenario I is depicted in Table 4.

Table 4

Compensation measures

	first year		*fifth year*	
	in percent	ATS billions	in percent	ATS billions
Lower payroll taxes	50	6.0	70	34.3
Fund for infrastructure, public transport, bio-mass etc.	20	2.4	20	9.8
Energy fund for co-generation and insulation	30	3.6	10	4.9

Scenarios II and III differ from the main scenario only in terms of compensation; thus, scenario II ("Budget consolidation") assumes no compensation at all, the entire tax revenue being used to improve the public sector financial balance. In scenario III ("Lowering of labour costs"), total compensation is in the form of lower payroll taxes.

The effects of certain model specifications are tested by using sensitivity analysis: scenario Ib ("Employment function") assesses the employment effects of labour demand depending on real wages (including non-wage labour costs).

3 *Simulation results*

Central scenario I ("Labour cost reduction and technology promotion") produces the most favourable macroeconomic results of all scenarios (Table 5). Both real GDP and employment are somewhat higher in the energy tax scenario at the end of the simulation period when compared with the baseline scenario without such a tax. GDP exceeds the value of the baseline scenario by 0.4 percent, employment is also 0.4 percent or 11,000 persons higher. Real investment in the 5th year is 4.2 percent higher than in the baseline scenario, thereby offsetting a slight fall in private consumption of 0.3 percent (energy consumption). The reasons for the small positive effect on overall growth and employment are the earmarking of part of the tax revenues for energy-saving investments as well as the partial compensation of energy tax revenues by cuts in non-wage labour costs. Inflation rises moderately.

Table 5

Simulation results - macroeconomic effects

Fifth year

	I Central scenario	Ib Employment function B	II Budget consolidation	III Labour cost reduction
	deviations from baseline in percent			
GDP, constant prices	0.4	0.0	– 2.5	– 0.2
Employment	0.4	1.1	– 2.1	– 0.3
Private consumption deflator	1.8	2.4	3.3	0.9
Demand, constant prices				
Private consumption				
Total	– 0.3	– 0.6	– 3.2	– 0.4
Without energy	0.4	0.1	– 2.9	0.1
Gasoline and oil	– 6.4	– 6.2	– 6.0	– 6.6
Heating, lighting	– 7.6	– 7.6	– 6.6	– 5.1
Gross fixed investment	4.2	3.2	– 5.1	– 0.7
Exports, goods and services	– 1.1	– 1.4	– 2.0	– 0.6
Goods	– 0.9	– 1.0	– 1.5	– 0.6
Imports, goods and services	0.2	– 0.2	– 3.7	– 0.6
Goods	– 0.3	– 0.8	– 4.7	– 0.9
Current account, percent of GDP	– 0.0	0.1	1.5	0.2
Government net lending, percent of GDP	– 0.3	– 0.5	– 1.7	0.1

If, instead of a partial earmarking, non-wage labour costs are cut by the full amount of energy tax revenues (scenario III), there will be a 0.2 percent fall in GDP (instead of a 0.4 percent rise in the central scenario), and employment will weaken by 0.3 %. The positive effect of a partial earmarking on investment and growth is due to the multiplier. Promoting investment in the improvement of energy efficiency may be justified in view of market imperfections when institutional barriers prevail: thus, for example, interests in re-enforcing the insulation of buildings differ between the owners of buildings and flat tenants; institutional barriers also prevent the introduction of energy co-generation etc. Financial incentives for the desired adjustment of behaviour, paid for by the tax revenue, may help to partially compensate for market failure. Thus, the fund will stimulate investment which would be profitable only when markets are efficient. Another advantage of earmarking is that it prevents a fall in the consumption of energy services when energy prices rise (especially in areas directly related to personal comfort, like a lowering of room temperature). The service provided by energy consumption remains unaffected by the induced change in technology. Lastly, promoting the development and diffusion of new technologies has positive external effects which are not captured in the model, however.

The impact of a reduction in payroll taxes may be deduced from a comparison between scenario II (no compensation) and scenario III (fully compensated energy tax): without compensation there is a distinct fall in output growth which may be largely offset via revenue-neutral compensation. In our central scenario, 50 percent of energy tax revenues are compensated via payroll taxes in the first year, and 70 percent in the last year. To what extent the cut in payroll taxes actually affects employment depends on the real wage elasticity of labour demand.

In order to assess the range of possible employment effects, two alternative labour demand functions have been used in the model. An employment function which specifies labour demand as depending on real wages according to historical experience (scenario Ib), compensation via lower payroll taxes has a stronger employment effect than in the central scenario I. In this case, employment would rise by about 34,000 persons (1.1 percent) above the baseline scenario after five years, while real GDP would remain unchanged. While this employment function may overestimate the micro-economic effect of factor substitution[5], the latter may be underestimated in the originally used employment function (central scenario I) without a real wage variable.

Apart from the macroeconomic consequences, the sectoral effects on different industries have also been investigated. The approach of a partially integrated input-output-macromodel enables us to estimate both the direct effects of an energy tax and the feed-back of the macro-effects to different sectors.

As expected, the sectoral effects for output mirror the differential tax burden according to the intensity of energy use. Sectors like basic metals, paper, and chemicals are negatively affected in terms of international competitiveness, as they are both energy- and export-intensive. Negative effects also prevail for energy producers suffering from lower final demand, as well as for direct suppliers to private households, as for example the food industry and, to some extent, hotels and restaurants. The impact on the agricultural sector is almost negligible. Positively affected are the technology-oriented sectors of metal-processing as well as the construction industry and suppliers of building material which benefit from stronger investment growth. As the major beneficiaries,

[5] The reason for this lies in the fact that the induced high employment effect of a strong reduction in payroll taxes needs a considerable change in capital endowment which cannot be implemented in a short period.

energy insulation and co-generation exhibit a low import propensity, these positive effects accrue to a large extent to the domestic economy: metal-processing industry and construction industry each grow by 2.8 percent faster than in the baseline scenario, the stones, glass industries by 1.2 percent (see Table 6).

Table 6

Simulation results - sectoral output and employment effects
Central scenario I

Fifth year

	Sectoral output effects	Sectoral employment effects
	deviations in percent	
Agriculture, forestry	-0.07	-0.07
Mining	-1.03	-0.18
Food, beverages, tobacco	-0.30	-0.16
Textile, apparel, leather	0.21	0.07
Wood processing, timber	1.23	0.25
Paper	-1.33	-0.53
Chemicals (excluding oil)	-0.34	-0.26
Mineral oil	-2.27	-0.60
Stones, glass	1.20	0.58
Basic metals	-1.43	-0.25
Metal processing	2.76	1.32
Energy and water supply	-0.80	-0.15
Construction	2.80	1.92
Wholesale and retail trade	0.23	0.02
Hotels, restaurants	-0.28	-0.09
Transport, communication	0.08	-0.07
Banking, insurance	0.50	0.31
Public and other services	0.52	0.20
Total	0.56	0.37

The sectoral pattern in the central scenario is determined by

- the ratio between energy intensity and labour intensity
- the extent to which energy-intensive sectors obtain tax relief (rebate system), and

- the extent to which investment is subsidised

The sectoral employment effects depend on the combination of output and productivity at the disaggregated level. In some positively affected sectors (textile, wood processing) induced productivity growth is very high compared to output growth, so that the employment effects are rather small.

As regards the tax relief for energy-intensive sectors via the rebate system, this exemption from the "polluter pays principle" constitutes a concession to the adjustment problems of the sectors most severely affected. The basic metals industry, to some extent, has to bear a double burden via the taxation of coal and coke. This may be avoided by taxing coal only; this would halve the negative growth effect and cushion the fall in employment.

Scenario II ("Budget consolidation") is based on the assumption that the total energy tax revenues from the central scenario I (ATS 12 billion in year 1, ATS 49 billion in year 5) are used for lowering the budget deficit. The decrease in the budget deficit by 1.7 percentage points in year 5 vis-à-vis the baseline scenario is "traded" against a restrictive effect on growth (-2.5 percent) and employment (-2.1 percent), as well as a stronger rise in consumer prices (+3.3 percent). This macro-effect, the most negative of all scenarios, is due partly to the absence of compensation via other taxes and partly to the absence of partial earmarking for energy-conserving investment.

The results of scenario III ("Lowering of labour costs") have already been referred to in the context of central scenario I: without the earmarking of tax revenues the macro-effects are slightly negative (GDP -0.2 percent) rather than positive (GDP +0.4 percent) in the case of earmarking; investment expenditures fall even below those in the baseline scenario. The pattern of private consumption, on aggregate, is similar to that in the central scenario, with some difference in energy consumption, since demand for heating falls less strongly in the absence of energy-saving investment. Activity is depressed in almost all economic sectors, though less than in the budget consolidation scenario. Despite price cuts, most service industries cannot raise output because of the fall in private consumption. Replacing the original employment function by one with real wage elasticity (employment function B) yields - as in the central scenario I - a positive employment effect.

4 Conclusions

- The model simulations suggest that the introduction of an energy tax carries markedly different macroeconomic and sectoral effects, depending on how the tax is designed.

- Positive effects on growth and employment can be expected from an energy tax which is compensated by a reduction in payroll taxes, and whose revenues are partly earmarked for the diffusion of more energy-efficient technologies.

- Compensation via a lowering of payroll taxes almost fully offsets the slowdown of GDP growth to be expected from a non-compensated energy tax.

- Partial earmarking of the energy tax revenues facilitates the technological adjustment process to the new price structure. The investment thereby induced stimulates economic development. At the same time, it reduces environmental pollution and therefore has positive environmental effects. Such a tax package may best reconcile economic and environmental goals by fostering environmentally responsible growth and a structural adjustment process towards sustainable long-term development.

- The method used to introduce the energy tax is also important: it is advisable to avoid the shock of a high tax by starting with low tax rates or a narrow tax base which should be gradually increased or enlarged (and credibly announced in advance), such that the higher price elasticity associated with stronger price increases is brought to bear on the whole economy. Again, both economic and environmental effects can be expected to be positive.

- Though crucial, an energy tax is only one instrument in reaching a certain energy or environmental policy goal. As a supplement, subsidies and changes in the institutional framework may boost the effectiveness of the tax.

References

Detemmerman, V., E. Donni and P. Zagami, (1996), „Energy Tax Increases as a Way to Reduce CO2 Emissions", in J.B. Lesourd, J. Percebois and F. Valette, eds. Models for Energ Policy, London: Routledge.

Koeppl, A., K. Kratena, C. Pichl, F. Schebeck, St. Schleicher and M. Wueger (1995), Makroökonomische und sektorale Auswirkungen einer umweltorientierten Energiebesteuerung in Österreich, Wien: WIFO.

Koeppl, A., K. Kratena, C. Pichl, F. Schebeck, St. Schleicher and M. Wueger (1996),Macroeconomic and Sectoral Effects of Energy Taxation in Austria, Environmental and Resource Economics 8(1996), 417-430.

Medieninhaber (Verleger), Hersteller: Österreichisches Institut für Wirtschaftsforschung • Wien 3, Arsenal, Objekt 20 • A-1103 Wien, Postfach 91 • Tel. (43 1) 798 26 01-0 • Fax (43 1) 798 93 86 • Verlags- und Herstellungsort: Wien

Verkaufspreis: S 100,–.