SOCIAL, ENVIRONMENTAL, AND MACROECONOMIC IMPACTS OF INTRODUCING A CO_2 TAX FOR NON-ETS SECTORS IN AUSTRIA

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Overview

In Austria GHG emissions that are not covered by the EU Emissions Trading System (ETS) may have to be cut by 36% until 2030 compared to 2005 levels, and by 80% until 2050. CO_2 taxes could provide economic incentives to decrease consumption of fossil fuels. However, increasing attention is put to negative side effects of CO_2 taxes such as (1) regressive impacts on household income groups as well as (2) impacts on the competitiveness of domestic industries. The introduction of tax rebate schemes, such as lump-sum payments for households or reduction of employers' contributions for industries may be ways to lower or neutralize these effects. We therefore aim to analyze the social, environmental, and macroeconomic impacts of different CO_2 tax and rebate schemes in Austria.

Methods

CO_2 tax and rebate schemes are simulated with the econometric dynamic input-output (IO) model WIFO.DYNK[AUT] for Austria. WIFO.DYNK[AUT] variants have been successfully used for energy and environment related analyses (Kratena, 2015; Sommer and Kratena, 2017). The model has a specific focus on energy demand and household income groups and is part of the macro-economic model family FIDELIO (Kratena et al., 2017). The modeling approach can be characterized as a hybrid between a classical IO and a CGE model and by the integration of rigidities and institutional frictions as well as a long-run full employment equilibrium. The model describes the inter-linkages between 62 industries as well as the consumption of five household income groups by 45 consumption categories. In contrast to static IO models WIFO.DYNK[AUT] simulates (i) household demand reactions via nested demand functions, (ii) changes in factor inputs via a $KLEM^mM^d$ trans-log production function (i.e. capital [K], labour [L], energy [E], and imported/domestic non-energy commodities [$M^{m/d}$]), and (iii) wage bargaining via wage curves. The household consumption sub-module differentiates between (i) investments in durable commodities such as vehicles, housing and appliances, (ii) non-durable commodities via an Almost Ideal Demand System and (iii) energy service demand. WIFO.DYNK[AUT] also accounts for household income and wealth, changes in gross fixed capital formation, as well as government expenses and revenue. Energy demand is modeled specifically in sub-modules for industries and households. These modules reproduce the energy balance provided by Statistik Austria and provide energy related CO_2 emissions for industry sectors and households:

- For households we explicitly model demand for service energy with respect to (i) household appliances, (ii) heating and (iii) private mobility (diesel and petrol). Energy consumption is linked to the durable stock and the energy efficiency embodied in this stock. Energy consumption in TJ is then converted do demand in € and consistently integrated into the household demand module.
- For industries, energy demand in TJ is based on real energy input (in €m) and the respective energy efficiency (i.e. TJ/€m) per industry. Furthermore, an additional trans-log production function estimates the shares in energy fuel sources as inputs for energy (the E in $KLEM^mM^d$). We thereby differentiate between five aggregate energy sources: oil, gas, coal, electricity & heating, and renewables.

Household data on income, consumption, and energy has been differentiated for five income groups based on (i) the Austrian consumption survey 2009/2010, (ii) EU-SILC 2010, and (iii) the Austrian energy balance. The classification is based on income after taxes and the EU equivalence scale.

Finally, impacts on the competitiveness of industries are captured by (i) changes in intermediate demand for M^m and (ii) changes in import shares for private consumption via Armington elasticities.

Results

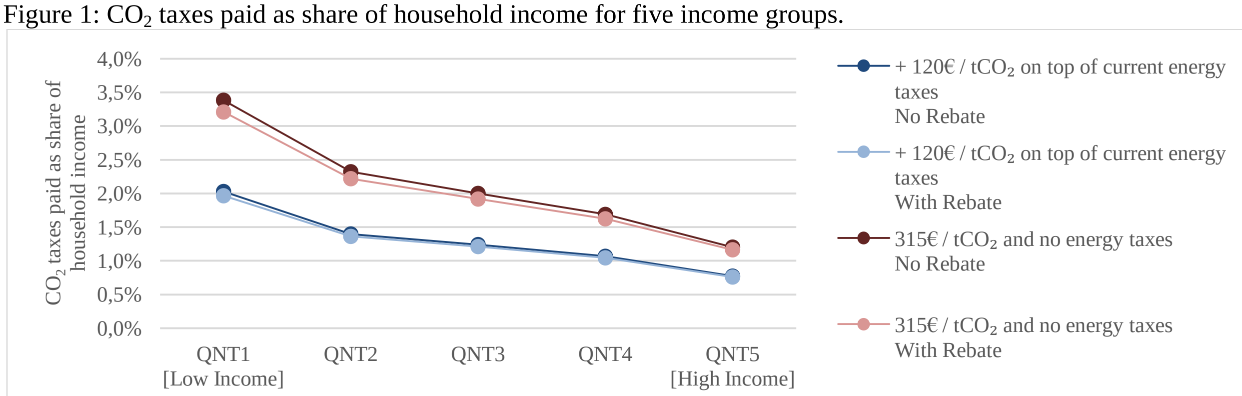
We provide comparative scenario simulations for various CO_2 tax scenarios (CO_2 tax level, energy taxes) and rebate schemes (no rebate, lump-sum payments for households and reductions in labor costs for industries). All scenarios are compared to the current base year of the model (i.e. 2012). Table 1 provides an overview of the most important indicators and selected scenarios. First, we find that reductions in CO_2 emissions are significant in the short-term (i.e. one year), with reductions in energy related CO_2 emission of -6% to -11% for all non-ETS emissions. Industry sector (-10% to -19%) react much stronger than households (-2% to -3%). Low elasticities for household can be attributed to the basic necessities of heating and commuting. Real household consumption and income decrease without rebates between -2% and -5%, but remain unchanged with per capita lump-sum payments. CO_2 taxes may

lead to small decreases in real value added by non-ETS industry sectors without rebates (ca. -1%). Impacts on commodity import shares are negligible in our simulations. Reducing labor costs can lead to increases in real value added, especially in labor-intensive sectors such as services. GDP decreases between -1% and -2% without rebates and stays stagnant with rebates. Employment can even increase slightly if labor costs are reduced.
We find that CO_2 taxes are regressive if measured with respect to share of income (see Figure 1). Although rebates do not have a significant impact on this indicator, they do affect changes in real consumption and real income (i.e. overall welfare indicators for households). An equal per-capita lump-sum payment would even redistribute wealth from high to low income quintiles as low income quintiles spend less money per capita on CO_2 taxes in absolute terms than the overall average (e.g. €219 compared to €263 in the +120€ / tCO_2 on top of current energy taxes scenario).

Table 1: Percentage change in selected indicators with respect to the base year 2012.

	CO_2 Tax	+ 120€ / tCO_2 on top of current energy taxes	+ 120€ / tCO_2 on top of current energy taxes	315€ / tCO_2 and no energy taxes	315€ / tCO_2 and no energy taxes
	CO_2 Tax Rebate	No	Yes	Yes	No
Energy related CO_2 Emissions	**All Non-ETS**	-6,6%	-6,2%	-9,9%	-10,5%
	Non-ETS Industry	-11,0%	-10,4%	-17,7%	-18,6%
	Households	-2,6%	-2,4%	-3,1%	-3,3%
Households (real values)	**Consumption – total**	-2,3%	-0,2%	-0,6%	-4,4%
	Consumption – lowest income group	-2,4%	0,4%	0,1%	-4,6%
	Consumption – highest income group	-2,1%	-0,4%	-0,8%	-4,0%
	Income – total	-2,4%	0,1%	-0,2%	-4,6%
Value Added (real)	**Non-ETS Industry**	-0,7%	0,5%	1,0%	-1,4%
	Transport Sector	-0,7%	0,0%	-0,5%	-2,0%
	Service Sectors	-0,7%	0,7%	1,3%	-1,4%
Macroeconomic	**GDP (real)**	-1,1%	0,0%	-0,4%	-2,4%
	Employment (FTE)	-0,7%	0,5%	0,8%	-1,5%

Figure 1: CO_2 taxes paid as share of household income for five income groups.



Conclusions

Our simulations show that CO_2 taxes can lead to reductions in CO_2 emissions in the short term and that rebate schemes can mitigate negative macro-economic impacts, increase employment, and counteract regressive impacts on households. Although impacts may be even larger in the mid- and short-term due to investments in low-carbon or carbon-neutral technologies, CO_2 taxes may still not be sufficient to meet Austria's mid-term and long-term mitigation targets. Hence, a comprehensive policy portfolio will be needed to ensure decarbonisation.

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