

What does Europe pay for clean energy?—Review of macroeconomic simulation studies

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Abstract

This paper analyses the macroeconomic costs of environmental regulation in European energy markets on the basis of existing macroeconomic simulation studies. The analysis comprises the European emissions trading scheme, energy taxes, measures in the transport sector and the promotion of renewable energy sources. We find that these instruments affect the European economy, in particular the energy-intensive industries and the industries that produce internationally tradeable goods. From a macroeconomic point of view, however, the costs of environmental regulation appear to be modest. The underlying environmental targets and the efficient design of regulation are key determinants for the cost burden.

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1. Introduction

Energy conversion and use are a major source of environmental pollution. Emissions from burning fossil fuels for transport, to generate electricity or to produce industrial goods substantially contribute to urban ozone and other air pollution, acid deposition, regional haze and visibility problems as well as the build-up of greenhouse gas (GHG) concentration in the earth's atmosphere. The consequences are human health problems, damage of ecosystems, crops and building material, amenity losses and global warming (cf. [European Commission, 2003](#)). In line with the economic theory of externalities, several environmental policy measures try to reduce emissions related to energy use by inducing incentives to increase energy efficiency and to use clean energy sources. The most important instruments in European energy markets are the European Union emissions trading scheme (EU ETS), energy taxes, policy measures in the transport sector and the promotion of renewable energy sources. All these

policy measures typically imply higher energy prices for consumers and often also for producers.

An increase in the price of energy as an input raises production costs. This can reduce the domestic and foreign demand for goods and services and thereby create macroeconomic costs. This paper analyses the macroeconomic costs of environmental regulation in European energy markets. For this purpose, we review the results of selected simulation studies that analyse the macroeconomic effects of environmental regulation. Although environmental regulation creates external benefits, such as avoided damage from climate change or reduced non-GHG air pollution, this paper does not include these benefits but only the internal benefits from the reallocation of resources, such as the profit gain of producers of energy-efficient technologies.

In our analysis, we focus primarily on policy measures that are implemented or intended at the European level. The baseline in all modelling studies is business-as-usual (BAU). As some policy measures are initiated on the national level, we also include by way of example the case of Germany for illustrative purposes. Effects on single sectors or firms, e.g. the implication of an energy tax for energy-intensive sectors or households, are only addressed

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within the macroeconomic framework. However, due to differences in energy intensity and possibilities to substitute energy-intensive technologies by more efficient technologies, the costs of environmental regulation can differ substantially between countries, sectors and firms. Higher energy prices reduce the profitability of energy-intensive companies, whereas producers of energy-efficient technologies may benefit. As the macroeconomic costs subsume all these effects they are usually smaller than the costs in specific sectors, such as electricity or energy-intensive manufacturing.

Generally speaking, the results presented in this review show that the macroeconomic costs of the European environmental policy as of today are fairly limited, i.e. usually below 1% of GDP. Eco-taxes even engender macroeconomic gains by way of double-dividend effects. The results for Germany are fully in line with the results for the EU as a whole.

2. Theoretical background

Energy conversion and consumption (e.g. burning fossil fuels) cause negative external effects in the form of environmental pollution and human health damages, which a priori are not taken into account in production and consumption decisions. This leads to a level of emissions from energy consumption above the socially optimal level that considers both private and social costs. The solution to the welfare problem in the economic literature is the internalisation of external effects via a Pigouvian tax, tradeable permits or other policy instruments. They tend to increase energy prices and try to limit emissions from energy consumption to the socially optimal level (Common and Stagl, 2005).

The aim of this literature review is to determine the macroeconomic costs of environmental regulation. Macroeconomic costs of environmental regulation do not contain external effects, such as ecological or human health damages. Similarly, the avoided damages are not taken into account. In this analysis, we consider only the economic consequences of higher energy prices caused by environmental regulation to quantify what Europe pays for clean energy. What Europe gains from clean energy is a question in its own right and beyond the purpose of our contribution. Nor are distributional issues of environmental regulation—e.g. the redistributive role of green taxation—taken into account.

According to the standard theory of optimal taxation, taxes levied on commodities generally create distortionary effects in the form of deadweight losses (cf. Harberger, 1974; Atkinson and Stiglitz, 1980). Hence, energy taxes or other policy measures that increase energy prices generally create inefficiencies. The distortionary effect of a tax decreases with the elasticity of demand. It is zero if the demand is perfectly inelastic. The demand elasticity of electricity, for instance, is typically relatively small. The deadweight loss of electricity taxes, therefore, is expected to

be small as well. Taxes on goods with an inelastic demand, such as electricity, can even have positive economic impacts if they replace more distortionary taxes on goods with higher elasticity of demand. This effect is called double dividend and it is extensively discussed in the economic literature.¹

There are a number of policy instruments that are targeted at changing the costs of energy consumption and therefore at influencing the incentives of producers and consumers. They include energy taxes, tradeable permits, emissions abatement subsidies and efficiency standards. As these instruments have different requirements in terms of information of the regulator, the effectiveness and efficiency can differ substantially on the microeconomic level (Perman et al., 2003). From a (deterministic) macroeconomic viewpoint, however, their economic impact depends essentially on the financial burden they put on input and output factors in equilibrium irrespective of the specific policy instrument used to levy the burden. In relation to labour and capital costs, energy costs are not very important for firms in most sectors and rarely a cause for relocation. Nevertheless, higher energy prices increase production costs. Thus, if companies face international competition and have only limited possibilities to reduce their energy consumption, unilaterally increasing energy prices reduce the profitability and competitiveness of these firms.

It is sometimes argued that higher energy prices can also have positive impacts if they lead to the development and implementation of new energy-efficient technologies. This effect is commonly known as the Porter Hypothesis. It states that stringent environmental regulations can in principal increase the competitiveness of firms, sectors and economies because they trigger environmentally benign innovations that may reduce production costs or create other competitive advantages. In addition, follower countries that also introduce ambitious environmental regulation may buy these new technologies (Porter and van der Linde, 1995; Porter, 1999). To our knowledge, simulation studies have not yet quantified the macroeconomic impacts of this effect.²

3. Results of selected simulation studies

3.1. Selection of simulation studies

Our literature review is based on macroeconomic simulation studies for the European Union (2001, 2003)

¹For literature surveys, see for example Goulder (1995), Bovenberg (1995) and Koschel (2001).

²The inclusion of innovations and technological progress in economic modelling is still in its infancy. Most simulation models set technological progress as an exogenous variable and therefore cannot testify to the Porter Hypothesis. The economic modelling with endogenous technical change is still at the beginning (cf. Löschel, 2002; Goulder, 2004; Bosetti et al., 2006a, b). Many empirical studies that analyse the Porter Hypothesis do not find a significant correlation between environmental regulation and competitiveness, neither positive nor negative. For literature surveys, see for example Jaffe et al. (1995), Jenkins (1998), Taistra (1999) or Kaiser and Schulze (2003).

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