The Kyoto Protocol and EU competitiveness

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A common fear is that environmental policy will induce relocation of firms and may distress economies. This fear is amplified by the decision of the USA to withdraw from the Kyoto protocol. Moreover, relocation puts the effectiveness of Kyoto into doubt. This paper demonstrates that relocation will not occur at a large scale provided that the environmental policy is designed efficiently. To quantify the effects of climate change policies we apply the general equilibrium model WorldScan. Given international trade in emission permits and the USA not ratifying the Kyoto protocol, compliance costs turn out to be modest on average. However, the effects differ substantially between countries and impacts for energy-intensive sectors are relatively large. Liberalization of European electricity markets may play a crucial role. Increased trade in electricity mitigates regional differences substantially. A trade-off appears when countries individually aim both at minimizing the total costs of climate change policy and at minimizing relocation of energy-intensive industries. If energy-intensive sectors are exempted from a carbon tax, relocation effects are reduced, but the burden of climate change policy shifts from the energy-intensive sector to other sectors and consumers. The costs for the society at large increase. Specific policies for specific sectors introduce inefficiencies. This applies in particular to the EU-proposal for emissions trade. The paper shows that exempting some sectors from emission trade and ignoring current taxes (e.g. excise duties on gasoline) may raise the costs of proposed system for emission trade dramatically.

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1. Introduction

This paper draws on a joint study by CPB, RIVM, VU and EUR on the effect of climate change policy on the competitiveness of European industries.[1] This study provides both a qualitative and a quantitative analysis of the consequences of climate change policies for (specific sectors in) European countries, including the Netherlands. A two-track research strategy has been followed. On the one hand, the study reviews the theoretical and empirical literature that addresses the impact of more stringent environmental policies on exports and location choices. On the other hand, the study also quantifies the effects of climate change policy on national income and sectoral employment using WorldScan, a dynamic applied general equilibrium model developed by CPB.

2. The theoretical and empirical literature

An extensive theoretical and empirical literature addresses the effects of economic policy on trade patterns and location choices. More specific studies into the effects of environmental policy are also widely available. The general picture that emerges from this literature is that the effects of environmental policy are likely to be modest.

There are several aspects to this. First, the literature on location choice emphasizes that environmental policy is but one of many factors that firms take into account when choosing among several options of location. On the priority list, environmental quality generally scores low.[2] Second, the idea that environmental policy erodes competitiveness is often based on a static view on competitiveness in which technology is considered exogenous. Including dynamic aspects, environmental policy may induce innovations in products and processes and may then even enhance competitiveness (the Porter hypothesis). Finally, with given environmental goals, relocation of economic activities can be a cheaper alternative than reducing the energy intensity of those activities. From a welfare point of view, a negative effect on exports or location choices does not have to be disadvantageous.

In other words, the economic literature shows that the negative effects of environmental policy are likely to be modest, especially for society at large. Nevertheless, for some groups in the society environmental policy is a burden. The literature on the political economy emphasizes that especially these groups will try to alter environmental policy. The burden will then be reallocated across society.

Empirical knowledge on country-specific relocation effects of firms is unfortunately very limited. Insofar as insights are available, these mainly apply to the US. These insights generally confirm the previously discussed theoretical conclusions. For Europe, the lack of results is mainly due to a lack of data. Specific conclusions for European countries are therefore difficult to reach on the basis of the available empirical literature. This leaves modelling exercises to provide quantitative indications for the effects of environmental policy as one of the few useful research methods.

3. A quantitative analysis of climate change policies: WorldScan simulations

To quantify the effects of climate change policies, we used CPB's applied general equilibrium model WorldScan. The model is especially useful in analysing the effects on international competitiveness and sectoral structure. Climate change policy takes the form of a so-called carbon tax. This is a tax on the use of energy, depending on the carbon content of the different energy carriers. Taxing carbon content is equivalent to a cap and trade system.

Two disclaimers apply. First, the model does not incorporate all adjustment costs that are associated with sectoral relocations, for example in terms of (temporary) unemployment. This results in an underestimation of costs. These costs can be substantial when they result from unexpected shocks (like the oil price shock in the 1970s). However, adjustment costs do not seem to be that relevant for climate change policy, which is anticipated long before its actual implementation. Second, in the analysis we disregard the possibility of reducing of other greenhouse gasses than CO_2. This is also true for the possibility of using the proceeds from energy taxes to lower distortionary taxes on labor ('double dividend'). This results in an overestimation of costs. On balance, there is no indication for systematic and substantial over- or under representation of costs.

4. Benchmark case

Table 1 shows how different regions will be affected (in 2010) by implementation of 'Kyoto'[iii]. The carbon tax, effects on welfare (expressed in terms of income) and effects on sectoral employment effects are given. In the benchmark case, the United States does not ratify the Kyoto Protocol and emissions permits are traded internationally. Simulations with WorldScan reveal that the total costs of 'Kyoto' may be modest. The costs of compliance with the agreements reached in Bonn and Marrakech amount to approximately 0.2% of national income in 2010 for Western Europe. The required emission reductions are mainly achieved by substitution between

energy and other production factors and by replacing energy-intensive goods and services with energy-extensive goods and services. Shifts from coal to gas are of minor importance.

The relocation effects are concentrated in the energy-intensive sectors. In Western Europe, employment in these sectors is reduced by 0.2%. The effects differ substantially between countries. In Spain, the reduction is 1.2%, whereas the effects in France are negligible.

Energy-intensive production relocates from Europe and other participants of ‘Kyoto’ to countries without binding restrictions on emissions (‘carbon leakage'). For example, in the United States employment in the energy-intensive sector increases by 0.3%. Overall, emissions in nonparticipant countries increase. It turns out that the leakage rate is approximately 22%: an initial decrease of emissions of 100 units is partly offset by an increase of 22 units in nonparticipant countries. Relocation thus undermines the effectiveness of Kyoto (without the US), but does not destroy it, by any means.

Table 1 Effects of Kyoto in 2010: Benchmark case compared to a reference scenario

	Carbon tax	Income [a]	Employment					
			Agri-culture	Consumer Goods	Capital Goods	Energy-intensive goods	Services	Trade & Transport
	$ per ton carbon	% of national income	% of sectoral employment					
European Union	27	-0.2	0.1	0.1	0.0	-0.2	0.1	-0.3
Netherlands	27	-0.2	-0.1	0.1	0.3	-0.5	0.1	-0.5
Belgium +Luxembourg	27	-0.2	-0.8	0.0	0.2	-0.5	0.1	-0.8
Germany	27	-0.2	0.0	0.1	0.1	-0.4	0.0	-0.2
France	27	-0.1	0.0	0.1	-0.1	0.1	0.0	-0.4
United Kingdom	27	-0.1	0.1	0.0	-0.1	0.2	0.1	-0.1
Italy	27	-0.1	0.1	0.0	-0.2	-0.2	0.1	-0.1
Spain	27	-0.2	0.3	0.2	0.0	-1.2	0.2	-1.0
United States	0	0.0	0.0	0.0	0.0	0.3	0.0	0.2
Rest OECD	27	-0.2	0.0	0.0	0.1	-0.3	0.0	0.0
Eastern Europe + Former Soviet Union	0	0.2	-0.1	-0.1	-0.2	0.3	0.0	0.0
Rest of the world	0	0.0	0.0	0.0	-0.1	0.3	0.0	0.1

[a] Equivalent variation, which is an income-based measure for welfare change

That the costs of Kyoto in West-European countries are modest is related to the so-called 'hot air'. The transition from a centrally-planned economy to a market economy has been paid for with a severe decline in economic activity. This reduced the emission of greenhouse gasses in former Eastern Bloc countries to levels that are below their Kyoto commitments. These countries can offer the difference between actual and committed emissions on the international market of emission permits without any (further) effort. The price of these permits is low, especially since the US will not demand emission permits. The consequence is that the total costs of climate change policy are low.[iv]

5. Variants

Important conditions for low total costs are international trade in emission permits and the United States not ratifying the Kyoto Protocol. Simulations reveal that the costs of Kyoto increase substantially when one of these conditions is not met. For Western Europe, the costs tend to roughly double when it cannot out source emission reductions or when the US would demand emission permits and drive up their price. Table 2 compares the effects in both variants with the benchmark case. The Table reveals the carbon tax, the leakage rate and the income change for various regions.

In the hypothetical case in which the United States would ratify 'Kyoto', the total costs would be modest for that country as well. The sectoral impacts would be larger. Employment in the energy-intensive sector would fall by 0.6 percent and in trade & transport by 1.5 percent (although total employment would not change). If the United States were to participate, the leakage rate would decline considerably, from 22% to 14%. This reflects the fact that much energy-intensive production moves to the United States if it does not ratify 'Kyoto'.

Especially the Netherlands is sensitive for changes in the intensity of the climate change policy. The reason is that the Netherlands has specialized in energy-intensive sectors (chemicals and transport) and already relies rather heavily on natural gas. If the United States does not ratify 'Kyoto', the Dutch economy as a whole will gain, but also the energy-intensive industry will gain. Climate change policy will result in substantial reallocation within Western Europe. If the US aims at reducing CO_2 emissions and the international price of emission permits increases, reallocation would take place at an even larger scale, at the expense of the Dutch energy-intensive industry. A similar picture would emerge if countries were not allowed to out source reductions. In both cases, lower total costs and less reallocation go hand in hand.[v]

Table 2 Effects of Kyoto with the United States and without emission trading, 2010

	Benchmark case	with US	no emission trading
Carbon tax ($/tC)	27	75	region specific
Leakage rate (%)	22	14	27
Income (% of national income)			
Europe	-0.2	-0.3	-0.4
the Netherlands	-0.2	-0.5	-0.6
Belgium + Luxembourg	-0.2	-0.5	-0.8
Germany	-0.2	-0.3	-0.3
France	-0.1	-0.1	-0.3
United Kingdom	-0.1	-0.3	-0.2
Italy	-0.1	-0.3	-0.4
Spain	-0.2	-0.3	-0.4
United States	0.0	-0.2	0.0
rest of the OECD	-0.2	-0.5	-0.4
Eastern Europe & former Soviet Union	0.2	0.6	-0.1
rest of the world	-0.0	-0.0	-0.0

[1] Defined as the ratio of emission increases in nonparticipating regions and emission reductions in participant countries

Countries may face a trade-off when they simultaneously aim at minimizing the total costs of climate change policy and minimizing relocation of energy-intensive industries. One way to reduce reallocation effects is to exempt energy-intensive industries. The relocation effects are then indeed smaller. The burden of climate change policy shifts from the energy-intensive sector to other sectors and consumers. The study shows that the costs for the society at large increase. This is illustrated in Table 3, column 2, which shows results from WorldScan simulations. In contract with the benchmark case, energy-intensive industries are exempted from a carbon tax. To reach the same emissions reduction, other sectors and consumers face tougher restrictions. The carbon value rises somewhat, from 27 $/tC to 33 $/tC. While energy-intensive industries are no longer faced with a burden, industries face higher taxes. This leads to a less efficient

allocation of endowments over sectors. Also consumption patterns will shift. As a result, income losses are somewhat higher. Employment changes turn out to be more modest than in the benchmark case. Dislocation effects are therefore smaller. However, there is a drawback in the form of an income and welfare loss. In this light one should be cautious regarding the European proposal for emissions trading. The exemption of sectors from emissions trading, e.g. trade& transport, may lead to higher costs.

Table 3 Effects of exemptions and tax reform, 2010

	Benchmark case	Exemption	Tax reform
Carbon tax ($/tC)	27	32	351
Leakage rate (%)	22	18	56
Income (% of national income)			
Europe	-0.15	-0.17	0.70
the Netherlands	-0.22	-0.22	2.30
Belgium + Luxembourg	-0.22	-0.27	-0.70
Germany	-0.16	-0.18	0.50
France	-0.09	-0.11	1.50
United Kingdom	-0.14	-0.16	0.80
Italy	-0.13	-0.15	0.40
Spain	-0.20	-0.21	0.40
United States	0.00	-0.08	0.00
rest of the OECD	-0.18	-0.42	-0.20
Eastern Europe & former Soviet Union	0.24	0.28	4.50
Rest of the world	-0.02	-0.01	0.10

[1] Defined as the ratio of emission increases in nonparticipating regions and emission reductions in participant countries

In the short-run, policy makers can potentially avoid trading-off both goals. In the presence of inefficiencies in the current system of taxation, for example, governments can achieve both goals of lower costs and less relocation by simultaneously introducing climate change policy and eliminating the inefficiencies. In an efficient system, carbon taxes for coal are higher than for oil products, which in turn are higher than for natural gas (because of differences in carbon intensity). Existing taxes do not satisfy this requirement. They are relatively high for oil products. Restructuring can reduce costs of climate change policy as well as reduce relocation effects in energy-intensive sectors. A trade-off does not emerge. This is illustrated in column 3 of Table 3. From simulations with WorldScan it turns out that many European countries benefit by shifting

existing taxes on oil and transport to coal and energy-intense production. The carbon tax replaces existing taxes and rises to 350 $/tC. In this tax reform case, structural shifts are considerable, e.g. from trade&transport to energy-intensive production.

6. Conclusions

The results of the quantitative analysis with WorldScan are in line with the evidence found in the theoretical and empirical literature. The effects of climate change policy are modest, provided that the policy is efficiently designed and emission permits are traded internationally. That the United States has refused to ratify the Kyoto Protocol has reduced costs only further for participating countries such as the Netherlands.

Restructuring the currently inefficient taxation system of energy carriers can substantially lower costs. A trade-off between total costs and relocation effects may eventually emerge. The basic reason is that relocation of economic activity provides countries with an instrument to comply with Kyoto at relatively low costs.

I. CPB Document 24 'Klimaatbeleid en Europese concurrentieposities' (in Dutch), 2002, (by Johannes Bollen, Henri de Groot, Ton Manders, Paul Tang, Herman Vollebergh and Cees Withagen).

II. These results are mainly based on studies that apply to the United States. Given the relatively large substitution possibilities in the United States, we can expect that the effects in Europe are even more limited.

III. Effects strongly depend on the reduction effort. In turn, this effort depends on the growth of emissions when no additional policy is implemented (the reference scenario). In the simulation, we have used a European baseline as produced by Mantzos and Zeka-Paschou, 2002.

IV. Actually, the amount of hot air is large enough to drive the permit price down to zero in a competitive market. However, we make the crucial assumption that suppliers of hot air exert some market power and maximise their short-run permit revenues. This implies that only 20% of the hot air is supplied to the market ('banking').

V. The scale of reallocation within Western Europe depends on the differences in production possibilities. Liberalisation of electricity markets could help to reduce these differences.