WHAT DO WE KNOW ABOUT CARBON TAXES? AN INQUIRY INTO THEIR IMPACTS ON COMPETITIVENESS AND DISTRIBUTION OF INCOME

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Contents

Summary

The Kyoto Protocol to the United Nations Framework Convention on Climate Change has set legally binding emissions targets for a basket of six greenhouse gases and timetables for industralised countries. It has also incorporated three international flexibility mechanisms. However, the Articles defining the flexibility mechanisms carry wording that their use must be supplemental to domestic actions. Although interpretations of these supplementarity provisions are still open to questions and debates, they at least indicate that domestic policies will have an important role to play in meeting their emissions commitments. Carbon taxes have long been advocated because of their cost-effectiveness in achieving a given emissions reduction. In this paper, we assess the main economic impacts of carbon taxes. We review the empirical studies on existing carbon/energy taxes and conclude that competitive losses and distributive impacts are generally not significant and definitely less than often perceived. However, given the Kyoto emissions commitments, future carbon taxes could have higher tax rates than those already imposed and thus the resulting economic impacts could be more acute. In this context, it has been shown that the use of the generated fiscal revenues will be of fundamental importance. Finally, we conclude by briefly discussing carbon taxes in combination with other domestic and international instruments.

1. Introduction

The Kyoto Protocol to the United Nations Framework Convention on Climate Change has set legally binding reduction targets for greenhouse gases emissions to countries listed in its Annex B and introduced three international flexibility mechanisms – namely international emissions trading, joint implementation, and the clean development mechanism (CDM) (*Annex B countries are the OECD countries and countries in transition to a market economy. The Kyoto Protocol includes six greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs). The Protocol will become effective once if it is ratified by not less than 55% of the countries to the Convention whose CO_2 emissions represent at least 55% of the total from Annex I countries in the year 1990.*). However, the Articles defining the flexibility mechanisms carry wording that their use must be supplemental to domestic actions. Although interpretations of these supplementarity provisions are still open to questions and debates, they at least indicate that domestic policies will have an important role to play in meeting Annex B countries' emissions commitments.

Article 2 of the Kyoto Protocol gives Annex B countries considerable flexibility in the choice of domestic policies to meet their emissions commitments. Possible policies include carbon/energy taxes, domestic emissions trading, command-and-control regulations and other policies. Carbon taxes have long been advocated by economists and international organisations because they can achieve the same emissions reduction target at lower costs than conventional command-and-control regulations. Moreover, carbon taxes can act as a continuous incentive to search for a cleaner technology, while for command-and-control regulations there is no incentive for the polluters to go beyond the standards, unless the standards are continually revised and set slightly above the best available technologies. In actual practice, few European countries have already implemented taxes based in part on the carbon content of the energy products.

In this paper, we will focus on the empirical assessment of the main economic impacts of carbon taxes, which may give some insights into the ongoing political debate on their implementation. Section 2 briefly compares carbon taxes with energy taxes. Section 3 discusses the treatment of the carbon tax revenues. In Sections 4 and 5, we assess the implications of carbon taxes for distribution of income and for international competitiveness, respectively. The paper ends with some concluding remarks.

2. Energy taxes versus carbon taxes

An energy tax is an excise tax, which is defined as a fixed absolute amount of, for example, US$ per Terajoule, per British thermal units, or per kilowatt-hours . This tax is imposed on both fossil fuels and carbon free energy sources, according to their energy (or heat) contents, with renewables usually being exempted. By contrast, a carbon tax is an excise tax imposed according to the carbon content of fossil fuels and is thus restricted to carbon-based fuels only (*A carbon tax can be translated in a CO_2 tax , since a ton of carbon corresponds to 3.67 tons of CO_2.*). Given that oil and gas have greater heat contents for a given amount of CO_2 emissions as compared with coal, an energy tax lies more heavily on oil and gas than a carbon tax. Moreover, an energy tax burdens nuclear energy, which could provide large-scale generation of electricity without a directly parallel production of CO_2 emissions.

If the goal is to reduce CO_2 emissions, a carbon tax is preferred to an energy tax on grounds of cost-effectiveness. The reason is that a carbon tax equalizes the marginal cost of CO_2 abatement across fuels and therefore satisfies the condition for minimizing the global cost of reducing CO_2 emissions. This implies that implementation of an energy tax will lead to poor target achievement or else to unnecessarily high costs as compared with a carbon tax (cf. Kågeson, 1991; Cline, 1992; Jorgenson and Wilcoxen, 1993b). This can be explained by two factors: price-induced energy conservation and fuel switching (Manne and Richels, 1993). Carbon taxes reduce CO_2 emissions through both their price mechanism effects on energy consumption and fuel choice. By contrast, since the energy tax is imposed on fossil fuels and nuclear energy, the incentive for fuel switching is lower, and the reductions in CO_2 emissions will be mainly achieved by price-induced energy conservation. Thus a higher energy tax is required for achieving the same reduction target as compared with a carbon tax. In other words, it is more costly to reduce CO_2 emissions through an energy tax than through a carbon tax. This has clearly been shown by the study of Manne and Richels (1993), which evaluates the implications of the Commission of the European Communities' (CEC) proposal for a mixed carbon and energy tax (*Recognizing that a carbon tax puts a relatively high pressure on coal, the most secure energy supply, and that both a carbon tax and an energy tax have a quite different impact on member states, a carbon/energy tax has been proposed by the Commission of the European Communities (CEC) as part of its comprehensive strategy to control CO_2 emissions and increase energy efficiency. The CEC proposal is that member states introduce a carbon/energy tax of US$ 3 per barrel oil equivalent in 1993, rising in real terms by US$ 1 a year to US$ 10 per barrel in 2000. After the year 2000 the tax rate will remain at US$ 10 per barrel at 1993 prices. The tax rates are allocated across fuels, with 50% based on carbon content and 50% on energy content (cf. CEC, 1991).*). Similar findings are also found by Jorgenson and Wilcoxen (1993b) and Beauséjour *et al*. (1995). The results of Jorgenson and Wilcoxen suggest that in 2020 the US GNP loss from an energy tax is 20% greater than that from a carbon tax in order to stabilize the US CO_2 emissions at 1990 levels in the year 2020. The results of Beauséjour *et al*. indicate that in 2000 Canada's GDP loss from an energy tax is 20% greater than that from a carbon tax in order to stabilize Canada's CO_2 emissions at 1990 levels in the year 2000. While being the more cost-effective of the tax instruments considered, the carbon tax is also less burdensome in that it raises a smaller amount of government revenues for a given reduction of CO_2 emissions (Jorgenson and Wilcoxen, 1993b; Beauséjour *et al*., 1995).

Let us now focus more in detail on the carbon tax. So far, a number of studies have focused on the cost estimates for achieving a given reduction in CO_2 emissions. These studies usually incorporate a carbon tax as an instrument to achieve the target because of its effectiveness. The main findings arising from these studies (cf. Whalley, 1991; Whalley and Wigle, 1991a, 1991b; Martin *et al*., 1992; Hoeller and Coppel, 1992; Pezzey, 1992; Walker and Birol, 1992; Manne and Richels, 1991, 1993; Felder and Rutherford, 1993; Kverndokk, 1993; Jorgenson and Wilcoxen, 1993a, 1993b; Martins *et al*., 1993; OECD, 1993; Poterba, 1993; Manne, 1994; IPCC, 1996) are that, among other things,

- The carbon tax should increase over time if it is to reflect the rising costs of damages from the accumulation of CO_2 concentration in the atmosphere; if it is to give the markets the signal that CO_2 emissions will eventually be heavily taxed; and if there are few economically feasible substitutes available. This signal strengths the incentive for technical innovation needed to make more stringent future emissions targets affordable; (*In addition, in presence of inflation, the tax rate has to be indexed to keep the price signal constant in real terms*.)

- There would be significant variation in timing and size of the carbon taxes among countries and regions, given that the marginal cost of abating CO_2 emissions substantially differs across countries and over time;
- The autonomous (that is, non-price-induced) energy efficiency improvement, the possibilities for fuel substitution, and the availability of backstop technologies are essential. Without non-fossil fuel options, the upper bound on the required carbon tax would rise. On the contrary, the autonomous energy efficiency improvement, and the cost and availability of low-carbon or carbon-free backstop technologies are crucial to limiting the tax level required (*As assumed in the GREEN model, the backstop technologies are produced at a constant marginal cost, without any constraint on supply (cf. Burniaux et al., 1992). Thus, the carbon tax needs not to increase further than that level. If there are few economically feasible substitutes available, however, the effectiveness of a carbon tax is likely to be much more limited. Thus, to lower CO_2 emissions very substantially would require a high carbon tax - certainly higher than the taxes already imposed (Barrett, 1991).*) and thus reducing the costs incurred for compliance with emission reduction targets;
- The carbon tax could be production- or consumption-based, but the effects across options would be significantly different among countries. A national production-based carbon tax operates much like an export tax. If applied, oil-exporting countries such as OPEC would gain substantially because the revenues generated from such a production tax accrue to countries proportional to their own production, but in the case of a national consumption-based tax that in effect acts somewhat like an import tariff, they would suffer considerably because the revenues generated from such a consumption tax accrue to countries proportional to their consumption;
- The carbon taxes imposed unilaterally or even regionally would be largely ineffective. This ineffectiveness is attributed partly to a relatively small share of the coalition (for example, EU, OECD) emissions in the world total and partly to strong economic growth and the resulting increase in emissions taking place in non-coalition countries that offset the coalition's achievements;(*This phenomenon is the so-called 'carbon leakage', with its average leakage rate being defined as the ratio of carbon emission increase outside the coalition to carbon emission cutbacks within the coalition relative to their reference levels (cf. Felder and Rutherford, 1993).*) and
- The carbon tax itself would impose a deadweight loss on a country where there are no distortions in the energy markets. But when existing distortions arising from energy subsidies are taken into account or when the revenues generated from the imposition of a carbon tax are recycled to the economy for replacing another indirect tax, the introduction of a carbon tax could even lead to a net gain (*For example, the results based on the GREEN model clearly indicate the net gains for the Eastern Europe and former Soviet Union if the existing energy subsidies are taken into account. See also in the next section the discussion on the 'double dividend' issue.*).

We will not go into these interesting topics any further, but instead focus on three aspects that are considered important when designing a domestic carbon tax, i.e. (i) the treatment of the carbon tax revenues, (ii) the impacts on the distribution of income, and (iii) the effects on international competitiveness.

3. The treatment of the carbon tax revenues

We begin with the treatment of the carbon tax revenues. It has been argued that there is a 'double dividend' from the carbon tax (Pearce, 1991): not only an environmental dividend through reduced emissions of pollutants, but also an additional dividend in terms of a reduction in the overall economic cost of raising government revenues (Lee and Misiolek, 1986; Feldstein, 1999) (*The non-environmental dividend is very often interpreted as using the extra carbon tax revenues to reduce existing distortionary taxes for raising government revenues. This dividend can of course have other interpretations. In the study of Bovenberg (1994), for instance, reduced unemployment is referred to as the potential extra dividend in addition to improved environmental quality. In the context of tradeable carbon permits, the extra dividend refers to the proceeds from the sale of carbon emission permits (Manne and Richels, 1995).*). In the literature, the *weak* 'double dividend' and the *strong* 'double dividend' are distinguished (see Goulder, 1995).

The *weak* 'double dividend' proposition states that in welfare terms the non-environmental dividend is always positive, as a reduction in distortionary taxes is always superior to a reduction of lump-sum taxes. In other words, costs savings may be achieved by using carbon taxes revenues to reduce distortionary taxes, with respect to the case where tax revenues are returned in a lump-sum way. The magnitude of the potential cost savings depends on each country's particular economic circumstances. For instance, in the US economy, as indicated in Bovenberg and Goulder (1996), capital is overtaxed with respect to labour. In this case, using carbon taxes revenues to correct taxation towards less taxes on capital may produce higher costs savings than reducing labour taxes.

The *strong* 'double dividend' proposition states that the non-environmental dividend is larger than the gross costs. In this case, it would mean that 'green tax swaps' could be costless to introduce, because they yield higher GDP or employment. In the literature, there are however ambiguities whether the strong economic double dividend hypothesis can be accepted or has to be rejected. On the one hand, results from some empirical studies (cf. Ekins 1998, EC 1997, Barker 1995, Bach *et al*., 1994) show that an improvement in the environmental quality can be accompanied by a simultaneous increase in employment. On the other hand, other studies seem to reject the hypothesis (e.g., Bovenberg and Goulder, 1996), at least when the initial tax system is relatively efficient. Such results are pointed out by most recent literature, which incorporates a new feature: the interaction of carbon taxes with the existing tax system. Indeed, the existence of an economic double dividend depends on two effects (see Parry, 1997). First, since carbon taxes add to existing distortionary taxes (e.g. on labour and capital), they may further reduce overall employment and investment. This is what is called the 'tax-interaction' effect, which raises the costs of reducing carbon emissions.

Second, carbon taxes revenues may be used to reduce the level of distortionary taxes, thus producing an economic gain (called the 'revenue-recycling' effect). The overall cost of carbon taxes thus depends on the relative weight of the previous two effects. If the gain from the revenue-recycling effect is higher than the costs from the tax-interaction effect, then there is an economic net benefit (i.e. a *strong* economic 'double dividend') from carbon taxes.

Of course, this 'double dividend' feature of a carbon tax has important implications for 'green tax swaps' for distortionary taxes, because different taxes have different distortionary effects on the economy. If the objective of a carbon tax is to reduce consumption of carbon-based energy products through reallocating spending away from CO_2-emitting activities and thus slow down (or even stabilize) the build-up of atmospheric CO_2 concentration rather than for macroeconomic management, the carbon tax is in essence an incentive tax rather than a revenue raising tax. In macroeconomic terms it seems therefore appropriate that revenues raised through an increase in one indirect tax (a carbon tax) could be offset by a reduction of another indirect tax, for example value added tax (VAT), so as to minimize the effect on the general level of prices (*A carbon tax, by raising the prices of fossil fuels, will raise the general level of prices. Offsetting it with reductions in VAT or other taxes tends to lower the price level, but the price effect is expected to vary, depending on the tax offset arrangements.*). This has been confirmed by the studies of DRI (1991), Standaert (1992), Walker and Birol (1992), and Barker *et al*. (1993), the results of which show that reducing VAT offsets the carbon tax's inflation more than reducing other taxes. The studies of Karadeloglou (1992) and Standaert (1992) also show that the effects in the case of reducing VAT on both GDP and employment are less negative than those in other tax offset cases. Another measure used to recycle all revenues from the carbon tax to the economy is by means of reducing income tax. If this is adopted, inflation is likely to increase, although the extent of acceleration depends on the character of wage negotiations for increases in disposable income resulting from the reduction in income tax. This higher inflationary response has been found in the modelling of the effects of the CEC tax (cf. DRI, 1991; Karadeloglou, 1992; Standaert, 1992; Barker *et al*., 1993). Alternatively, if the carbon tax revenues are retained in treasury coffers to reduce public sector deficits, then this will depress the economy, certainly in the short term. If the revenues were all spent by the government, for example on non-fossil energy investment, this would imply a large investment programme which could lead to macroeconomic imbalance and rapid inflation (Barker *et al*., 1993).

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