

New Zealand Tax Reform-Where to Next?

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**Carbon Taxes Vs Tradable Permits: Efficiency and Equity Effects for a Small
Open Economy**

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1. Introduction

Economists and some governments, including New Zealand, have debated the relative merits of a tax or a system of tradable permits as a market based and cost effective policy intervention to reduce pollution¹. Actual examples include the pollution of the atmosphere, water ways and the landscape, with greenhouse gasses being a key contemporary policy topic. Greenhouse gas emissions associated with the combustion of fossil fuels, deforestation, agriculture and other industrial processes (but with scant attention to human breathing) are a form of global atmospheric pollution with a high probability of external costs of climate change in the future. In principle, a tax set at the marginal external cost or a tradable permit with the quota set at the quantity equating marginal social benefits and costs would result in a net gain in economic efficiency. In response to meeting its target under the 1998 Kyoto agreement to reduce greenhouse gas emissions, the New Zealand government initially focussed on a carbon tax, then in 2005 switched to a tradable permit scheme, and in 2009 proposes to review the options. Meanwhile, 27 European Union countries have introduced a tradable permit scheme, and Australia proposes to introduce one in mid 2010. A global agreement with all the large polluters participating seems some time away. The objective of this paper is to compare and contrast the operation and economic effects of a carbon or emissions tax versus a tradable permit scheme to reduce greenhouse gas emissions in the context of a small open trading economy, such as Australia or New Zealand, where these countries are likely to implement their policies before other countries with whom they trade join a global greenhouse reduction policy program.

¹ In the context of greenhouse gas emissions, economists in favour of the tradable permit scheme include Garnaut (2008), and those arguing the superiority of a tax scheme include Cooper (2004), Nordhaus (2005) and Shapiro (2007).

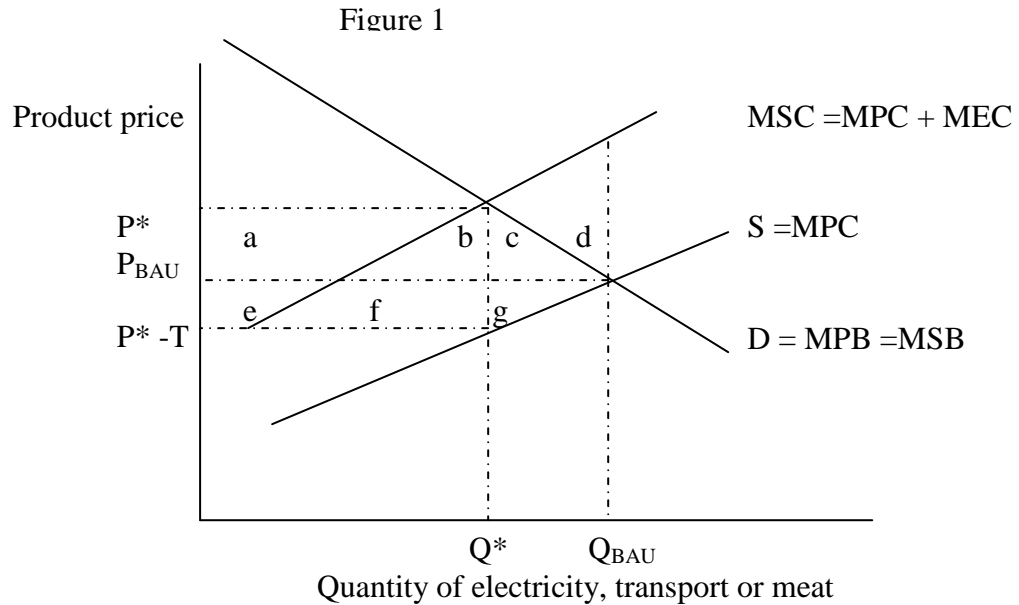
The rest of the paper is organised as follows. Section 2 sketches the context of the greenhouse gas externality market failure problem, and it describes the carbon tax and tradable permit policy intervention options. The economic incidence and distributional effects, and the efficiency effects, of the two policy interventions, particularly as they apply to petroleum products, electricity products, agriculture, and the second round effects on other industries using these products as intermediate inputs are discussed in Section 3. A small trading country context is considered, and in particular if the country implements the intervention before other countries with whom it trades. Section 4 considers in more detail the challenges and relative properties of the tax and tradable permit options of developing a cooperative policy strategy among most of the world's governments. On the assumption that Australia and/or New Zealand implement either a tradable permit or a carbon tax scheme to reduce greenhouse gas emissions before many of the key countries from whom it imports or to whom it exports, Section 5 investigates the arguments for assistance to the so called trade exposed energy intensive industries (TEEI) and the way assistance could be provided under the two policy strategies. A final section concludes.

2. Policy Problem and Intervention Options

This paper proceeds on the assumption that on available scientific evidence there is a high probability that the production of greenhouse gases, including carbon dioxide and methane, as a by product of many production processes for products we value in consumption are adding to the global stock of greenhouse gas emissions, and that further increases in this global stock of emissions will cause over the coming decades and centuries significant changes in climate, such as warming, changes in rainfall patterns, and more frequent and adverse extreme weather events (see, for example, IPCC, 2007). In turn, the climate changes will bring much higher costs in the future for adaptation of, for example, agriculture, water supply, integrity of infrastructure, loss of biodiversity and population relocation relative to the costs of reducing emissions (see, for example, Stern, 2006, and Garnaut, 2008). As is the case with most issues in science and economics there is uncertainty and contested arguments and evidence in the area of climate change. At a minimum, some investment in reducing greenhouse gas emissions is seen as a prudent form of insurance.

From an economic perspective, greenhouse gas emissions are a form of global externality with a very long life. No one owns the atmosphere, and under the current market system it is treated as a common pool resource with no enforceable property rights. Apart from some regulations designed to reduce local smog, businesses and households ignore the external costs of greenhouse gas emissions. Relative to many other pollution problems for which the external costs are local and short-lived, with greenhouse gas emissions the external costs are associated with the global stock of emissions and the emissions have lives of decades to centuries.

The nature of the market failure with greenhouse gas emissions can be illustrated with two simple diagrams, one for a particular product and a more general one for the greenhouse gas emission product. In Figure 1 for a desired consumer good such as electricity, motor transport or beef we have a competitive market supply and demand model. The demand curve, D , also represents the marginal private benefits, MPB , of the product to consumers, and we further assume this also equals the marginal social benefits, MSB . The supply curve, S , under competition represents also the marginal private cost curve, MPC , of capital, labour and materials, but it treats the disposal of greenhouse gas emissions as a zero private cost. A competitive market would result in production and consumption of the desired product of quantity Q_{BAU} , and also a quantity of greenhouse gas emissions, and a price of P_{BAU} .

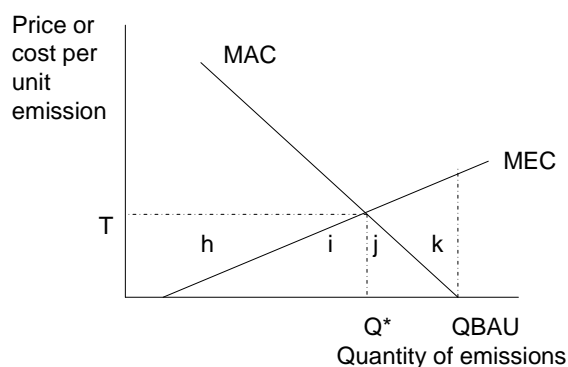


From a society efficiency perspective we need to recognise the external costs of the greenhouse gas emissions represented by the marginal external cost of emissions per unit of the desired product produced and consumed. In Figure 1 this is represented by the marginal external cost, MEC. The marginal social cost, MSC, includes both the MPC and the MEC. Then, the efficient level of production and consumption of the electricity, transport, meat, etc falls from Q_{BAU} to Q^* . Also, the quantity of greenhouse gas emissions is lower, but in general not driven to zero. There is a net efficiency gain of area d, and this is the argument for correcting the market failure associated with the pollution.

A more general representation for the economy of the social benefits and costs of the pollution externality useful for studying policy intervention options is given in Figure 2. Here we aggregate across all products that involve the pollution external cost, and the horizontal axis shows the quantity of pollution or greenhouse gas emissions for the economy. The marginal abatement cost function, MAC, shows the cost of reducing greenhouse gas emissions from the business as usual output Q_{BAU} , corresponding to Q_{BAU} of Figure 1, but the MAC aggregates across all greenhouse gas

emitting activities². As the pollution emissions are reduced, increasing costs per unit of reduced pollution are incurred as consumers switch their purchases from carbon intensive to carbon extensive products which are poorer substitutes, as firms switch to less carbon intensive production methods which are more and more expensive, and as more R&D is outlaid to achieve better substitutes for the carbon intensive products and production processes. The marginal external cost function, MEC, is shown as increasing with the level of pollution. The efficient level of pollution is at emissions level Q^* where $MAC = MEC$, or where $MSC = MSB$ for each product.

Figure 2



Governments have available to them a number of policy instruments to achieve the desired shifts in Figures 1 and 2 from business as usual quantities of products, production processes and pollution at Q_{BAU} to the socially efficient quantities at Q^* . Broadly, these instruments include: establishing a system of property rights over the global atmosphere; regulations, for example renewable energy targets, the use of fluorescent rather than incandescent light bulbs, and on/off days for using a private car; subsidies, for example for solar energy and insulation of buildings; and the market based instruments of a carbon or emissions tax and a tradable permits scheme.

² In the special case of a single product and a constant ratio of the pollution to the product output, the MAC of Figure 2 equals $MPB - MPC$ of Figure 1.

This paper focuses on the market based options. They internalise the costs of the current market pollution externality to all producers and consumers, and they are recognised as the more cost effective ways of tapping into all the available options to cost effectively reduce pollution (see, for example, any of the environmental economics textbooks, including, Tietenberg, 2006, and Perman et al., 2003).

There are similar design options available for both the tradable permit and carbon tax options. The preferred tax or permit quantity base along the supply chain on efficiency grounds is closest to the pollution step. This seems the case for fossil fuel fired electricity generators. However, considerations of operating costs, both for businesses and government, may result in choosing an earlier or later stage in the supply chain. For example, while the combustion of petroleum products results most directly in pollution with the millions of vehicles and other appliance uses, a more concentrated and small number of firms at the petroleum refinery (and importer) stage minimise the compliance and administration costs. Similar challenges are relevant in the case of ruminant animals, but with more concentrated meat processors being a more cost effective collection point. It is important to focus not on the initial or statutory incidence of the policy intervention, but rather on the economic incidence once market prices and quantities along the supply chain have adjusted to the changed set of incentives.

Consider initially the operation of, and efficiency and distributional implications of, the carbon tax and tradable permit systems in a simple one period situation where we have close to perfect information, and in particular of the MAC and MEC functions. In the context of Figure 2, economic efficiency would have a carbon or emissions tax at tax rate T per unit of pollution, and a tradable permit scheme would limit the quantity of emissions to Q^* . The market price of the tradable permits would also be at price T , and the tax would restrict pollution to Q^* . Further, if government were to auction the tradable permits they would sell at price T , with both systems collecting additional government revenue of area $h + i$. Then, the higher cost of production, namely the additional cost per unit of pollution per unit of desired product produced, becomes reflected in the product supply curves of Figure 1. These higher production costs induce businesses to choose less pollution intensive production methods, the higher product prices induce households to shift consumption away from pollution

intensive products, and there are better incentives and returns from R&D that reduces the carbon footprint, all of which reduce pollution as sought.

Note from Figure 1 that much of the extra cost associated with the policy intervention to reduce greenhouse gas emissions is passed forward to consumers as higher prices P^* . The more elastic product supply relative to product demand, the higher the proportion of the costs of the carbon tax or of the tradable permits is passed forward to the households. In the case of a perfectly elastic supply (or constant returns to scale production technology), 100 per cent of the cost increase ultimately is borne by households³. Of course, by the same reasoning, most of the benefits of reduced costs of adaptation to climate change (the external costs of pollution) ultimately will be passed on to households. Then, in this static and perfect knowledge world, the carbon tax and tradable permit schemes are essentially the same with identical implications for distribution and for efficiency.

In the more realistic world of imperfect knowledge and when the relevant MAC and MEC curves vary over time, some important differences between the tradable permit system, essentially a quantity based policy intervention, and a carbon or emissions tax, essentially a price based policy intervention, become important. Because of imperfect knowledge of the MAC and MEC functions, both in terms of the basic science and in the estimation of social costs and benefits, it is inevitable that the chosen tax rate or tradable permit quantity will not be at the point where $MSB = MSC$. As a consequence, the full efficiency gain (of area d in Figure 1 or of area k in Figure 2) will not be achieved; and in the extreme cases of too high a tax or too small a tradable quota the chosen policy can create a social loss relative to business as usual.

Where we have a good idea of the relative shapes or elasticities of the MAC and MEC curves but are unsure about their position, Weitzman (1974) has shown that for comparable percentage errors (relative to the optimum) the tax or price option will involve smaller efficiency losses than the tradable permit or quantity option when the

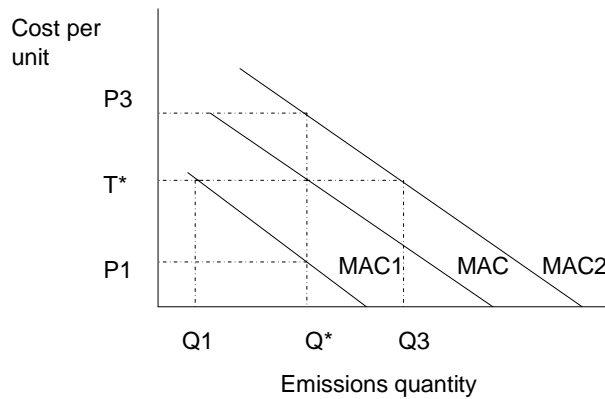
³ While Figure 1 is best interpreted as a perfect competition model, roughly the same distributional story holds for a wide range of imperfect competition models (see, for example, Freebairn, 2008). Most analyses of the incidence of indirect taxes, both by government statistical agencies (for example Australian Bureau of Statistics, 2007) and by academics (for example, Creedy and Sleeman, 2006), use the 100 per cent pass through model of the economic incidence of indirect taxes, of which a carbon tax or a tradable permit is a special case.

MEC is flatter or more elastic than the MAC; and vice versa. If we take a short term perspective, the MEC is likely to be highly elastic because it is the global stock of greenhouse gasses rather than the annual flow which is the link to climate change and pollution costs. In the short term the MAC is likely to be inelastic because of the importance of complementary long lived capital items, such as power stations and motor vehicles, in the quantity of greenhouse emissions. Both these observations favour the choice of a tax. However, the relevant time frame is the long run because of the long life of greenhouse gases pollution. Over a longer period the MAC will become flatter with greater opportunities to change the complementary capital stock and to induce and adopt new technology, and the MEC becomes less elastic with a focus on the stock (or cumulative flows) of greenhouses gases. Then, in the appropriate longer run context it is difficult on a priori grounds to apply the Weitzman model in judging a tax or a tradable quota as likely to minimise the efficiency loss in the inappropriate choice of the tax rate or quota quantity.

Inevitably the MAC curve will shift from year to year. For example, variations in economic growth over the economic cycle and of climate as it affects cooling and heating demands are important short term shifters, and over the longer term population growth, technology and changes in preferences and industry mix will affect longer term trends. In all cases, knowledge about the magnitudes of these shifts will be imperfect and arrive with lags. Shifts in the MAC curve will have different implications for the patterns of stability of the decision environment facing businesses, households and governments. As illustrated in Figure 3, for an initial function MAC with a choice of tax rate T^* or tradable permit Q^* , with each having comparable dual quantity and permit price effects, shifts in the MAC curve, either inwards to MAC1 or outwards to MAC2, result in different patterns of price and quantity stability and volatility. The tax option results in stable extra costs for greenhouse gas intensive products and production processes and incentives for R&D, but with volatility in the reduction of emissions. The tradable permit system results in the opposite of a stable and guaranteed level of pollution, but with volatility of the permit prices. If the MAC is inelastic as seems likely in the short run, shifts in the curve will result in much greater volatility of prices with a tradable permit scheme than will be the volatility of the greenhouse gas emissions under a carbon tax; and vice versa. Experiences with the European Union ETS system and the US SO₂

permits system reveal quite extreme volatility of permit prices, and in fact greater volatility than oil prices (Shapiro, 2007)⁴.

Figure 3



Two sets of arguments have been advanced in favour of the tax option with its price stability relative to the volatile prices of a tradable permit scheme. While both the tax and tradable permit mechanisms allow markets to find the least cost way of reducing emissions in any given period, Orszag (2008) argues that over a number of periods price stability will reduce the long term costs of reducing emissions, and he estimates cost savings of up to a fifth. So long as the MAC function is convex to the origin, as seems likely, this inter-temporal cost saving argument in favour of a tax over a tradable permit scheme is compelling. By contrast, given that it is the stock of emissions rather than short run variations in the flow of emissions that cause the external costs, volatility from year to year in the flow of emissions have minimal social costs. Second, stability of the cost and price increment effects of the tax policy intervention relative to the tradable permit intervention to reduce GHG emissions reduces the volatility of relative prices. This stability generally contributes to more

⁴ Detailed design features of a tradable permit scheme, including the right to bank or carryover permits and perhaps also a limited borrowing right, should help to reduce the price volatility, but these are available with the two schemes. Establishment of a deep international market in tradable permits should further reduce price volatility, but this development requires much work for an international agreement.

effective and efficient decision making by firms and consumers, and also by macroeconomic policy managers⁵.

3. Some Details for a Small Trading Country

This section explores in more detail for the specific context of New Zealand the expected market responses and efficiency and equity effects of a carbon tax or a tradable permit scheme on the petroleum products, electricity, agricultural, and other industries which use energy as intermediate production inputs. The New Zealand example, or illustrative small open trading country case, is further considered in the two different contexts of where all countries participate in a global agreement or New Zealand reduces greenhouse gas emissions before some of its key trading partners.

In the context of a relatively free world market for nearly homogeneous crude oil, petroleum products and gas, New Zealand and other small trading countries are price takers. Domestic taxes on these fossil fuel products in the form of excise taxes now in common use, or the cost imposts associated with proposals for a carbon tax or the costs of tradable permits, would be passed forward 100 per cent as higher prices to household and business buyers. In the specific case of petroleum products and gas, but not other products discussed below, both New Zealand and Australia have proposed what effectively is a consumption or destination base tax for greenhouse gas reduction policy interventions; namely, to tax or require tradable permits for imports and domestic production but to exempt exports.

Assessing the market reactions of the cost increment with a carbon tax or tradable permit on the greenhouse emissions of the electricity generation industry is more challenging. While it is a non-traded product, electricity is a non-storable and hence heterogeneous product by time of day and by season, and it is produced with a variety of technologies which vary by carbon intensity (from nearly zero for renewables and nuclear, to gas, black coal and brown coal), by cost and then by mix of fixed and variable costs, and by ease and cost of short term changes in output levels. As a result, pricing involves a complex ranking of technologies by time of day and season. Then,

⁵ Some supporting evidence can be gained from studies of periods within a country and across countries of higher inflation being associated with greater variability of relative prices and lower productivity.

the extent of pass through of the costs of imposts on greenhouse gas emissions on wholesale electricity prices will vary from zero if the fossil fuel burning technologies are the infra-marginal producers to 100 per cent if they are the marginal generators. Taking Europe as a guide for New Zealand⁶, the estimates of Sijm et al. (2006) for Europe that between 60 and 100 per cent of the extra permit costs were passed forward as higher prices suggests that most but not all of the costs will be passed on as higher electricity prices.

Agriculture, and particularly the production of greenhouse gases by ruminants and fertilisers, is another and different story. Because of measurement and administrative uncertainties, no country, including New Zealand, has proposed an arrangement for these emissions; rather, inclusion of agriculture has been delayed for several years. Also important is that agriculture is a traded industry, and it is a reasonable approximation to assume that New Zealand is a price taker, both as an importer (eg of grains) and an exporter (eg of meat and dairy products). Then, if New Zealand introduces costs on greenhouse gas emissions by agriculture before some of the major countries with whom it trades, New Zealand agricultural producers will bear most of the additional costs with no ability to pass forward the cost increases as higher prices to either New Zealand households or to export buyers. As other trading countries introduce policies placing an explicit cost on the production of greenhouse gases by agriculture, the relative world prices of agricultural products will rise, and more so the more greenhouse intensive the product.

All industries use petroleum products and electricity as intermediate or production inputs. That is, with either a carbon tax or a tradable permit scheme on petroleum products, gas and electricity generation described above, most of the extra costs will be passed on to the business buyers as higher input costs. In turn, we can expect these additional production costs to be passed on as higher prices of all products, with the price increase proportional to the direct and indirect or business input carbon intensity. Effectively, the cost increment associated with a carbon tax or tradable permit scheme is the same as the indirect tax changes associated with the GST tax

⁶ Data from the International Energy Agency shows that for Europe about 40 per cent of the electricity generation capacity is non-fossil fuel, and then among the fossil fuels gas is nearly as important as coal. In Australia by comparison, coal provides 84 per cent of the electricity generation capacity and will be the marginal producer for most of the time.

reforms in New Zealand in 1985 and Australia in 2000 (both of which involved a combination of a rationalisation of existing indirect taxes and a tax mix change of more tax on consumption and less on income). Analyses for both countries assuming constant returns to scale production technology and competitive pricing resulting in a 100 per cent pass forward of the net indirect tax changes corresponded closely with realised outcomes (see, for example, Stephens, 1989, for New Zealand, and Dixon and Rimmer, 2000, and Treasury, 2003, for Australia). Effectively, this important part of the extra cost imposed for greenhouse gas emissions has a production or origin base as imports are exempt and exports are taxed.

The foregoing partial equilibrium model assessment of the effects of a carbon tax or a tradable permit scheme on individual products highlights the costs of the policy interventions and it underplays the benefits. First, the schemes change relative prices, with the prices of those products relatively intensive in their direct and indirect production of greenhouse gases rising relative to those products which are relatively extensive in their direct and indirect production of greenhouse gases. As shown in general equilibrium modelling, for example by Adams (2007) for Australia, while some industries contract as shown for example in Figure 1, the relatively greenhouse gas extensive products and production processes expand because their relative prices and costs fall. While the composition of employment, capital and natural resource use change to reduce the carbon foot print, their aggregate levels change very little, if at all. Second, and as a part of this reallocation process, the net tax revenue increase for government allows a fiscal expansion in aggregate demand via a combination of a reduction in other taxes, increased expenditure and a lower deficit. Third, the lower level of greenhouse gas emissions reduce external costs which provide benefits in the form of lower costs in adapting to a smaller dose of climate change.

4. Global Dimensions and the Policy Options

The need for a cooperative global agreement to reduce greenhouse gas emissions brings out some interesting comparisons between the carbon tax and tradable permit policy instruments. It is the stock of global emissions rather than the annual flow of emissions from any country which drives the external costs associated with climate change. From an individual country's selfish perspective, free riding is the dominant strategy. For example, in terms of Figure 2 an individual country bears all the costs of

area j but only gains a minute share of the saved external costs for the globe of area j + k, most of which goes to other countries incurring no costs. In the absence of a global government with power to enforce compliance by individual countries a cooperative agreement among the different countries is required.

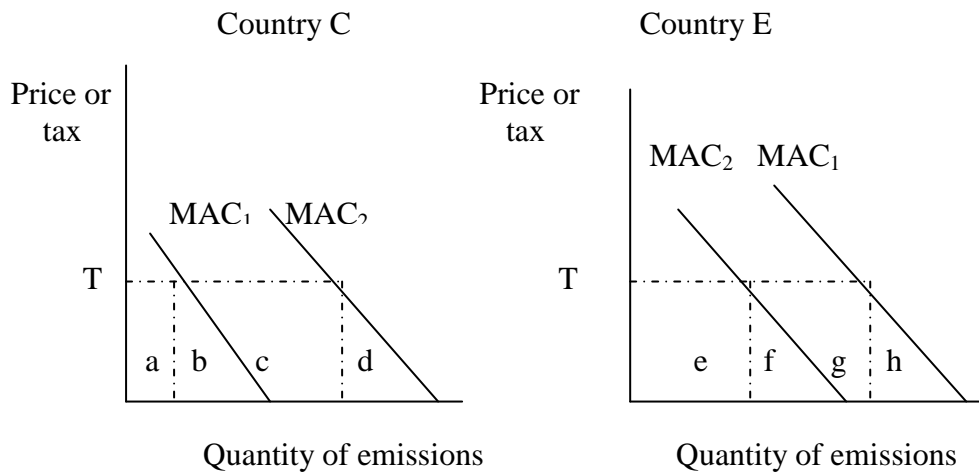
In principle, either a well functioning tradable permit scheme or a harmonised tax scheme will provide a least cost global reduction in greenhouse gas emissions. With a competitive market the world price of the tradable permit will equalise the MAC across countries. A harmonised carbon tax at about the same price as the permits will have the same cost efficiency property. However, there are some equity or fairness considerations of the carbon tax which seem more likely to facilitate the negotiation of a cooperative global agreement.

One of the challenges to reaching a cooperative global agreement is to induce the cooperation of developing countries. Among other issues of what might represent a “fair agreement”, they seek to embark on an industrial revolution to raise living standards much as the developed countries have, and anticipating a faster rate of economic growth they will be more affected by an historical greenhouse gas emission target than slower growing developed countries. With respect to the latter issue, a case can be argued that a tax system which automatically recycles money back to the developing country government and is robust to different growth rates is more appealing than a tradable permit scheme, and especially one which allocates permits with respect to an historical benchmark (of, say, pollution as in Kyoto or even population as proposed by Garnaut).

Consider Figure 4 which shows the MAC functions for two countries as MAC_1 for the current year and MAC_2 for a period in the future. Country C is a developing country and the MAC curve shifts outwards with economic growth. Country E is a developed country, and for dramatic effect the MAC is shown to shift inwards with slow economic growth and technological change. Assume for further simplicity only a negligible change over time in the tax rate or the tradable permit price to emit greenhouse gasses, at price T. Under the tradable permit system, country C with the shift of MAC_1 to MAC_2 would have to purchase a large number of additional permits at a cost to the developing country of area b+c, and presumably by buying them from

other countries, including from country E which can sell surplus permits and receive revenue of area $f + g$. Such a transfer from the developing countries to developed countries will be resented⁷. The prospect of large revenue transfers becomes a reason for the developing countries to resist joining a cooperative international agreement based on a cap-and-trade system, and especially one that initially allocates permits by country based on current emission levels (as underlies the Kyoto Protocol).

Figure 4



By contrast, under the emissions tax scheme, country C would reap a large increase in tax revenues, area $b+c$, and country E a small fall in tax revenues, area $f+g$, with no inter-country transfers. At the same time, under both policy intervention strategies the same carbon price incentives are in place to reduce global emissions, and the perceived losses to the producers and consumers (ignoring the external benefits of less global pollution) of each country of the greenhouse gas polluting goods are little changed, namely areas d versus b for country C and areas h versus f for country E. On this policy strategy comparison, the tax option has more attractive distributional effects over time, and with similar efficiency implications.

⁷ Of course, an alternative would be to allocate the permits with some dynamic pattern that recognises likely different patterns of shifts in the MAC curves across countries. The tax option handles this issue endogenously without the need for projections or for political lobbying and compromises.

A related issue is the perceived integrity and fairness across countries with different political persuasions and administrative capacities of a tradable permit scheme versus a carbon tax. With a tax for each country, the government revenue gaining incentives more closely match the spending incentives. While such desirable incentives also arise if the tradable permits are auctioned, it is less so where some of the permits are gifted. Failures of poor administration, and even corruption, of one country are largely contained to that country with a pollution tax. By contrast, with a tradable permit scheme, the failures of one country will spread to other countries and then potentially undermine the integrity of a global quota.

5. Policy Design Issues for an Early Mover

Australia's announced policy, and earlier proposals from New Zealand, to reduce greenhouse gas emissions with a tradable permit scheme would result in these countries imposing extra costs on their production and consumption of products which include greenhouse gas emissions as a by-product before many of the countries from whom they import or export introduce similar pollution charges. In effect, as argued in Section 3, the carbon tax or the cost of tradable permits represents an additional indirect tax levied on production. The cost increment reduces the international competitiveness of the trade exposed energy intensive industries (TEEI) over the interim period before other trading partner countries also introduce policies to place an explicit cost or price on their greenhouse gas emissions. This section explores the effects of such an early mover strategy on the structure of industry and consumption and on global greenhouse gas emissions, then the case for assistance to the TEEI, and an evaluation of different options for providing this assistance.

As discussed in Section 3 above, with the exception of the final or household consumption of petroleum products and gas, the proposals considered in New Zealand and Australia primarily impose extra costs on the domestic production of products that directly and indirectly generate greenhouse gas emissions. This production or origins base cost is explicit in the case of industries which use electricity, petroleum products and other industrial products such as metal products and concrete as inputs, and when agriculture is included a production base also is explicit. That is, imports will be exempt, production of exports will be taxed, and production for domestic consumption will be taxed.

Without any assistance to the TEEI under a production or origin base system, the structure of the economy of an early mover country will respond to the changed set of incentives. Higher costs of greenhouse gas inputs for domestic production with no change in competitor country costs will result in more imports and less exports. The resulting increase in the current account deficit will lead to a depreciation of the currency and a partial compensating incentive to the traded sector. However, relative prices in terms of carbon intensity are changed. In the new equilibrium, production and exports of relative greenhouse intensive products will fall (with the cost increase greater than the price increase of the depreciation), production of relative greenhouse gas intensive import substitutes will fall, and production of the relative greenhouse gas extensive exports and import substitutes will increase (with the price increase of the depreciation exceeding the cost increase of pollution). While these industry structure changes result in a fall in the aggregate greenhouse gas emissions of the early mover country, in a global context, and this is the relevant measure for external costs, these gains will be offset by “carbon leakage”. That is, the non-participating countries where the high greenhouse intensive products have an increased comparative advantage expand production and largely replace the early mover country production reductions. Some argue further that aggregate or global pollution may increase on the presumption that pollution per unit output in New Zealand is less than the alternative countries’ production.

Further, if, as expected, over time as more countries implement policies to place an explicit price on greenhouse gas emissions, the initial change in the comparative advantage of the early mover countries relative to the late movers will be reversed. As more and more countries join a global agreement the world price of traded greenhouse gas intensive products will rise, absolutely as well as relative to other traded products. Then, interim assistance to the TEEI in the early mover countries could be justified to avoid unnecessary industry restructuring and its reversal. Of course, it might be argued that far-sighted and rational business investors also could and would take a longer term view and see through the temporary change and reversal of comparative advantage. An equity and fairness claim for interim assistance remains.

Accepting the arguments for interim assistance to the TEEI to reduce “carbon leakage” and to avoid unnecessary structural changes to investment, employment and production, what form might the assistance take? The cleanest option is to shift from a production base to a consumption or destination base. That is, tax the greenhouse gas component of imports and domestic production, but exempt the greenhouse component of exports, much as is done with existing VAT and GST taxes (but using the greenhouse gas component as a base rather than value added). Effectively, the early mover country taxes the greenhouse gas component of its consumption. At the same time, it leaves unchanged the comparative advantages of its traded sector relative to the non-traded sector and of its export and import competitor industries relative to the production of other countries with which it trades. For the tradable permit system, a mix of a tax on imports, or a requirement for imports to purchase permits, and free permits for exports are required. By contrast, the carbon tax option readily lends itself to a consumption base solution.

Proposals to assist the TEEI in the Australian Pollution Reduction Scheme (Australian Government, 2008, and also Garnaut, 2008), and described for the now withdrawn New Zealand tradable permit scheme, involve granting free permits to both the greenhouse gas intensive export and import competing industries, but with no cost impost on imports. This results in a relatively very much smaller base for reducing greenhouse gas emissions than either an origin or a destination base. The Australian scheme for example envisages that about 30 per cent of the permits for domestic production pollution will be returned as a 90 per cent subsidy for the very pollution intensive and a 60 per cent subsidy for the medium pollution intensive exporters and import competitors. This unusual proposed tax base distorts the allocation of resources in favour of the traded sector (which largely is exempt) and away from the non-traded sector (which is taxed) for no good market failure reason.

The details of the level of, and the length or conditional properties of, any concessions to the TEEI raise a further set of challenges and options.

6. Conclusions

It has been argued that a carbon tax relative to a tradable permit system to reduce greenhouse gas emissions in a small open economy that takes an early mover

decision, such as Australia or New Zealand, has some advantages and few disadvantages in terms of efficiency, equity and administrative simplicity. Both are market based policy interventions to internalise pollution costs and both draw on the wealth of business and household privately held information to minimise the cost per greenhouse gas reduction.

In a static perfect knowledge world, the two policy strategies are essentially the same. Both place a cost on the greenhouse gas emissions. For non-traded products, and for traded products under a global agreement, most of these cost increments are passed forward to households as a form of indirect taxation. But, if the country is a first mover, producers of export and import substitution products will bear most of the costs, although there will be some offset with an equilibrating currency depreciation. In this first mover context, to reduce “carbon leakage” and unnecessary industry structural adjustments there are efficiency and fairness arguments to provide interim assistance to the trade exposed industries. Such assistance is best designed using a consumption or destination base structure, and here a carbon tax falling on imports as well as domestic production but exempting exports is more straight-forward than a modified tradable permit scheme.

Recognition of the reality of imperfect knowledge of both the MAC and MEC functions, and that the MAC function shifts over time and at different rates across different countries, results in different outcomes for the carbon tax and the tradable permits schemes. The carbon tax system results in greater stability and certainty of the cost increment, but with greater variation and uncertainty about the reduction in emissions. In the context of the long life and stock externality properties of greenhouse gas emissions, and likely convexity of the MAC function, the greater price stability favours the carbon tax above the quantity stability property of the tradable permit.

Achieving a cooperative agreement among most of the medium and large greenhouse gas polluting countries is necessary if the efficiency gains of lower pollution are to be achieved, and in a cost effective way. A harmonised carbon tax would seem to offer some advantages relative to a tradable permit scheme, even though current policy is following the later option. A tax provides stronger incentives for compliance and

better insulates poor administration, and even corruption. The inter-country re-distributional effects of different rates of economic growth are automatically limited with a tax system, particularly when compared with a tradable permit scheme where the country allocation of permits is tied to an historical base.

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