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Policy instruments for reducing greenhouse gas emissions

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Benjamin Franklin once said that 'In this world, nothing is certain but death and taxes' and a significant body of the scientific literature including the IPCC have indicated that the climate change problem has become such a pressing issue that we now face a stark choice between the premature death of hundreds of millions of the people on this planet (from storm, flood, starvation, war or pestilence) and the use of taxation or other financial strategies to change the relative cost of carbon intensive sources of energy compared to the cost of 'green' sources of energy. A change in the relative cost of 'green energy' will not itself solve the problem, but it is a necessary (though not sufficient) step if there is to be the required behavioural change which will support the application of engineering solutions to the problem which has been signaled by a large group of climate scientists. This paper addresses possible approaches to solving the problem of climate change by reducing greenhouse gas emissions (GHGEs). It considers the European Union's emissions trading scheme (ETS) as an example of a market and government failure to achieve a reduction in emissions through a neoliberal approach to pricing emissions. The discussion then focuses on the design features of a carbon tax and some alternative policy instruments that could contribute to a solution to the problem and it raises the main advantages of a carbon tax over an ETS.

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Policy Instruments for Reducing Greenhouse Gas Emissions

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Abstract

Benjamin Franklin once said that 'In this world, nothing is certain but death and taxes' and a significant body of the scientific literature including the IPCC have indicated that the climate change problem has become such a pressing issue that we now face a stark choice between the premature death of hundreds of millions of the people on this planet (from storm, flood, starvation, war or pestilence) and the use of taxation or other financial strategies to change the relative cost of carbon intensive sources of energy compared to the cost of 'green' sources of energy. A change in the relative cost of 'green energy' will not itself solve the problem, but it is a necessary (though not sufficient) step if there is to be the required behavioural change which will support the application of engineering solutions to the problem which has been signaled by a large group of climate scientists.

This paper addresses possible approaches to solving the problem of climate change by reducing greenhouse gas emissions (GHGEs). It considers the European Union's emissions trading scheme (ETS) as an example of a market and government failure to achieve a reduction in emissions through a neoliberal approach to pricing emissions. The discussion then focuses on the design features of a carbon tax and some alternative policy instruments that could contribute to a solution to the problem and it raises the main advantages of a carbon tax over an ETS.

Introduction

In recent years the build-up of carbon in the atmosphere has been recognized as a major environmental problem which is likely to lead to global warming, with a range of negative long-term impacts upon the atmosphere of the planet. There seems to be a consensus that urgent action is necessary to curb the build-up of carbon in the atmosphere but no global consensus on the urgency of the action required and the best way to deal with this problem. In this paper we recognize the key roles of science and technology in relation to the problem, as science has identified the problem and the solution lies in developing and sharing alternative technology. But a key requirement is for behavioural change, as people and businesses will have to change their energy sources from those currently dominated by carbon fuels to alternative 'green energy' sources over time and this can be facilitated by a price signal. The cost of carbon-based energy must be changed to reflect its full cost (including its environmental damage) and there are three main policy instruments available to governments for imposing a price on greenhouse

emissions. One popular approach is based on a cap-and trade system, such as the European Union Emissions Trading Scheme (EU ETS) and proposed in the Australian Carbon Pollution Reduction scheme (CPRS). This approach imposes a quantity cap on emissions and expects the resulting scarcity to create a market determined price for emissions. A second approach would levy a charge directly upon polluters through a carbon tax or an emissions fee, this approach directly imposes a price upon emissions and expects the cost increase to reduce demand which will reduce the quantity of emissions indirectly. A third approach would regulate emissions directly through pollution controls, renewable energy requirements or other controls, directly reducing emissions by requiring action by polluting industries to reduce their emissions.

For a long time economists and accountants have been aware of the externalities of modern industrial society. This is an important case of market failure whereby business acts within a market so as to affect people outside the market and such an event is unlikely to produce outcomes which involve the most efficient use of resources. Since the industrial revolution business has operated in an environment where it did not bear the full cost of production because of its capacity to externalize some of its costs through the pollution of air, soil and water. In the early days of the industrial revolution most of the costs of pollution were borne by the community and over time some of these costs have been returned to business through a range of pollution control regulations which forced business to clean up some of the environmental damage that was a result of production or to bear the cost of installing various pollution control devices. The first step in requiring a reduction in emissions thus arose from direct regulation of business pollution.

Many governments seem to have accepted the need to impose a price upon carbon emissions into the atmosphere as the way to generate a market-based adjustment to the relative cost of various sources of energy. But the developing consensus in most developed countries in favour of a ‘cap and trade’ system (an emissions trading system or ETS) to produce a market adjustment may not be the best way to deal with the present problem of global warming. It could adjust relative prices over time so as to produce a long-term result which is favourable to the environment, but it may act too slowly and uncertainly to have the desired result. It may also be too difficult for the developing countries, which are becoming more important polluters, to put an ETS in place, because they lack the relevant control instruments and accounting structures to measure emissions and to enforce compliance. The European Union’s attempt to put in place a ‘cap and trade’ system should be a warning to all as it started well but almost collapsed because of the lack of transparency in reporting emissions from industries in certain countries and the range of exclusions from the trading base.. This eventually produced huge fluctuations in the carbon price from time to time and a limited overall impact on emissions, with the latest example being 2008 emissions which were 145m tonnes above the cap (Carbon Market Data, 2009).

The European Union Emissions Trading Scheme (EU ETS)

In January 2005 the European Union Greenhouse Gas Emissions Trading Scheme (EU ETS) commenced operation as the largest multi-country, multi-sector greenhouse gas

emissions trading scheme worldwide. In the first phase of the scheme a limited number and type of installation was to be involved and it was to be restricted to the monitoring and control of CO2 only. Some 12,000 installations covering energy activities, production and processing of ferrous metals, the mineral industry and pulp, paper and board activities were covered by Phase 1 of the EU ETS.

Under the EU ETS the specified large emitters of greenhouse gases must monitor and report their CO2 emissions. In order to ensure that real reductions in CO2 emissions occurred EU governments were to ensure that the total amount of allowances issued to installations was less than the amount of CO2 that would have been emitted under a predicted scenario of normal business operations. Each member state was able to allocate a quantity of certificates as set down in the Member State National Allocation Plan.

The scheme allows a regulated entity to use a carbon credit to comply with its obligations to return an amount of emissions allowances to the government which is equivalent to the amount of the installation's emissions into the atmosphere during the year. The installations subject to this scheme may get the allowances free from their government, and it was expected that the various governments would offer credits equivalent to at least 95% of expected emissions, with trading in a maximum of 5% of emissions. Installations were expected to purchase extra credits from other installations or traders and to be able to sell any excess allowances that they accumulated to anybody on the open market. A regulated entity could acquire carbon credits from any carbon reduction project that was certified as eligible to issue carbon credits by the host government or the Clean Development Mechanism Executive Board of the EU.

Experience over the past few years has shown that European governments were guilty of allowing their industries as much carbon dioxide as they could emit at little or no cost. Recently released data from the European Commission shows that most member states granted their industries carbon emission allowances which were far too generous in the period 2005-07, and that this resulted in the virtual collapse of the carbon market in 2007 and an overall increase in emissions over the initial period. Published figures now show that actual emissions from installations covered by the EU ETS in 2005 were several million tonnes below the granted permits. This distorted the market and undermined the credibility of the emissions trading scheme.

In the first year of operation of the EU ETS some 360 million tonnes of CO2 were traded for a total sum of 7.2 billion Euros. During the first year the price of emissions increased steadily to reach a peak of 30 Euros per tonne in April 2006, but this price began to fall rapidly soon after as it became clear that many countries had given their industries such generous emission caps that industry did not need to reduce emissions. This created a crisis of confidence in the scheme and CO2 prices fell rapidly over the next year to a trading price of 1.2 Euros per tonne in March 2007. The price eventually declined to 0.10 Euros per tonne by September 2007, which discredited the market and caused calls from many NGOs for more stringent restrictions on CO2 and tighter allocations of emission credits in the second phase of the scheme.

The second phase of the EU scheme has begun and they are confident of not repeating the mistakes of the first phase. The allowances are said to be tighter and the scheme will include more greenhouse polluters, including the airline industry. It appears that a secondary market has developed, whereby a financial intermediary will accept the risk of guaranteed delivery of a EUA for a price around 18 Euros. It is clear that a profitable industry may develop around the acquisition and sale of permits and a number of exotic financial instruments have been developed to facilitate this, but the profits from this activity will go to traders and entrepreneurs who use the system to make money while having no commitment to greenhouse gas reductions and this may drain resources from the greenhouse gas abatement activity. It also means that there will not be enough money to compensate lower income groups for the cost of their contribution to greenhouse gas abatement.

Some recent evidence indicates that the price of a European Union Allowance (EUA) rose to a high of €37 in July 2008 and that this price fell below €9 recently as a result of the Global Financial Crisis (GFC), a further warning of the volatility of markets. This sort of price volatility is bad for business planning and management, though good for speculators and indicates the failure of an ETS to satisfy the real needs of all parties to the system.

The North American Acid Rain Program

The 1990 US Title IV SO_2 Cap was a successful attempt to limit emissions using a market mechanism and is described as "riding on the coat tails of the earlier lead-in-gasoline and CFC trading programs" (Smith, 2007, p 3). This scheme only affected emissions from coal-fired electricity generators and was relatively easy to manage and monitor. Despite the narrow focus of this market, prices for emissions permits "have varied from a low of $70 in 1996 to $1500 per ton in 2005" (Nordhaus, 2005, p 15) and Smith observed that prices varied from $400 per ton to $1500 per ton in 1996 alone (Smith, 2007, p3). Smith also suggested that such fluctuations in the SO_2 price meant that costs added to the affected energy suppliers "vary between 7 percent and 26 percent of its base operating cost" (Smith, 2007, p 3). She then argued that the "(v)ariation of CO_2 prices, such as those observed in the EU ETS market over the past two years (approximately $2/ton to $35/ton), would cause all coal-fired units to see additional costs varying between about 10 percent and 175 percent of their base operating costs" (Smith, 2007, p 4).

Such price fluctuations would impose a huge burden on the management of electricity suppliers and "would be extremely undesirable, particularly for an input (carbon) whose aggregate costs might be as great as petroleum in the coming decades." (Nordhaus, 2005, p 15). These price fluctuations in the SO_2 trading scheme have arisen despite the findings of Ellerman et al that "the temporal efficiency of SO_2 allowance banking are both reassuring and surprising" (Ellerman et al (2002) p23), though "not necessarily efficient in any exact sense" (Ellerman et al (2002) p 24).

The success of the Title IV program in reducing acid rain can be contrasted with the abject failure of the Regional Clean Air Emissions Market (RECLAIM) in Southern

California. This emissions trading initiative was launched in 1994, targeting SO_2 and NOx emissions, and it allowed a range of trading, including swaps between stationary and mobile sources of emissions (Green et al, 2007). "RECLAIM never came close to operating as predicted, and was substantially abandoned in 2001. Between 1994 and 1999, NOx fell only 3 percent, compared to a 13 percent reduction in the five year period before RECLAIM." (Green et al, 2007, p.3). The evidence from these markets is of some success in reducing emissions, but the successes have been mixed, resulting from differences in approach and in design and enforcement of the various systems, as argued by Ellerman et al, (2000, p321). These arguments include: the small number of relatively large sources of SO_2: design problems must be solved; the operation of the US Acid Rain Program was complicated and "(t)here is a potentially large distance between embracing emissions trading in principle and producing a detailed program that will perform well in practice" Ellerman et al, (2000, p321).

A Carbon Tax or Charge on Polluters

In economic terms a carbon tax and an ETS are virtually identical, both aim to raise the price of carbon, either directly through a tax impost or indirectly through a cap on the quantity of emissions which aims to create an artificial scarcity. Thus, it would seem logical to impose a tax on carbon emissions, as this would be simpler and more certain in impact than an ETS. Political fear of introducing a new tax seems to be the major explanation for government decisions to adopt an ETS, though the most prominent argument in favour of an ETS is that the economic cost would be lower from an ETS because those firms with a lower marginal cost of abatement would have an incentive to do so. Though there is no evidence to support this assertion at this time it is obvious that the same incentives would exist in the case of a carbon tax, firms would reduce their tax if they abated their pollution and all firms would have the same incentive not just those with a low marginal cost of abatement.

There is a large body of literature in economics comparing a carbon tax and an ETS and a survey conducted by the Wall Street Journal indicated that most economists favoured some form of carbon tax (Green et al, 2007, p 4). Also, the Committee for Economic Development of Australia (CEDA) has recently published a report which includes a number of papers from economists who favour a carbon tax (CEDA, 2009). Further, Professor Gregory Mankiew of Harvard (former chair of the President's Council of Economic Advisers under the Bush Administration) operates a web site entitled the Pigou Club, which includes the names of a very large number of economists and public figures who favour a carbon tax. So there is a large body of informed opinion in support of a carbon tax yet the public debate has been dominated by the ETS alternative.

The big advantages of a carbon tax over an ETS are that the tax would be simpler to administer, more economically efficient, more transparent and more visible (and thus harder to evade or avoid) and the revenue would flow to an accountable government which would be able to use the extra funds for a socially useful purpose such as providing access to 'green' energy for low income households and to fund green energy sources. Much of the revenue under an ETS would flow to a range of market participants who

were motivated solely by their economic interests and who would be encouraged to develop a range of exotic market instruments with uncertain economic and environmental consequences over time. The evidence from Europe is that the secondary market for carbon permits and related derivatives was not large enough or well-informed enough to operate efficiently. There have been wide price fluctuations as a particular piece of information has reached the market. Short-run over-reactions to particular information triggers are common in markets, but in an efficient market there are a range of information sources for the market, and in such a situation the market is less likely to be surprised by a particular announcement.

The design of a carbon tax is likely to be much simpler than that of an ETS if the aim is to change the relative price of generating carbon into the atmosphere as a way of reducing the volume of greenhouse gases, because a carbon tax will change the price of carbon-based energy by a specified and predictable amount. In contrast an ETS aims to change the price of greenhouse gases indirectly by specifying a fixed quantity of such gases that can be generated in total, creating an artificial scarcity which will give carbon credits a price determined by market trading. The market price of carbon credits will impose a cost upon those firms that need to buy the credits and this will be reflected in their cost structure, but the price will change as market conditions change and this volatility will be used by market traders for their own advantage. As any economist knows it is possible to control the price of a commodity or the volume sold but not both, unless you are a monopolist selling an essential commodity. Price volatility such as described by Dr Anne Smith above ($2/ton to $35/ton) could have a disastrous impact on the cost structure of energy utilities. This would be enough to create a costing and pricing disaster for coal-fired energy utilities with completely unpredictable consequences for the solvency of the energy suppliers and the continuity of energy supply.

Business would face greater certainty under a carbon tax because the cost increase would be specified by the tax rate. The tax could start at a low level, equivalent to say $10 per tonne of carbon, which is generally agreed to be too low to have a significant impact on business costs and is unlikely to drive investment decisions. If accompanied by a ten year plan to slowly increase the tax this would signal a clear government intention to steadily raise the cost of carbon through tax increases over a specified number of years, which would allow business to adjust to a steady change in price. This could be structured in such a way as to make it easy for business to adjust to a changing price for carbon and the tax rate change would only be one part of the change in total business cost. This is in contrast to the price determined in a market which will be highly volatile, and the volatility will make business budgeting and planning much more difficult while the volatility will encourage market speculators to profit from market instability. The revenue from a carbon tax will go to the government instead of to a range of private sector market players and this revenue could then be used to subsidise ‘clean’ energy alternatives and low income households who are most likely to be affected by an increase in energy prices associated with a steadily increasing price for carbon. The extra revenue could also be used to remove a number of economically inefficient nuisance taxes, including stamp duties, which would improve the overall efficiency of the tax system.

To develop a carbon tax we need to consider two key variables, the tax base and the rate. Clearly the easiest tax base would be stationery energy suppliers which are large and highly visible and which could pass the cost of the tax onto both private and business users of their energy. This would have a broad enough spread to have a direct impact on the quantity of energy demanded and thus the amount of greenhouse gases generated. This would encourage energy conservation strategies and the change in relative price of the various energy sources (with green energy becoming relatively less expensive because it would not bear the carbon tax). The carbon tax base could start with the easy targets where evasion and avoidance was least likely, and where satellites could be used to monitor compliance, and then move to include a range of other industries. Heavy industrial users of energy would provide another identifiable and auditable source of emissions, with transport being the most likely target after the stationery energy providers and heavy industrial users because it is a significant greenhouse contributor and because it would be a relatively simple task to place a carbon tax on aviation and motor fuel.

But perhaps the best feature, in economic efficiency terms, is that a carbon tax could be levied upon firms that pollute or upon the consumers of products which generated carbon pollution in the production process. A carbon tax upon consumers would operate in the same way as the GST and could be administered without any further complications than a change in the rate of tax collected through the GST. The tax could then be remitted at the border for all exporters in the same way as the GST and this would correct a major inequity in the CPRS proposal to compensate some exporters only, those defined as energy intensive trade exposed (EITE). Under recent proposals some exporters would have been be compensated for the impact of the CPRS by receiving up to 95% of permits free, while other exporters received no compensation and would be forced to bear the full cost of compliance with the new system.

Further, in a report to the Committee for Economic Development of Australia (CEDA) Access Economics "modelling shows, for the same assumed carbon price… The projected decline in welfare, as measured by GNP per tonne of CO2-e abated within Australia, is smaller for the consumption-based approach than a production-based CPRS approach". The chief executive of CEDA David Byers said in response to the Access Economics concept modeling 'that the CPRS would involve losses of real GDP per million tones of abatement about 50% higher than a consumption-based carbon tax".

A Carbon Tax for Developing Countries

Perhaps an ETS could be designed which would not be exploited by market operators in the developed countries who develop derivative securities based upon carbon credits, but experience so far does not provide much evidence in support of this. The experience from Europe also points to the need for highly sophisticated accounting and economic information to support an ETS. The failure of the EU to manage their system despite the presence of a set of sophisticated economic, bureaucratic and political controls over the operation of the system should alert all to the cost and difficulty of managing an effective ETS. The lesson from Europe is of the failure of their initial ETS because of information problems that caused a failure of bureaucratic controls over the system. There was an

information failure, a regulatory failure and a market failure which caused the initial system to collapse. Information asymmetry is a major problem in any market and this is a common cause of market failures even when the total quantity of information is adequate. Markets can be manipulated by 'insiders' who have access to superior information to the detriment of the main body of market players.

Developing countries do not have the economic and accounting information to make an ETS work and market manipulation is likely to produce a range of largely unpredictable and dysfunctional consequences. Many developing countries have difficulty in operating an effective income tax system[1] and raise most government revenue from indirect taxes and charges for services. It is often relatively easy for citizens in developing countries to move their wealth and income around so as to minimize their direct taxes. In such an environment, where the economic and accounting information is not sufficient to operate a comprehensive income tax system, it would not be possible to operate an effective ETS system. A comprehensive solution to the greenhouse problem is not possible without eventually including the large developing countries, especially China, India and Brazil, none of which should be forced to bear the cost of the bureaucracy which will be needed for an ETS. However, they will be able to monitor and tax the greenhouse gases emitted from stationary power sources and large industrial sites at relatively little cost using satellite technology. The extra revenue that they raise from a carbon tax could then be used to compensate lower income people who were likely to be disadvantaged by an energy cost increase and any extra revenue could be used to invest in low emissions technology.

A carbon tax could be levied on either the consumers of products which contain some carbon or on the carbon footprint of those firms which generate carbon in their production process.
A carbon tax could be administered by existing tax institutions and the revenue could be used to remove or reduce, existing taxes which distort economic activity, used to compensate low and middle-income households affected by the tax or used to develop the new technology which is needed to address the current problem. It could be levied on production or on consumption of greenhouse pollutants and collected and managed by the existing tax authorities and the tax could be remitted at the border for all export industries as is done with the GST. Reimbursement of the tax at the border for all exporters will also be fairer than a system which nominates some as emissions intensive trade exposed (IETE) firms which receive compensation while other exporters do not receive compensation, as under the proposed Australian CPRS.

[1] Andrew B. and M. Hughes, (1999), Some Implications of Different Asia-Pacific Tax Regimes, AOTCA Technical Reports, Vol 5, December.

Bird R. and E Zolt, (2005), The limited Role of the Personal Income Tax in Developing Countries, Journal of Asian Economics, Vol. 6, Issue 6, December.

Some Other Policy Instruments

There are a range of other policy instruments which could be used to encourage the abatement of GHG, ranging from direct limits on pollution, subsidies to GHG abatement activities, renewable energy targets, 'green' projects like tree planting and sequestration of carbon in the soil using biochar. A range of these policy instruments have been applied in different contexts with a certain level of success, especially direct government limits on pollution but these measures tend to be costly to enforce and to impose unnecessary costs on the business subject to the restrictions. Many of these measures are short-term in impact and only affect a small section of the community and will not have a long-term impact on prices and behaviour and without behavioural change then it will be impossible to solve the climate change problem.

Perhaps the policy instrument with the most potential to reduce emissions over time is to mandate a level of renewable energy from all energy supply firms such as the Renewable Energy (Electricity) Act 2000 as amended. On the face of it this Act requires energy suppliers to generate 20% of their electricity from renewable sources by 2020 in Australia but it has been compromised by concessions to various interest groups, for example coal seam gas (methane) is deemed to be a renewable energy source under the legislation, a patent absurdity. Energy suppliers are encouraged to invest in renewable energy sources and as they supply power from this source they gain renewable energy certificates (REC) which can be sold on the open market or to their customers, such as the energy retailers, who can use the REC to meet their obligations under the renewable energy target. The energy producers must first invest in renewable energy sources before they obtain REC and the financing costs of the new investment will be passed on to consumers in due course as energy prices rise. The longer term impact of the policy will be to increase the volume of energy from renewable sources and the extra investment will cause a rise in energy prices which may encourage consumers to cut their energy consumption or themselves invest in decentralized energy from photo-voltaic cells or small wind generators or similar, again having the effect of increasing the supply of renewable energy.

Conclusion

In economic terms, a carbon tax and an ETS are virtually identical as they both aim to raise the price of carbon, either directly through a tax impost or indirectly through a cap on the quantity of emissions. But a tax on carbon emissions would be simpler and more certain to increase the cost of fossil fuels and to have an impact on behaviour than an ETS. Political fear of introducing a new tax seems to be the main explanation for the tax option not being adopted by many governments, though some have argued that a market-based solution will produce the required change in behaviour at the least cost.

There are several advantages of a carbon tax over an ETS. The impact and incidence of a tax would be more certain than with an ETS as the tax could be levied on volume of emissions measured objectively by satellite monitoring equipment at a publicly announced rate. The impact could be gradual, as a tax can be phased in with scheduled

rate adjustments according to an announced timetable in such a way as to give industry time to adjust. The tax itself would be stable, in contrast to the price fluctuations that have occurred in the largest established ETS market, the EU ETS and the only ETS which was successful in reducing emissions, the US Acid Rain Program. The economic effect of a tax would be more certain because the increased cost of emissions would be stable. In addition, the revenue would be collected by the government and this would facilitate revenue recycling to low income families and GHG abatement projects, or it could be used to lower other taxes in a way that increased the equity and efficiency of the tax system overall.

There are other likely advantages as well. The instability of prices in an ETS market would add uncertainty and could adversely impact on investment decisions and the level of economic activity in the productive sectors of the economy. With a tax, there would be no need for a secondary market for securities or a range of complex derivatives, which could distort the flow of revenue and economic activity and which would divert income from abatement activities to a small number of market players who were able to exploit the market volatility of an ETS. The management of a carbon tax would be simpler than an ETS and could become the responsibility of existing institutions – unlike an ETS which requires a range of new institutions such as a registry and enforcement body, a monitoring authority, and a new trading entity. The integrity of a tax would be far higher than an ETS because cap and trade systems are inherently more exposed to fraud and evasion, with much selling of permits which do not reduce emissions elsewhere, and with buyers not knowing about this fraud or mistake in such a time frame as to allow transactions to be unwound. Overall, an ETS is an artificial market based on a scarcity created by a government for an intangible commodity, as it requires a government to create an artificial scarcity for the commodity to have value, whereas a carbon tax does not require any such economic fiction.

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