



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*



Emissions Trading versus a Carbon Tax

AARES National Conference 2010

William Acworth and Brett Janissen, Allen Consulting Group

February 2010

Emission Trading versus a Carbon Tax

It is now widely accepted that human induced greenhouse gas emissions are resulting in climate change. Uncertainty surrounding the timing, severity, and costs of climate change has led to debate over the most appropriate policy response.

There is a consensus that market based solutions such as Emission Trading Schemes (ETS) or carbon taxes are more efficient policy responses when compared to command and control standard based regulation. However, whether to apply an ETS or a carbon tax as the primary policy response to reduce greenhouse emissions is a question that divides expert opinion.

This paper assesses the efficiency and political economy implications of these two measures. The merits of the two policies are assessed with regard to:

- treatment of uncertainty;
- impact on short and long term carbon prices;
- dynamic efficiency;
- revenue raising capacity;
- implementation and administration costs;
- political acceptability; and
- international consistency.

Certainty: Price or emissions?

An efficient economic policy is one that equates the marginal cost of reducing emissions with the marginal benefit of avoided climate change impacts. Under conditions of perfect information, either an ETS or carbon tax could be used to reduce emissions to the target levels, with both approaches offering equivalent environmental and efficiency outcomes.

However, climate change policy making is full of uncertainty. Policy makers must estimate the marginal costs and social benefits of climate change mitigation. If these costs are not estimated accurately, the policy will result in firms emitting a sub-optimum level of greenhouse gases, leading to welfare losses. A critical question for policy makers is therefore: when faced with uncertainty, is a price based carbon tax policy more or less efficient than a quantity based ETS?

Martin Weitzman discussed the efficiency of taxes compared to quantity regulations under conditions of uncertainty in a seminal 1974 article. Weitzman concluded that under conditions of uncertainty, either a tax or a quantity type regulation could be efficient, depending strictly on the slope of the marginal benefit curve. If the marginal benefits of providing a good are relatively constant, then a tax is an efficient policy. This occurs as a tax results in a smaller social welfare loss than a quantity regulation when actual costs differ from expected costs. However, when the marginal benefits of action change rapidly, then a quantity based regulation is the more efficient policy. This logic — as applied through the 1980s, 1990s and into the early years of this decade — has often been applied to highlight the theoretical superiority of carbon taxes (i.e. a mandated price approach) to control greenhouse gas emissions. It is nicely summarised by Pezzey (2003):

Though there is great uncertainty about both the costs and benefits of control, the stock effect caused by the long atmospheric lives of most GHGs almost certainly makes the marginal benefit cost curve much flatter than the marginal control cost curve (Pizer 2002, Philibert 2002; and this argument may well also apply to other long-lived stock pollutants). Therefore, following Weitzman (1974), it would be better to use a tax-based instrument to control the price of GHG emissions, than to use permits to control the quantity of emissions.

Pezzey John C.V., 2003, 'Emission Taxes and Tradeable Permits', *Environmental and Resource Economics* 26, p. 329.

Advocates of a carbon tax argue that there is only a weak relationship between incremental emissions and incremental damages from climate change. This implies that the marginal benefits of climate change mitigation are relatively stable, and a tax should be used to reduce the risk of welfare losses associated with excessive and unexpected costs in achieving a particular outcome. In other words, if forced to choose between price certainty and emissions certainty, choose the one that is most likely to obviate higher costs.

However, in recent years climate science has increasingly highlighted emission thresholds in the climate system, and the risk of runaway climate impacts once these thresholds are crossed. Within the scientific community there is mounting concern that we are accelerating toward irreversible tipping points — and these may be much closer than what was thought five or ten years ago.

A recent greenhouse science report, prepared by an alliance of leading researchers for the Danish Prime Minister, who hosted the 2009 United Nations Framework Convention on Climate Change negotiations, carries this message in its Executive Summary:

Recent observations show that greenhouse gas emissions and many aspects of the climate are changing near the upper boundary of the IPCC range of projections. Many key climate indicators are already moving beyond the patterns of natural variability within which contemporary society and economy have developed and thrived. These indicators include global mean surface temperature, sea-level rise, global ocean temperature, Arctic sea ice extent, ocean acidification, and extreme climatic events. With unabated emissions, many trends in climate will likely accelerate, leading to an increasing risk of abrupt or irreversible climatic shifts... Rapid, sustained, and effective mitigation based on coordinated global and regional action is required to avoid 'dangerous climate change' regardless of how it is defined.

Richardson et al, 2009, Synthesis Report from CLIMATECHANGE: Global Risks, Challenges & Decisions, 10-12 March 2009, University of Copenhagen.

This new concern may well swing old economic arguments over policy choices made under risk and uncertainty in favour of quantity targets and greater assurance over emission outcomes. In fact, in a recent article, Weitzman (2009) emphasised the economic case for stronger, more decisive action to cut emissions and fight climate change. Though not a treatise on taxes versus cap and trade systems, it does support the case for more certain and aggressive abatement outcomes. Weitzman's five key findings are:

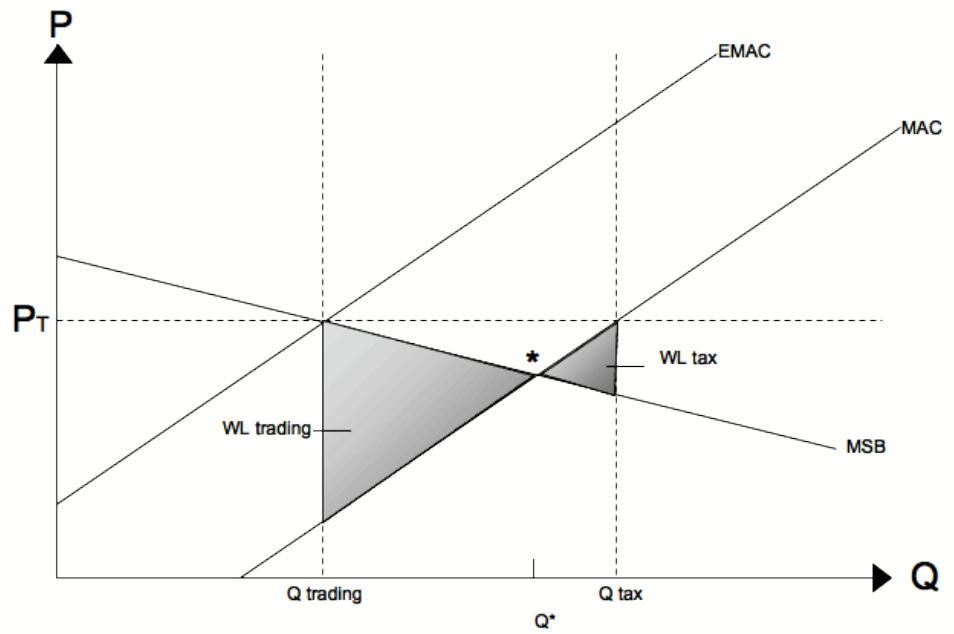
- 1) from deep structural uncertainty about the prospects for disastrously large temperature changes, there is a strong prima facie case that the relevant probability density function (PDF) of climate change catastrophes has an extreme tail that is heavy with probability;
- 2) when this heavy tail is combined with very unsure high-temperature damages, this aspect can dominate the discounting aspect in calculations of expected present discounted utility, even at empirically plausible real-world interest rates;
- 3) all of this translates into placing severe limitations on the reliability of policy advice coming from standard cost-benefit analysis (CBA) of climate change;
- 4) the conventional economic advice of spending modestly on abatement now but gradually ramping up expenditures over time is an extreme lower bound on what is reasonable rather than a best estimate of what is reasonable; and
- 5) removing the artificial limitation on conventional CBA that comes from excluding high-impact disasters can shift a more inclusive economic welfare analysis strongly away from the gradualism of a climate-change policy ramp.

Weitzman, Martin L., 2009, 'On Modeling and Interpreting the Economics of Catastrophic Climate Change', *The Review of Economics and Statistics*, 91.

Weitzman's theory is illustrated in Figure 1.1 and Figure 1.2 where the marginal costs of emission abatement turn out to be cheaper than originally estimated. Under such conditions, a carbon tax results in a level of abatement that is greater than the social optimum, and generates a welfare loss (see Figure 1.1). An ETS results in lower than optimum abatement and a welfare loss. However, the slope of the Marginal Social Benefit (MSB) curve dictates the relative size of welfare losses, with an ETS scheme being more efficient when damages from climate change increase quickly with increased emissions (see Figure 1.2). These insights into welfare economics also hold when the marginal costs of abatement turn out to be more expensive than originally estimated.

Figure 1.1

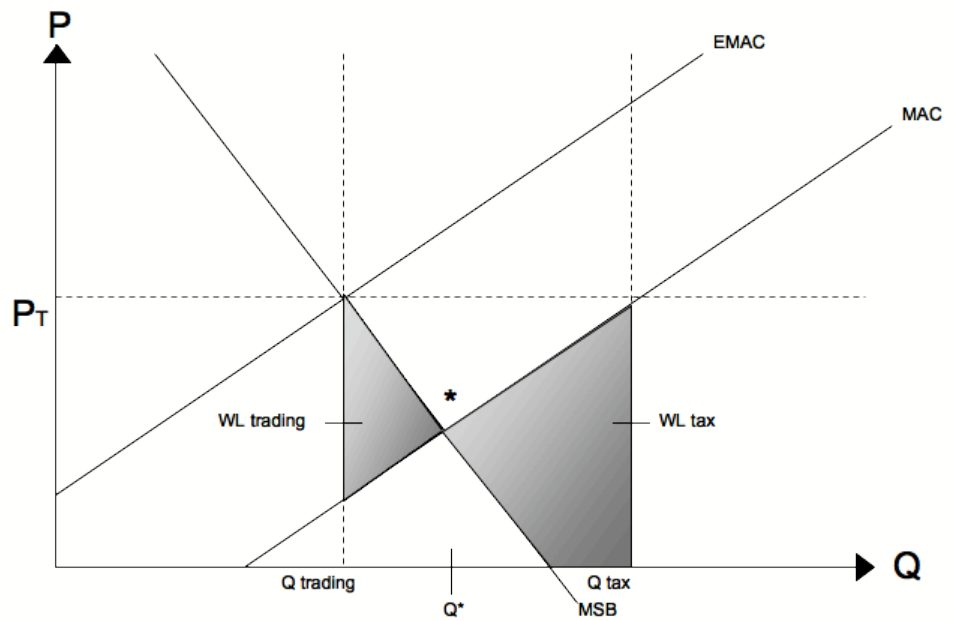
TAX VS ETS: THE 'INSTRUMENT' COSTS OF GETTING IT WRONG - FORGIVING CLIMATE SYSTEM



Source: Allen Consulting Group (2010)

Figure 1.2

TAX VS ETS: THE 'INSTRUMENT' COSTS OF GETTING IT WRONG - UNFORGIVING CLIMATE SYSTEM



Source: Allen Consulting Group (2010)

Price stability

A carbon tax explicitly sets the price of carbon within the economy and creates price certainty as a result (this is, at least, until the tax is varied). An ETS sets the quantity of emissions and allows the price to vary based on the demand for emission permits.

Experiences with ETSs in the past suggest that price volatility can be of considerable concern. For example, excess permit demand led to a ten-fold increase in the price of nitrous oxide emissions in Southern California's Regional Clean Air Incentives Market trading scheme in 2000. Further, an over allocation of permits in the European Union Emissions Trading Scheme resulted in prices falling close to zero in the pilot stage of the scheme.

Price stability has a number of attractions from a policy and efficiency perspective, and is probably the biggest argument in favour of a carbon tax over an ETS. Firstly, carbon price volatility could be quite disruptive considering the carbon reliance of modern industrialised economies. For example, carbon prices will not only affect the direct cost of emitters, but also prices in energy markets, and energy intensive goods and services. Secondly, a stable (and high) carbon price is likely to be more effective in fostering investment into climate change abatement technology, assuming investor preferences for more rather than less certainty.

The volatility of an ETS (generating the same basic price outcome 'on average') could discourage risk adverse investors. However, there are a number of mechanisms that can be used to smooth the inherent price volatility associated with an ETS. These include banking and borrowing (which establishes explicit inter-temporal arbitrage opportunities) and price caps. These mechanisms are discussed below.

Banking and borrowing

Banking and borrowing can be used to introduce inter-temporal flexibility into an ETS, thereby allowing participants to distribute abatement choices (and costs) through time. During periods of high emission demand, polluters can borrow permits from future periods. Borrowing will increase the supply of permits in the current time period and therefore ease price spikes during periods of excess demand. With banking, polluters that face a marginal cost of abatement that is below the current permit price can save permits for future time periods. This shift in permit 'supply' tends to boost the permit price in the current period, and lower it (from what it would otherwise be) in the future period.

Banking and borrowing allows polluters to equate the marginal cost of abatement through time. The effect is a smoother carbon price trajectory that will encourage earlier investment into climate change abatement technology by connecting current and future price expectations.

Over the medium term, a healthy ETS with banking and borrowing might even improve price certainty relative to a carbon tax. Under an ETS the carbon price path would be dictated by expectations surrounding carbon markets, whereas the government would determine a carbon tax. To achieve increasingly stringent abatement outcomes, the government determined price would need to be ratcheted up over time. The inter-temporal connection offered by emissions trading allows companies to ascend a price ‘ramp’. Government determined taxes — aimed at achieving the same or similar emission outcomes — would see companies ascending a carbon price staircase, with little certainty over the size of the next step, or those beyond it.

Price cap

A price cap could be introduced into an ETS to act as a safety valve, relieving the economy from high permit prices during periods of excessive demand. Of course, market prices and associated volatility would rule below the cap. But it would cover off the risk of ‘excessive’ price spikes. Importantly, price cap designs either implicitly or explicitly allow access to a virtually unlimited supply of fixed price emission permits. The interaction of this government sanctioned supply with banking provisions would need to be carefully managed, given its potential to impact on the achievement of emission targets through time.

Dynamic efficiency

A further consideration in the emission tax versus ETS debate is the impact of each policy on firm incentives for innovation in alternative energy sources and emission abatement technology. Despite the potentially higher implementation and running costs of an ETS, it is feasible that private sector participation in permit trading could drive standards of monitoring, measurement and verification, due to risk aversion and competitive ‘learning’ among private enterprises and players. This notion of innovation, the rate of improvement and efficiency gain, and the ability to quickly build on the experience of others is at the heart of what economists call ‘dynamic efficiency’.

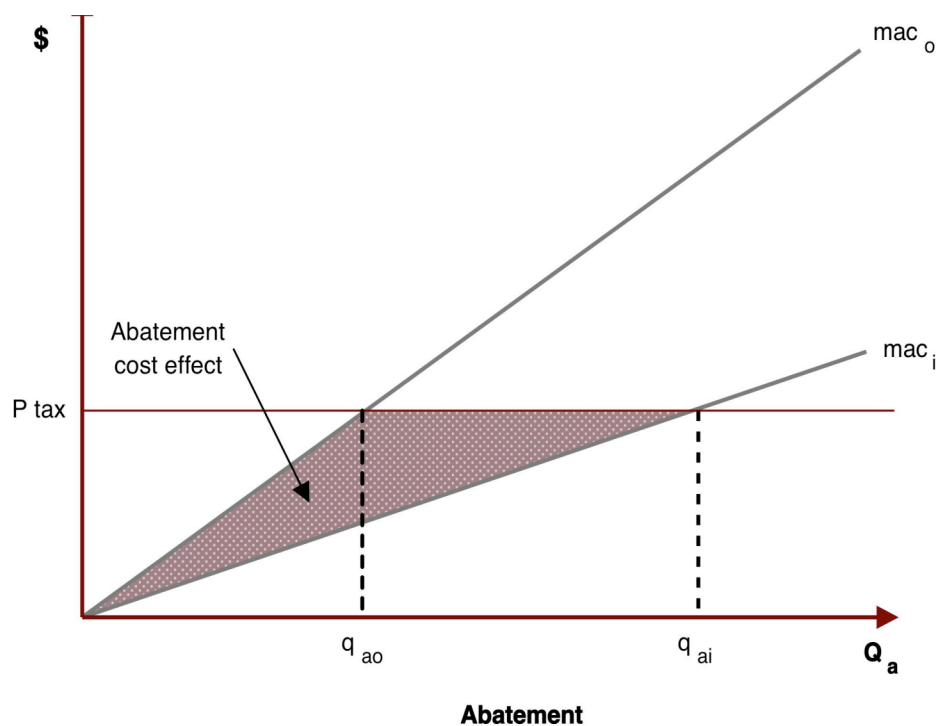
Over the long-run, technology can reduce the cost of environmental protection and ameliorate the trade-off between environmental quality and economic growth. Given the on-going resistance of governments worldwide to commit to specific emission reductions, innovation in clean production technology appears to be critical in solving the problem of global climate change. Understanding this, careful consideration should then be given to the relative impacts of government policies on the incentive for private sector innovation. This is a topic that has been discussed theoretically in economic literature, however, has yet to appear in the political debate.

Traditionally, analysis has focused on the incentive for innovation under different environmental policies in a single-firm setting. Amongst these researchers there is a consensus that market based policies drive more innovation than command and control type regulation (Dowing and White 1986, Magat 1978, Zerbe 1970).

However, for many environmental problems, and certainly climate change, innovations are applicable to more than one firm. Milliman and Prince (1989) first assessed innovation in a multi-firm framework under different policy settings. Since then, their framework has been applied to assess the incentives for innovation under different circumstances (see for example, Fischer, Parry, and Pizer 1998 and Requate 1997). The economic framework described in Milliman and Prince (1989) and further developed by Fischer, Parry, and Pizer (1998) is drawn upon here to discuss the relative economic incentives for innovation under an emissions tax and ETS.

The cost reduction associated with adopting a new technology, sometimes referred to as the *abatement cost effect*, represents the willingness to pay for innovation (Fischer, Parry and Pizer 1998). Under a tax regime, as innovation makes abatement cheaper, the total amount of abatement increases. This occurs as it is cheaper to reduce some emissions than to pay the emission tax. However, under an ETS, abatement is fixed at the level set by the cap. The *abatement cost effect* is smaller under an ETS compared to an emission tax, as abatement does not increase as costs fall.

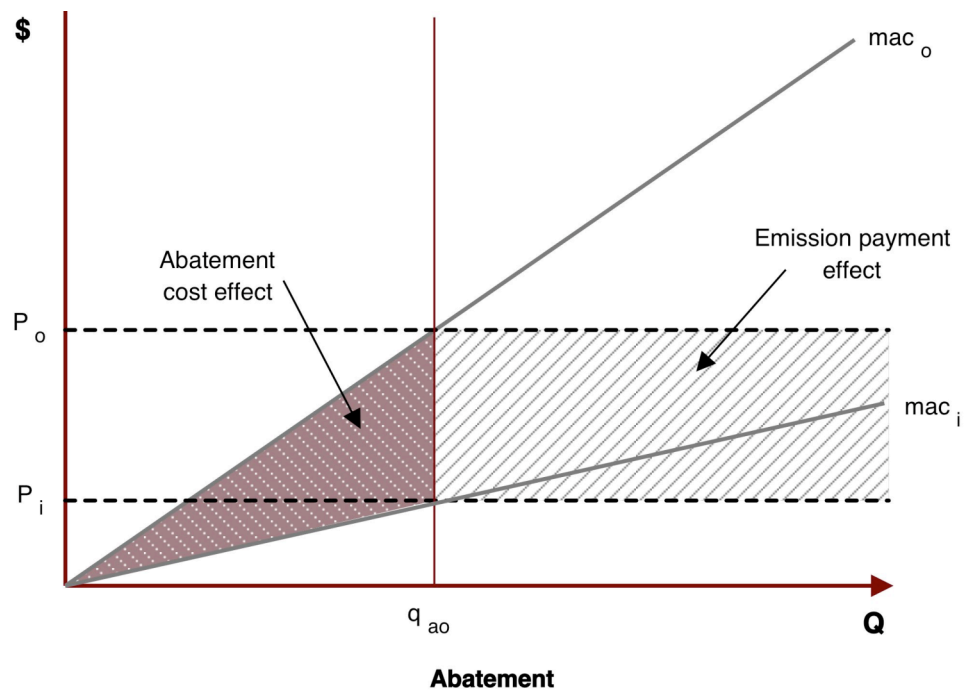
Figure 1.3

INCENTIVES FOR INNOVATION UNDER A TAX

Source: Allen Consulting Group (2010).

Figure 1.4

INCENTIVE FOR INNOVATION UNDER AN ETS



Source: Allen Consulting Group (2010).

However, under an ETS, the collective adoption of technology also affects the market for emission permits (everything else held constant), creating further incentives (and disincentives) for innovation. Collective adoption of any innovation will reduce permit demand and therefore the price of permits. When permits are auctioned, the reduction in the permit price represents a direct benefit to innovating firms and further increases incentive for innovation. This effect has been termed the *emission payment effect*. The size of the *emission payment effect* will be determined by the impact of the innovation on the market for emission permits. Therefore, innovations that greatly reduce firm emissions and are widely applicable across all polluters will have a higher *emission payment effect* than more sector specific advances in technology.

The reduction in permit price however, can also act as a disincentive for innovation. The lower permit price offers non-adopting firms a cheaper option for covering their emissions rather than adopting innovative technology. This perverse effect has been termed the *adoption price effect*.

Given the competing incentives for innovation under an emission tax and ETS regime it appears ambiguous which policy instrument will drive more innovation. Milliman and Prince (1989) concluded that, the addition of the emission payment effect under an ETS policy setting is generally sufficient to increase the overall incentive for innovation above that of a tax. Further, Miliman and Prince (1989) suggest that under an emission tax regime, optimal agency response to a reduction in the tax rate may be difficult as it will:

- be met with resistance from environmental interest groups; and

- reduce emission tax revenues and thus may be met by regulator resistance.

Therefore:

Not surprisingly, firms may sometimes doubt that this adjustment process will be resolved to their advantage. In turn, firm technological change incentives under emission taxes may be dampened

Milliman. S.R, and Prince. R, 1989, "Firm Incentives to Promote Technological Change in Pollution Control", *Journal of Environmental Economics and Management* 17, pp. 247-265

While using the same economic framework, Fischer, Parry and Pizer (1998) broadened the scope of the research and concluded that either policy tool can perform significantly better than the other, depending on the specific circumstances. Specifically:

- with little imitation, taxes provide more incentive for innovation;
- where new technologies are easily imitated and the royalties from research and development difficult to capture, an ETS will provide stronger incentives for investment;
- where marginal environmental benefits from emission abatement are steep, an ETS will drive higher innovation; and
- where marginal environmental benefits from emission abatement are flat, an emission tax will drive higher innovation.

Finally, the authors conclude that the discrepancies between policies are greatly reduced when regular policy adjustment is possible.

Currently, there is no consensus preferring an emission tax over an ETS on the grounds of innovation. From the limited research, it appears that different policies will drive different incentives for innovation based on the specific market conditions. Further, views differ on the extent to which a market-based approach which is a characteristic of emissions trading, can affect the psychology of innovation relative to a government applied tax. Though both generate a price, only emissions trading creates buyers and sellers and a commodity that can be readily linked to commerce and enterprise. However, as noted previously, the volatility of market determined prices — as opposed to government stipulated ones — can deter risk averse investors. A fundamental question arises: does a market-based system 'feel' different and lead to a different entrepreneurial response than a set of abatement objectives backed by a carbon tax? This certainly appears to be an area for further theoretical, experimental and empirical study. The price stabilising effect of inter-temporal market linkages (through banking and borrowing of emission permits) versus step changes in mandated tax rates consistent with deepening abatement targets is also relevant.

Revenue raising capacity

Critical to the ETS versus carbon tax debate is the question of how revenue generated from these policies is distributed. It is often argued that a carbon tax should be favoured over an ETS because it generates revenue for government, and therefore allows a range of other (potentially efficiency or welfare enhancing) initiatives to be funded. Government carbon tax revenue could be used to further increase economic efficiency by:

- reducing distortionary taxes (this is commonly referred to as the ‘double dividend’);
- funding research and development;
- supporting climate change adaptation; or
- providing support for groups and activities in line with broader community objectives.

However, some authors have highlighted that government revenue collected from the private sector will not necessarily be well spent. Parry and Pizer point to the opportunities and risks associated with these major revenue raisings:

Income taxes cause a variety of distortions in the economy; for example, they can deter educational and other investments that would increase an individual’s earning power, since part of the rewards will be taxed away by the government, and they can also lower the incentive for some people to join the workforce. These economic distortions could be reduced, albeit modestly, if CO₂ tax revenues were used to lower individual income taxes. Even if the revenue from a CO₂ tax is not used to cut other taxes, it could still flow to a variety of important uses — including support for energy R&D, adaptation, or assistance to stakeholders and communities adversely affected by the policy. Weighing against this revenue-raising advantage is the risk that government will spend the additional revenue on programs that cost more than the benefits they provide, thereby exacerbating the cost of the program relative to giving allowances away for free.

Parry I.W.H, and Pizer W.A., 2007, ‘Emissions Trading versus CO₂ Taxes’, Resources for the Future, Washington DC., May 2007, p. 3.

Allocating permits for free based on simple rules may represent a robust alternative outcome where revenues are spent poorly by governments. Further, adoption of emissions trading does not preclude revenue raising. While past ETSs have commonly allocated emission permits for free, it is quite feasible for permits to be allocated through an auction process. Auctioning permits allows governments to capture the revenue generated from introducing a carbon price. In fact, if all permits were auctioned, the fiscal implications of a tax and trading scheme would be the same. A potential benefit of auctioning permits is flexibility over the point at which firms must pay for emissions and how industry assistance is delivered.

Implementation and compliance costs

Implementing an ETS is likely to be more expensive than a carbon tax as it will require the establishment of new institutions. While a carbon tax can ‘piggy back’ on existing tax infrastructure, an ETS will require the development of a national registry, mechanisms for trading, complex legislation and increased monitoring and verification costs. Further, the compliance costs for firm participants are also likely to be higher than those of a carbon tax (at least in the early phase) since participation in a trading scheme will likely require new expertise.

While there is a consensus that implementation and running costs are likely to be more expensive under an ETS, the magnitude of the additional cost is subject to debate. Robson (2007) claims that emission trading enforcement costs, compliance costs and administration costs could be staggering. However, Parry and Pizer (2007) point to experience with other trading schemes to suggest that institutions will develop quickly at only a modest cost.

It is also important to note that if credits for bio-sequestration are to be recognised as a valid abatement response (as is the case under the Kyoto Protocol, and likely to continue into the future), then to have value to emitters with a tax liability these need to be tradable (otherwise, emitters would need to grow their own forests to derive the offset benefit). Embracing and crediting bio-sequestration means having a trading system (of emission or carbon tax ‘credits’), even if this needs to be welded on to a primary carbon tax arrangement.

Political acceptability

On the grounds of political acceptability, an ETS is normally favoured over a carbon tax. Voters traditionally see a carbon tax as a revenue raising tool with potential, yet not well defined, environmental benefits. In contrast, the perceived objective of an ETS is to limit emissions, with government revenues a potential consequence. This is frequently offered as the key reason for the failure of the European Union carbon tax in the 1990s. It is certainly a strong selling point with business, that emissions trading, via permit allocation arrangements, offers the ability to implement abatement incentives without a transfer of revenue from the private sector to government, and can achieve distributional objectives without a reliance on revenue collection and subsequent disbursement. Permit allocation offers a facility for these elements to be put in place prior to imposition of emission constraints.

Recently, ETSs and carbon taxes have been debated with regard to their ability to deliver compensation and facilitate voluntary emission reductions. This debate is outlined below.

Delivering compensation

When moving towards a carbon constrained economy, policy makers may wish to ease the transition by compensating industries that are most affected. These are normally industries that are carbon intensive and have little means to pass on the increased costs associated with a carbon price. Compensation can be administered easily and transparently via free allocation under an ETS.

While it is possible to provide compensation under a carbon tax regime, it is generally more complicated to do so. Under a carbon tax regime, compensation can be provided through either tax exemptions or compensation paid to an emitter through a financial transaction. Tax exemptions are relatively easily administered, however, remove entirely the incentive for emission abatement. While financial compensation does not distort the economy-wide incentive for abatement, it is often complicated to administer as tax revenue must first be collected and later transferred back to emitters, with the level of compensation normally determined by best practice baselines. Further, the requirement to calculate industry specific emission baselines increases the implementation costs of a carbon tax closer to that of an ETS.

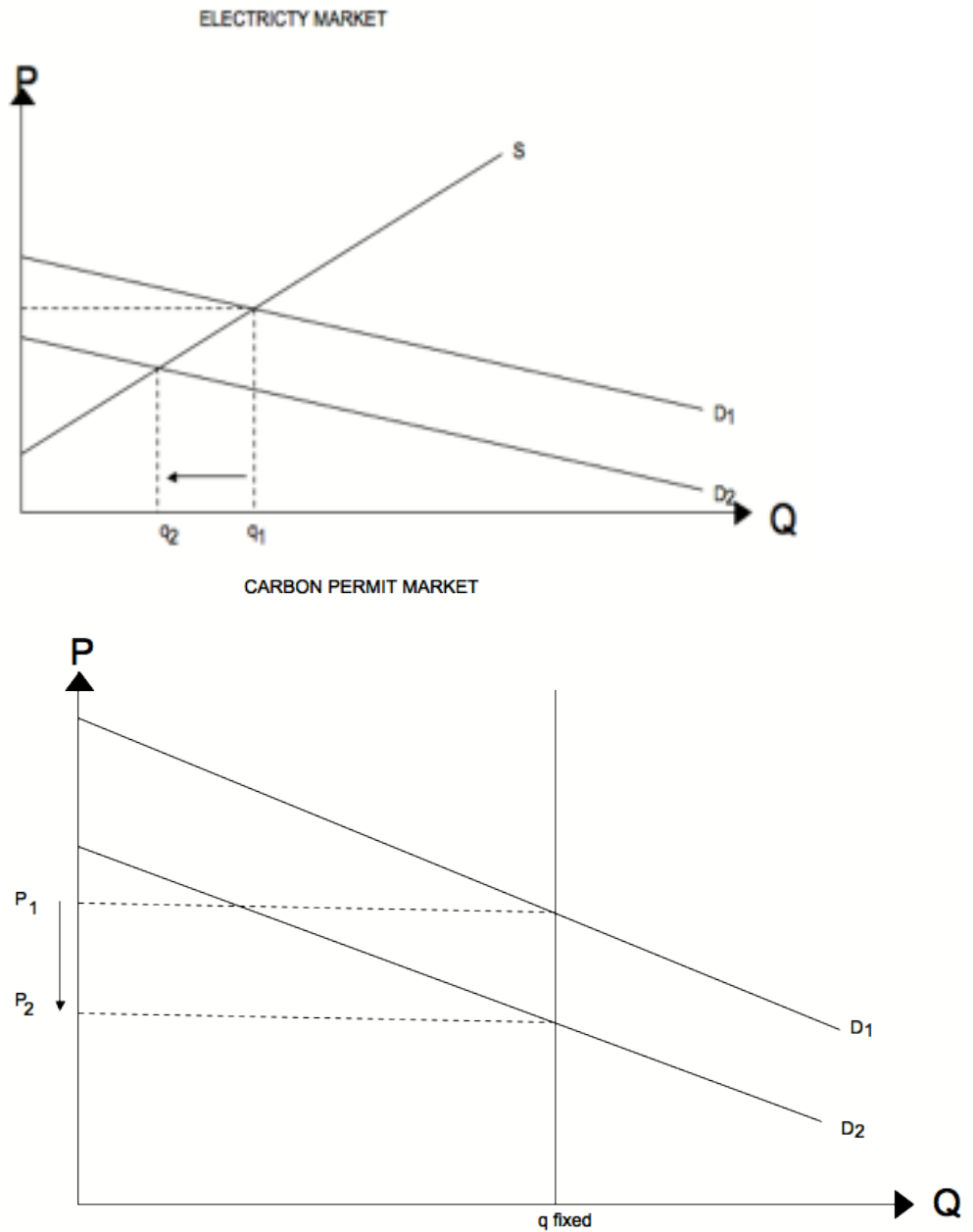
Both policies are subject to lobbying by key industries. Under an ETS lobby groups will push for free allocation or exemptions while under a carbon tax concessions or tax exemptions are sought. And while a tax delivers cash to recipients, permit allocation delivers an asset (whose value moves explicitly with the current and future value of carbon) that can be held or cashed in at the discretion of the user.

Voluntary emission reductions

Despite their advantage in terms of political acceptability, ETSs have recently come under scrutiny in Australia because of their inability to facilitate voluntary emission reductions. This was well articulated by The Australia Institute. The Australia Institute explains that imposing an emissions cap will fix emissions in the short term. While the cap is effective in restricting emissions to the set target, it will also negate any emission reductions below this target. This is significant when considering voluntary emission reductions. For example, increases in renewable energy demand or improvements to energy efficiency.

Consider the example illustrated in Figure 1.3, where voluntary emission reductions occur in the household sector in the form of solar panel installations. The reduced demand for carbon intensive electricity (a shift from D1 to D2) will place downward pressure on the demand for carbon permits. However, given a short-run fixed permit supply, this will only result in a reduction in the permit price (P1 to P2) and do nothing to reduce the quantity of Australia's emissions. Voluntary abatement activity in this instance has simply freed up emission permits under the cap for others to use, and lowered the 'price' of emissions that equates to delivery of the emissions target.

Figure 1.5

VOLUNTARY ACTION: SAVINGS NEUTRALISED UNDER A CAP AND TRADE SYSTEM

Source: Allen Consulting Group 2010

This effect can be of concern for a variety of reasons:

- individuals or industries should be able to express their preference for stronger climate change mitigation, and help support such an outcome;
- effective action in the household sector may strengthen social norms surrounding climate change mitigation and encourage further voluntary abatement; and

- discouraging sectors from action on climate change mitigation could result in a lack of research and development into sector specific emission abatement technology.

However, an international commitment to tighter emission targets in the future will ensure a steady increase in the carbon price, alleviating the demand for voluntary reductions. This implies that this phenomenon of disenfranchisement will be more significant at lower carbon prices when the pool of those willing to pay more than the prevailing market price for carbon is larger.

It is important to note that abatement action in sectors not covered by the ETS — once the scheme cap has been set — will not have the effect of lowering the domestic carbon price under an ETS. It will result in abatement that is supplemental to the cap and trade system, and impact the national greenhouse accounts but not the trading registry. Further, as Frank Jotzo (2009) points out, the more voluntary climate change abatement undertaken, the easier it will be to collectively meet the national emissions target. That in turn will make it possible to commit to more ambitious future targets. In addition, individuals and industry can express a preference for increased mitigation by buying permits from the market to reduce the cap — and retiring them unused.

International consistency

Climate change is a global problem. No single country's efforts to mitigate climate change will ever be sufficient to affect the global outcome. Therefore, international cooperation is required. From an efficiency perspective, international action is also desirable, as it allows emission abatement to occur where it is cheapest to do so, regardless of geographic location.

In theory, either an ETS or carbon tax could be administered internationally. A uniform tax would require participating countries to:

- initially agree to a uniform tax and any uniform tax exemptions;
- enforce similar monitoring and enforcement provisions; and
- implement the tax at the same point of obligation, or to design special provisions to avoid double counting.

Global enforcement of a uniform tax would be particularly complex. Internationally, energy markets are already heavily regulated, often with competing taxes and production subsidies levied on a single unit of output. In many cases, the intended effect of a carbon tax could be offset through equivalent production subsidies, masking the carbon price signal. Considerable 'slippage' might be experienced before a uniform and consistent abatement price signal was actually generated, as opposed to a reshuffling of the tax and subsidy mix. With reference to the earlier discussion of economic versus environmental uncertainty, it does appear that we have now entered a realm where significant and observable global abatement outcomes are desirable. This logic would seem to drive the case for national emissions targets.

While a global ETS would require similar provisions regarding the point of obligation, monitoring and enforcement laws to a carbon tax, it has the advantages of allowing markets rather than international negotiations to set the carbon price. Allowing trading of carbon permits across national borders will create international markets facilitating international price discovery.

However, linking trading schemes internationally may also have some pitfalls. Adverse conditions in one national market affect all other markets via these linkages. For example, lax monitoring and enforcement in one country could result in fraudulent or devalued carbon permits being traded globally. This could undermine international targets and erode business and consumer confidence in carbon markets.

Finally, it is necessary to consider the policy choice debate in terms of current international negotiations. Since the 1992 Earth Summit in Rio de Janeiro, emission targets have been the focus of international climate change policy. The first legally binding targets were set for the period 2008-2012 under the Kyoto Protocol. A post-2012 successor regime is currently being negotiated.

Australia's international commitments are also important when considering the appropriate policy choice. As Jotzo (2009) argues, if a tax falls short of achieving the overall national emissions target, then Australia will be liable to purchase permits from overseas. This in effect shifts uncertainty away from industry to the broader economy. A similar logic applies to the need to account for emissions that fall outside the scope of the national emissions trading system.

Australia's Carbon Pollution Reduction Scheme: Where does it fit?

Although the discussions in this paper have been couched in terms of an ETS versus a carbon tax as alternatives, it is possible for there to be some mixing of the elements of each. This is demonstrated in the case of the Australian Government's proposed Carbon Pollution Reduction Scheme (CPRS), which has at its core a cap and trade scheme but which also includes some features of a carbon tax that increases price certainty, especially in the early years of the scheme. Other complementary policies would also reduce price volatility and account for voluntary action.

Price cap

An element of price certainty has been introduced into the proposed CPRS in several ways. As a transition measure, in the first year of the scheme (2011-12) the commencement of mandatory obligations will take place under a fixed price permit arrangement. In effect, the government will make available all permits needed at a fixed price of \$10 per tonne of CO₂-e. In the following four years the price cap will be set at \$40 per tonne, rising at 5 per cent real per annum.

Cap guidance and 5 year rolling target

In a further effort to improve certainty for participants and moderate price volatility, the government will specify a scheme cap for at least five years in advance. In addition, up to a further ten years of guidance will be provided through the establishment of ‘gateways’ or ranges within which future CPRS caps will lie. To maintain five years of guidance, CPRS caps will be extended by one year, every year. Gateways will be extended for five years, every five years.

Banking and borrowing

As discussed earlier in this paper, ETS provisions that allow scheme participants to bank and borrow emissions permits also serves to moderate price volatility. As detailed in the Australian Government’s Climate Change White Paper, this would be a feature of the CPRS, although borrowing provisions would be limited. Permits will be able to be banked indefinitely while liable entities will also have a small borrowing allowance — they will be able to meet up to 5 per cent of their liabilities by using the following year’s vintage permits.

Support for voluntary action

The Australian Government has also introduced several complementary measures to the CPRS to support individual voluntary action. These include:

- taking Green Power purchases into account when setting future emission caps, allowing a tighter cap to be achieved; and
- establishing an Energy Efficiency Savings Pledge Fund to facilitate the voluntary buying and canceling of emission permits to generate additional emission reductions.

Concluding thoughts

Climate change is now at the forefront of both government policy and private sector strategic planning. A critical element of climate change mitigation policy is the establishment of a carbon price to encourage a movement towards a carbon-constrained economy. While a carbon tax has merits in terms of consistency and simplicity in national implementation, it cannot deliver assurance over emission targets, whereas an ETS can. With growing scientific evidence of dramatic climate change and increasing calls for rapid, deep cuts in global emissions it is now more important than ever that global targets are achieved and emission thresholds are not breached. Further, climate change is a global problem that requires a global response. The ability for individual countries to commit to and achieve emission targets and to link emission trading schemes in the future will assist in international collaboration and global carbon pollution management.

References

- Congressional Budget Office (CBO), 2008, *Policy Options for Reducing CO₂ Emissions*, Congress of the United States, Washington DC.
- Department of Climate Change (DCC), 2008, *Carbon Pollution Reduction Scheme White Paper*, Department of Climate Change, Canberra.
- Downing. P. B, and White. L.J., 1986, 'Innovation in Pollution Control' *Journal of Environmental Economics and Management* 13, 18-29.
- Department of Climate Change (DCC), 2009, 'Supporting Individual Action — Fact Sheet', Department of Climate Change, see <www.climatechange.gov.au>.
- Denniss. R, 2008, *Fixing the Floor in the ETS: The Role of Energy Efficiency in Reducing Australia's Emissions*, The Australia Institute, Canberra.
- Fischer. C, 2000, 'Climate change Policy Choices and Technical Innovation' Resources for the Future, Washington DC.
- Fischer. C., Parry. I.W., and Pizer. W.A., *Instrument Choice for Environmental Protection When Technological Innovation is Endogenous*, Discussion Paper 99-04, Resources for the Future, Washington DC.
- Glomma. G, Kawaguchib. D, and Sepulvedac, 2008, 'Green Taxes and Double Dividends in a Dynamic Economy', *Journal of Policy Modeling* 30(1).
- Gronwald. M, and Ketter. J., 2009, *Evaluating Emission Trading as a Policy Tool — Evidence from Conditional Jump Models*, CESifo Working Paper Series No. 2682, June 2009.
- Hawksworth. J, and Swinney. P, 2009, *Carbon Taxes vs Carbon Trading: Pros, Cons and the Case for a Hybrid Approach*, Price Waterhouse Coopers, London.
- Hepburn, C., 2006, 'Regulation by Prices, Quantities, or Both: a Review of Instrument Choice', *Oxford Review of Economic Policy Vol 22 (2)*, 2006.
- Jotzo, F., 2009, *Emissions Confusion: Trading vs taxes*, East Asia Forum, June 2009, see <www.eastasiaforum.org>.
- Magat. W, 1978, 'Pollution Control and Technological Advance: A Model of the Firm', *Journal of Environmental Economics and Management* 11, 127-160.
- Milliman. S.R., and Prince. R, 1989, Firm Incentives to Promote Technological Change in Pollution Control, *Journal of Environmental Economics and Management* 17, 247-265.
- Nordaus, W., 2007, 'To Tax or Not to Tax: Alternative Approaches to Slowing Global Warming', *Review of Environmental Economics and Policy*, 1 (1).
- Parry, I., and Pizer, W.A., 2007, 'Assessing U.S Climate Policy Options', Issue Brief 5: Emissions trading versus CO₂ taxes versus Standards, Resources for the future, Washington DC.

Pezzy. J.C.V., 2003, 'Emission Taxes and Tradeable Permits', *Environmental and Resource Economics* 26.

Requate. T, 1997, 'Incentives to Innovate Under Emission Taxes and Tradable Permits', *European Journal of Political Economy*, 14.

Robson, A., 2007, 'Submission to the Prime Ministerial Task Group on Emissions Trading', see <www.pmc.gov.au>.

Richardson. R, Steffen. W, Schellnhuber. H.J, Alcamo. J, Barker. T, Kammen. D.M, Leemans. R, Liverman. D, Munasinghe. M, Osman-Elasha. B, Stern. N, Wæver. O., *Synthesis Report from CLIMATECHANGE: Global Risks, Challenges and Decisions*, 10-12 March, University of Copenhagen.

Weitzman, M.L., 2009, 'On Modeling and Interpreting the Economics of Catastrophic Climate Change', *The review of Economics and Statistics* 91(1).

Weitzman, M.L., 1974, 'Prices vs. Quantities', *Review of Economic Studies* 41(4).

Zerbe. R.O., 1970, Theoretical Efficiency in Pollution Control, *Western Economic Journal* 8, 364-376.