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Rationales for Additional Climate Policy Instruments Under a Carbon Price

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Abstract

The plan to introduce a carbon pricing scheme in Australia has focused attention on the future relevance and necessity of using other policy instruments to reduce carbon emissions. Significant reports, including the Wilkins Review and reports by the Productivity Commission, have argued using the standard neoclassical economics framework that once a carbon price is established, it should be (almost) the only instrument needed to tackle climate change mitigation in Australia. With a small number of exceptions for complementary instruments to address some market failures, the use of other climate policy instruments, it is argued, will result only in unnecessary duplication and potential distortions. The aim of this article is to show that there are, in fact, a significant number of rationales for implementing several climate policy instruments in combination with a carbon price, and we should not be too quick to dismiss certain climate policy instrument combinations.

JEL Codes: B5; Q2; Q5

Keywords

Climate change policy; carbon pricing; complementary policies; policy mixes; policy interaction; renewable energy policy.

1. Introduction

With growing awareness of the huge costs of mitigating and adapting to climate change (and the great dangers of getting climate strategy wrong), the choice as to the most appropriate set of policy instruments to address this issue has been receiving significant attention (OECD 2008). The primary approach, particularly during the 1960s, to address environmental problems involved the use of command-and-control type policy instruments such as technology or emissions performance standards. The rise of environmental economics as an established sub-discipline of economics has led policy-makers over the last two decades to consider more market-based instruments, such as environmental taxes or permit trading schemes, to be the preferred policy solutions to environmental pollution problems (Stavins 2003).

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For climate change policy making, this trend has seen the dominance, at least among mainstream economists, of carbon pricing as one of the preferred policy instruments of consideration for developed countries seeking to adopt a climate policy that can deliver significant cuts in greenhouse gas (GHG) emissions. The leading example of this approach is the European Union Emission Trading Scheme (EU ETS), which began operation in 2005. Other schemes that are currently operating include the New Zealand Emission Trading Scheme (NZ ETS), the Regional Greenhouse Gas Initiative (RGGI), which operates across 10 states in the United States, and the NSW Greenhouse Gas Abatement Scheme (GGAS). In November 2011, the Australian Federal Parliament passed legislation to introduce the Clean Energy Future policy package, whose centrepiece is an emissions trading scheme with an initial three year fixed price period from July 2012 (Commonwealth of Australia 2011).

The appeal of carbon pricing, whether in the form of an emissions trading scheme or a carbon tax, is quite apparent in the orthodox neoclassical economics framework — it attempts to address most directly what is deemed to be the underlying cause of the problem. As Nicholas Stern has put it:

> The science tells us that GHG emissions are an externality; in other words, our emissions affect the lives of others. When people do not pay for the consequences of their actions we have market failure. This is the greatest market failure the world has seen. (Stern 2006: 1)

The standard neoclassical solution to the problem of a negative externality has been well defined since at least Pigou (1920). A tax — often described as a Pigovian tax — is levied on the production or consumption activities that are generating the externality, with the level of the tax being set equal to the previously unaccounted social costs of the activity. With a proxy for the social cost brought into the (self-interested) decision making of firms and households, the market outcome should move to the socially efficient level. Economists sometimes describe this as the 'first best' solution.

Part of the attraction of the Pigovian tax is that it does not require the government or regulator to know the individual abatement costs of firms or households, but only requires that actors know their own abatement costs in making the decision of whether to internally abate or pay the tax. Furthermore, a carbon price should permeate the economic system, from production decisions on the use of raw materials and production processes to the final consumption choices by households on goods and services of varying carbon content. This should result in the least cost abatement for the economy.

The same underlying mechanism is also the basis for using an emissions trading scheme (ETS). This involves the creation of an artificial market of 'permits to pollute'. Under ideal conditions, the carbon tax under a tax scheme should equal the permit price under an emissions trading scheme for a given emission target (Montgomery 1972). As with a tax, the permit price of the ETS should permeate the economic system and lead to least cost abatement.

It is within this context that the question arises of the necessity and relevance of using other policy instruments to mitigate carbon emissions once a carbon pricing scheme is in place. As reviewed in section 2, these instruments range from production subsidies to technology standards to R&D grants and information disclosure policies. Is there any necessity for using such policy instruments once a carbon pricing scheme has been implemented?

From the perspective of orthodox neoclassical economics, the first pass in answering this question is simple — no. If we are facing a single environmental issue that can be addressed directly, a 'first-best optimum' can theoretically be reached through the use of a single instrument (OECD 2007). A single Pigovian tax should correct the externality in a Pareto efficient manner. To employ further instruments only risks creating distortions that may, at minimum, result in redundancy, and even threaten undermining the efficient solution itself. A policy mix risks becoming a policy mess.

The inefficiency of additional climate policy instruments under a carbon price (for example, renewable energy subsidies) is often illustrated using a standard carbon abatement cost curve (e.g. McKinsey 2009), showing how such additional policies may only result in resources being pushed toward more expensive abatement options and (under an emission cap) displacing cheaper abatement options, thus raising the overall cost of abatement for the economy (e.g. Fankhauser et al. 2011).

On a second pass, however, orthodox economic theory does provide openings to justify the use of multiple policy instruments for addressing environmental problems. The most important justification is if we can no longer assume the ideal functioning of the relevant markets surrounding the externality. In this case, 'second-best' theory comes into play, where one or more deviations from the ideal conditions of the general equilibrium system mean that attainment of other Pareto optimal conditions is no longer necessarily welfare-increasing (Lipsey and Lancaster 1956). The relevant implication here is that addressing a single externality may not necessarily be best achieved by a single policy instrument, if there are interactions between the externality and the other market imperfections and constraints. It may be possible that a mix of policy instruments will achieve a better outcome.

From this perspective, a key determinant of whether one believes that multiple policy instruments are likely to be necessary is whether one believes that market failures and other imperfections are common and pervasive phenomena or relatively rare and benign occurrences. As is well known, many of the heterodox economic traditions take the former view. Consider, for example, the post-Keynesian economist Joan Robinson commenting on the problem of externalities:

> The distinction that Pigou made between private costs and social costs was presented by him as an exception to the benevolent rule of laissez-faire. A moment's thought shows that the exception is the rule and the rule is the exception. (Robinson 1972: 101)

By comparison, in the lengthy debate in Australia over whether to adopt an emissions trading scheme, a number of important reports and submissions seem to adopt the orthodox line of thinking in dealing with this question, indicating that only a relatively small set of market failures offers reasons for having complementary policies and that the presumption should always be that the market is working effectively. The *Strategic Review of Australian Government Climate Change Programs* (Commonwealth of Australia 2008a) and reports and submissions by the Productivity Commission (2008, 2011) appear to adopt a position that once the 'prices are right' in an appropriate carbon pricing scheme, then (with some small exceptions) there will be little need for other mitigation polices, including those at other levels of government. Even the flagship Renewable Energy Target (RET) program, which aims to have 20 per cent of electricity generation come from renewable sources by 2020 and is, to date, one of Australia's most successful policies in terms of aggregate greenhouse gas emission reductions, is questioned (Climate Spectator 2011).

These *a priori* arguments have been further reinforced by empirical studies that appear to show comparatively high costs, on a per-tonne of carbon abated basis, for many climate-related programs in operation in Australia. For instance, the Productivity Commission (2011) estimated that various clean energy programs and policies in Australia's electricity sector cost between $44 and $99 per tonne of CO_2 abated. Their modelling suggested that the same level of abatement could be achieved with a carbon price of $9 per tonne. Daley and Edis (2011) found similarly high costs for many of these programs.

These concerns have fed into the political debate. In August 2011, Federal Climate Change Minister Greg Combet questioned the efficiency of state-based solar feed-in tariffs, which pay owners a premium on electricity from home solar PV systems (*The Australian* 2011). The Western Australia Premier Colin Barnett and the Business Council of Australia have also called for the removal of the national Renewable Energy Target (*Perth Now* 2011).

In Europe, while there is still general support for renewable energy targets and associated policy instruments such as feed-in tariffs and green certificate schemes, there has also been increasing reflection on the apparent high costs of such programs and the distortions that they may be causing to the carbon price in the EU ETS (Fankhauser et al. 2010; Moore 2011; Moselle 2010a, b).

This article will not attempt to determine whether particular schemes, such as solar feed-in tariffs, are an appropriate element of a climate change strategy, particularly in the presence of a carbon pricing scheme. Rather, the more modest aim is to challenge the use of stylised models and reasoning to prematurely reject instrument combinations under a carbon price. In particular, analysing instrument selection through the use of simplified, static cost abatement curves, surrounded by a small set of acknowledged market failures, omits from the analysis a number of relevant issues that open up a relatively wide set of possible reasons for using multiple climate policy instruments. As we will see, the rationales draw upon both conventional and heterodox economic traditions. They involve looking beyond market failures to include system failures that are particularly related to responses to the implications of fundamental uncertainty. Furthermore, it also needs to be understood that implementing a carbon pricing policy, such as contained in the Clean Energy Future package, involves a policy package of monitoring, management mechanisms, and collection administration that naturally opens up complementarities with other instruments.

Of course, providing potential rationales for the use of multiple instruments is still a long step from justifying any particular set of instrument combinations — the policy mix. Indeed, no combination of reasons offered can justify a 'pay-whatever-it-takes' approach to employing additional climate policy instruments such as feed-in tariffs or renewable energy targets. Rather, the aim here is to show that it may be mistaken to prematurely dismiss certain climate policy mixes based on the narrow application of standard neoclassical economic arguments and modelling.

This article takes the existence of a carbon pricing scheme as given and questions whether there are weaknesses or other constraints with carbon pricing that warrant the use of other climate policy instruments (or 'complementary' policies). However, it can be argued that the difficulties with carbon pricing may be so profound that no amount of 'patching up' will sufficiently solve the inherent problems (Paton and Bryant 2010; Rosewarne 2010; Spash 2009). Certainly the evidence to date from the most significant experience with carbon pricing — the EU ETS — has been mixed. Some studies, such as Ellerman et. al. (2010), are generally positive, given that the first phase of the EU ETS was meant to be a learning process. Others have been much less complimentary (e.g. Helm 2009). This article does not attempt to address this broader evaluative question of the suitability of employing market logic to this environmental problem and the long run viability of carbon pricing (see, for example, the article by Spash and Lo (2012) in this symposium for a more detailed discussion of this issue).

The outline of this article is as follows. Section 2 provides a brief review of the range of possible climate policy instruments and offers examples of their use in Australia at the Commonwealth (Federal) and State levels. Section 3 provides a range of rationales for having multiple climate policies, starting with the generally accepted market failures acknowledged in the mainstream economics literature and moving on to system failure arguments from the more heterodox traditions. Section 4 briefly discusses some of the implications of such rationales for policy instrument selection. Section 5 concludes the article.

2. Climate Mitigation Policy Instrument Options

Environmental economics offers a range of policy instruments to tackle pollution problems such as greenhouse gas emissions (OECD 2008; Sterner 2002). The aim of this section is to provide the reader who may be unfamiliar with environmental economics with a quick overview of the variety of instruments that are available. We also provide some examples that are currently in operation in Australia. No attempt is made here to evaluate these instruments.

One representative taxonomy of emission reduction policy instruments, based on Productivity Commission (2011) and International Energy Agency (2011), is shown in Table 1. It divides the instruments into the following types: (i) explicit carbon prices; (ii) subsidies and (other) taxes; (iii) direct government expenditure; (iv) regulatory instruments; (v) support for research and development (R&D); and (vi) information, education, and other instruments.

In the environmental economics literature, the focus of research has been upon the efficiency and environmental effectiveness of single instruments or comparison of two instruments (Goulder and Parry 2008). Much less research has involved the evaluation of policy mixes or the rationales of multiple policy instruments (Bennear and Stavins 2007; Lehmann 2010).

In practice, however, the use of multiple policy instruments is the norm rather than the exception in environmental policy (Bennear and Stavins 2007). The Wilkins Review, conducted in 2008, found over 260 relevant programs at the national and state level in Australia (Commonwealth of Australia 2008a). The Productivity Commission (2011), similarly, found around 230 relevant programs in Australia, 300 in the United States (federal and state) and 100 in the United Kingdom. The taxonomy in Table 1 provides some examples of the various types of policies used in Australia.

Unfortunately, as noted by the OECD (2008), such wide ranging environmental policy instrument mixes are usually not implemented as a result of an integrated and coherent policy design process, but are more often than not the result of an *ad hoc* process of adapting to the evolving challenges and political demands of the day. Only in a few cases have policy mixes been fully designed and articulated in a coherent manner.

For this reason, it is both understandable and important that we clearly define the purpose of the policy instruments that are employed, including an understanding of how they may interact with each other. In the following section, we look at some of the challenges that may arise in implementing climate policy that open up the possibility of policy mixes. Although motivated by the question of whether other instruments are necessary in the presence of a carbon price, many of the arguments can be applied more generally to climate policy mixes, whether they include a carbon pricing scheme or not. We will not go deeply, however, into the question of how various specific policy instrument combinations could address such issues.

Table 1: Taxonomy of emissions reduction policies and illustrative Australian examples

Explicit carbon prices

Emissions trading scheme — cap-and-trade
- part of proposed Clean Energy Future policy package after third year.

Emissions trading scheme — baseline and credit
- NSW Greenhouse Gas Reduction Scheme (GGAS).

Carbon tax
- First three years of the Clean Energy Future policy is similar to a carbon tax (Comm.)

Subsidies and (other) taxes

Capital subsidy
- Renewable Energy Bonus Scheme (Comm.)
- Solar cities program (Comm)

Feed-in tariff
- Solar feed in tariffs (SA, Vic, NSW, Qld)

Tax rebate or credit
- Hybrid vehicle registration discounts (Vic)

Tax exemption
- Tax breaks for green buildings (Comm.)

Preferential, low-interest, or guaranteed loan
- Greens loans programs

Other subsidy or grant
- Biofuels Infrastructure Grants Program (Vic)

Fuel or resource tax
- Fuel excises (Comm.)

Other tax
- Green Vehicle Duty Scheme (ACT)

Direct government expenditure

Government procurement — general
- Cleaner NSW Government Fleet Program

Government procurement — carbon offsets
- Carbon Neutral NSW Government

Government investment — infrastructure
- Energy efficient government buildings (SA)

Government investment — environment
- Installation of Adelaide's first public 'smart' electric vehicle recharging station

Regulatory instruments

Renewable energy target
- SA Renewable Energy Target

Renewable energy certificate scheme
- Large-scale and Small-scale Renewable Energy Target/Scheme (LRET & SRES)

Electricity supply or pricing regulation
- GreenPower Accreditation Program

Technology standard
- CO_2 Emissions Standards for Light Vehicles

Fuel content mandate
- NSW Biofuels Mandate

Energy efficiency regulation
- NSW Energy Savings Scheme (ESS)

Mandatory assessment, audit or investment
- Mandatory greenhouse gas emissions and energy use reporting

Synthetic greenhouse gas regulation
- Ozone Protection and Synthetic Greenhouse Gas Management Act 1989

Urban or transport planning regulation

Other regulation
- Carbon Farming Initiative

Support for research and development (R&D)

R&D — general and demonstration
- National Low Emissions Coal Initiative
- Australian Solar Institute

R&D — deployment and diffusion
- Carbon Capture and Storage Flagships Program

Information, education and other

Information provision or benchmarking
- Carbon Management Information and Tools (Victoria)

Labelling scheme
- Mandatory energy efficiency labeling for appliances

Advertising or educational scheme
- Showcase renewable and energy efficient technologies (ACT)

Broad target or intergovernmental framework
- National Waste Policy

Voluntary agreement

Source: Based on Productivity Commission 2011: xvii

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3. Rationales for Multiple Policy Instruments

In this section, a number of rationales is offered for the use of multiple policy instruments to achieve greenhouse gas emission reductions. At the broadest level, one possible way of understanding the following set of rationales is in terms of the concepts of 'market failure' and 'systems failure', in which the former is grounded in risk management and the latter in management of fundamental uncertainty. In the former, the risk management approach enables an optimisation of the policy toward what a single carbon price strategy would have achieved if there had been no market failure. That is, in the presence of a carbon externality, the existence of other mutually reinforcing market failures may provide a reason for using more than just a carbon pricing scheme in the climate policy mix. The systems failure approach situates the analysis as one characterised by institutions, evolution, and fundamental uncertainty and is not an optimising approach. Rather it allows for a more flexible and iterative approach to achieving the target of significantly reduced emissions of greenhouse gases (e.g. Courvisanos 2009a). As we will see, some of the categories below are characterised by both market and systems failure.

Along the way, we will explore some examples of how these rationales may support the use of some of the specific types of instruments mentioned in section 2. However, as discussed in section 4, we will also see that some of the rationales provide less guidance as to the most appropriate policy instrument response.

3.1 Knowledge Spillovers from Technological Innovation

Reducing GHG emissions while maintaining or increasing levels of economic activity will require significant technological innovation. A well known potential market failure that may affect innovation and diffusion of technology generally is the limited ability of firms to capture the returns from new ideas, owing to the multiple channels through which diffusion of knowledge occurs. A phenomenon known as 'knowledge spillover', in which one firm's innovation spills over and provides similar advantage to a neighbour (and possible rival), is likely to induce firms to invest less in research and development (R&D) than would be desirable for society.

In effect, this market failure is due to imperfect property rights in the stock of knowledge, leading to the social return on investment in R&D being greater than the private rate of return on investment in R&D. While intellectual property rights can help address this issue, they are often imperfect in practice, meaning that private investors are not always able to capture the full social benefits from their innovation (OECD 2007).

Various attempts have been made to estimate the magnitude of R&D spillovers. It is generally agreed that such spillovers are greater for fundamental research than later stage development (Nordhaus 2009). For climate mitigation policy, Grubb et al. (1995) have indicated that technological spillover effects may dominate the effect of a carbon pricing mitigation policy. They estimate that the benefits of stimulating and adjusting innovation and diffusion directly may be up to seven times larger than the emission reduction benefits derived

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from direct Pigovian taxes. Grubb and Ulph (2002) have also shown that the blunt use of a carbon price may also not be efficient if the long-run potentials of low emission technologies are varied. Rather, a more focused stimulation of innovation and diffusion, using other policy instruments such as R&D grants or tax breaks, is needed. Thus, pure pollution control policies using a Pigovian tax are not efficient from a dynamic perspective (Lehmann 2010).

As well as knowledge spillovers occurring from R&D, similar effects may occur with learning-by-doing (LBD). This captures the basic idea that the cost of producing a good declines with cumulative production as the firm learns how to produce the good more effectively (Arrow 1962). While there is little work on the extent of LBD spillovers, there is evidence of significant LBD present in a number of renewable energy technologies (Jasmab 2007).

3.2 Information Problems

Households and firms who are poorly informed may act inefficiently even if faced with adequate incentives such as an energy or carbon tax (OECD 2008). For example, households may not be aware of the energy efficiency of electrical appliances they buy or how to minimise the energy consumption of such devices. Thus, a growing body of literature advocates the provision of information as a policy device to support carbon pricing policies (Jaffe et al. 2005). This may include public information programs (media campaigns and websites) as well as labelling standards on the energy efficiency of devices. It may also include having better quality feedback on electricity consumption and usage (e.g. from smart meter devices). For commercial purposes, government agencies may be in a better position to collect information on future energy conditions (e.g. demand) and make such information available to the public.

Another information market failure that can arise is the classic principal-agent or split incentive problem. In most rental properties, landlords make the decision about whether to invest in energy efficiency (by, for example, improving thermal insulation) or installing distributed generation renewable energy devices (e.g. photovoltaic cells), while tenants pay the energy bills. If the rental market does not adequately reflect the value of such investments then landlords are not compensated for their investment decisions with higher rents, and they will tend to under-invest in such energy efficiency or renewable energy installations (Levinson and Niemann 2004). Renters, in turn, either lack the power to make investments or will not occupy the premises long enough for the efficiency benefits to offset the upfront costs. In such cases, it may be justified for the government to impose energy efficiency or renewable energy standards, or offer incentive schemes for landlords to implement such measures.

3.3 Imperfect Functioning of Financial Markets

Information problems may also contribute to imperfections in the operation of capital markets, where information differences between the firm and potential investors about the future returns from R&D and/or adoption of existing technologies may hamper a firm's ability to raise capital for such activities. Similarly, imperfect financial markets may affect the ability of households and small firms to finance investments in profitable energy-saving equipment that has high upfront costs but low running costs (OECD 2008). Once again, the incentive signals for innovations provided by a carbon price may be greatly impeded and require other policies to ameliorate or compensate for these problems.

In addition to such information or transaction-cost market failures, it may also be argued that predatory behaviour in financial markets may cause systems failure (see Galbraith 2008) that affects the financing of innovation.

3.4 Market Power

The existence of market power can provide a number of possible distortions and is a particularly pertinent concern in the electricity generation sector (Gillingham and Sweeney 2010), which is a major source of GHG emissions. For example, the exploitation of market power in substitutes for clean energy (i.e. the fossil fuel market) may raise the profitability of low carbon energy generation and artificially drive over-investment. On the other hand, incumbent fossil fuel generators may have an incentive to buy-out or use their market power to reduce emerging competition from renewable energy sources, which may lead to under-investment in renewable energy. Such strategies may include the use of vertical market power, where vertically integrated utilities may favour their own (fossil fuel) generation facilities over independent, small scale (renewable energy) generators. The more systemic problems that can arise have been discussed in the literature on the politics of monopoly capitalism (see Courvisanos 2009b).

There is a range of potential policy responses, the most direct being better policing of anti-competitive activities by the appropriate energy regulator and/or competition commission. However, to the extent that such monitoring and enforcement is deficient, other measures that are potentially justified include the use of feed-in tariffs for outside suppliers (to compensate against favouring in-house generation) and mandatory purchasing of energy from small scale or renewable energy suppliers (Gillingham and Sweeney 2010). The latter can also be an effective policy strategy to create critical mass in the formative stages of a new technology.

3.5 Administration and Other Transaction Costs

Another potential rationale for a policy mix is the situation where fully implementing a first-best policy involves prohibitively high transaction costs, i.e. costs that exceed the value of internalising the externality (Lehmann 2010; Tietenberg 1995). While it is not generally the case that applying more instruments will reduce total administrative costs, there can be some situations where this does occur (OECD 2007). In such cases, it may be possible that a portfolio of policies results in higher net value of internalisation benefits minus total transaction costs than is possible from any single instrument.

For example, with large emission trading schemes such as the EU ETS, the size of the transaction costs of administration of the system and the compliance costs incurred by companies participating in the EU ETS are not inconsiderable. For small and medium size enterprises, these costs can outweigh the efficiency benefits of using a permit trading system and it may be more cost effective to regulate these firms using other instruments such as emission standards (Schleich et al. 2004). This consideration was seen in the adjustments to the EU ETS in phase 2 of the scheme, which involved raising the CO_2 emissions threshold for qualifying companies required to participate in the scheme.

3.6 Regulatory and Other Policy Distortions

A range of pre-existing regulatory and other government policy distortions may also bias against low carbon technologies such that introducing a carbon price does not necessarily 'level up the playing field', as it is sometimes claimed. For example, in Australia, there still exist various continuing subsidies to the fossil fuel industries. Denniss and Macintosh (2011) estimate such subsidies to be in the order of $9 billion per year.

Another source of distortions is in the various electricity market rules and regulations that may bias against some aspects of renewable energy generation (Gillingham and Sweeney 2010). For example, when households face a fixed pricing structure that is not sensitive to a fluctuating wholesale price, they may underestimate the value of solar photovoltaic (PV) systems whose output often coincides with the peak demand period (and highest wholesale prices). Borenstein (2008) estimated that the fixed retail pricing structure in California had lead to an undervaluation of solar PV systems by up to 20 per cent.

The most direct response to such distortions is to remove the distortion rather than compensate for it in other ways. This would involve the removal of fossil fuel subsidies and implementation of a more flexible retail pricing structure (for example, time-of-use pricing or real-time pricing) through the use of smart meter technologies. However, as before, where direct solutions are not feasible or are prevented by other political constraints, it may be appropriate to use subsidy instruments such as feed-in tariffs to compensate for and counteract such distortions or biases.

3.7 Multiple Modes of Behaviour

From the perspective of heterodox economics, an obvious criticism of relying solely on a carbon pricing mechanism for climate policy is that it is based on a concept of human behaviour as one that is rational, narrowly self-interested, and purposefully aimed towards subjectively defined ends.

The economic literature that critiques this so-called '*homo economicus*' is vast, including contributions by Thorstein Veblen, Karl Polanyi, John Maynard Keynes, Herbert Simon, Amos Tversky, and Amitai Etzioni, to name just a few. It is not the aim here to examine the various criticisms of rational economic man or the alternatives that have been proposed. For our purposes, it will suffice to consider just three aspects that may be relevant for climate policy.

Habit as a mode of human behaviour has been neglected for many decades in mainstream economics but was once prominent in the institutionalist thought of Thorstein Veblen and John Commons, as well as sociologists such as Max Weber and Emile Durkheim (Hodgson 2004). For our purpose, we can define habits as essentially submerged repertoires of potential behaviour that can be triggered or reinforced by an appropriate stimulus or context. The mechanisms of habit are largely unconscious, but they may press on our awareness.

For climate policy, it is important to recognise that many of our emission-related activities have a habit basis, and we should look to appropriate policies to drive behavioural change. For many desirable behavioural changes, such as turning off lights or changing travel routines, the imposition of a small price increase from a carbon tax may have minimal or no effect. It may not be so much due to a lack of information of these price changes as a complete by-passing of any deliberative cost-benefit decision making in such behaviours. Educational policies that attempt to break habits through consciousness-raising measures may be useful to support a carbon pricing policy.

A second form of criticism of *homo economicus* points to the excessive emphasis on extrinsic motivation (rewards and punishments from the economic and social environment) as opposed to intrinsic motivation. Veblen, for example, highlighted the inherent pleasure from craftsmanship and drive for technological improvement (Veblen 2006). Intrinsic motivation has been particularly studied by social and educational psychologists since the early 1970s, and a number of intrinsic motivators — such as curiosity, the need to direct our own lives, to learn and create things, and to do better to ourselves and our world — have been shown to be powerful motivators (Pink 2010). Importantly, Bruno Frey and others have indicated that in some contexts, too much emphasis on rewards and punishments (extrinsic motivators) can 'crowd out' (discourage) intrinsic motivation. For example, paying someone for lowering their carbon footprint by recycling may actually push them away from doing those tasks 'to help the environment' and towards doing them simply for the extrinsic reward, which may be a weaker motivator (Frey 1997).

One example of a direct interaction between these different motivations of behaviour arises from the existence of a national cap on carbon emissions in a standard emissions cap-and-trade scheme (such as will occur with the Clean Energy Future proposed scheme after three years). An inherent design feature of standard cap-and-trade schemes is that, once the cap on emissions has been set, no actions by individuals, organisations, communities, or governments within the scheme can provide additional reductions beyond the level of the cap without further specific provisions. Thus the emissions cap is also an emissions floor. In Australia, a number of commentators raised the concern that this design feature could have the undesirable implication of discouraging ethically motivated mitigation action — 'if my socially responsible behaviour is not going to make a difference to total emissions, then why bother?' (Fear and Denniss 2009). The need for supplementary instruments or adding new design dimensions to the standard cap-and-trade scheme to avoid muting this mode of behaviour has been discussed by Twomey et al. (2010).

Another weakness of *homo economicus* that is particularly highlighted by sociologists is that the model ignores or avoids the question of the origins of preferences and the parameters of the so-called utility function. The role of education, training, and social influences from family, peers, and marketing is typically taken as being outside the scope of traditional economic analysis.

This exogeneity of preferences contrasts with *homo sociologicus,* in which tastes are taken as partially or even totally determined by the societal environment (Hirsh et al. 1990).

One implication for climate policy is that the general level or specific form of consumption (e.g. suburban use of enormous off-road vehicles for school and shopping trips) is not an issue of analysis (outside of the budget constraint), as these are driven by exogenous preferences. Again, Thorstein Veblen provided an early analysis of the nature of 'conspicuous consumption' and has provided a useful insight into this important driver of excessive consumption (Veblen 2004). More recently, Fred Hirsch's (1977) identification of 'positional goods'- whose value is mostly a function of their ranking of desirability by others — has provided a framework for understanding the dynamic of 'keeping up with the Joneses'. Robert Frank (2005) has described it as a 'positional good externality' which creates a futile 'expenditure arms race' for goods and services. This phenomenon is clearly wasteful, but mainstream economic theory has little to say on it. It has been argued by some that governments can improve social welfare by imposing high consumption taxes on certain luxury goods to correct for this externality and mitigate the social waste. On the other hand, as just mentioned, a pricing mechanism may not necessarily be effective and other moral suasion approaches could also be considered. In any case, there may clearly be a role for policy measures beyond a simple carbon price. Jackson (2009) provides a useful review of the 'iron cage' of consumerism in the modern economy and suggests other ways that this could be changed.

3.8 Institutional and Co-Evolutionary Aspects of Innovation

Institutional and evolutionary economics can also provide perspectives on why a carbon price may be inadequate as a comprehensive strategy for transitioning to a low carbon economy. In particular, it can provide a systemic perspective on social and technological systems, such as the energy system, whose transformation will be a vital part of any transition. This contrasts with the simple 'black box' perspective in neoclassical economics which sees technology as a mere input-output relation, with relative prices on either side being the sole driving factor. As described in de Laurentis and Cooke (2008) and Foxon (2008), a co-evolutionary analysis offers a dynamic and multi-level perspective on the interaction between technology, institutions, and organisational strategies. This approach suggests that the rationale for government intervention to support innovation goes beyond simple 'market failures', where individuals in the system face divergences between their private and social returns, to the systemic context in which these actions take place. The concept of 'systems failure' is proposed as a rationale for policy interventions and provides a more complex picture of a wider set of drivers and barriers to successful innovation (Edquist 2001).

There are a number of different insights from this approach, of which only a few can be mentioned here. One key idea that directly follows from a co-evolutionary perspective is the possibility of path dependency and 'lock-in' of the techno-institutional complex. Of particular interest is how path dependency creates a technological trajectory that sets up factors, such as supporting technological infrastructure and institutional frameworks, that favour the incumbent technology and bias against potential competing technologies.

Within this framework, one can argue that the electricity sector has become locked into a centralised, fossil fuel-based system, in which the co-evolution of both physical and social infrastructures has created an environment that makes it difficult for new technologies to compete, even if they have many superior intrinsic characteristics. Thus, even where fossil fuel subsidies have been removed, transmission access is freely available, and carbon emission externalities are being priced, the history of the energy system is still embedded in the current technological infrastructure, institutions, and even culture of consumption (Unruh 2000). The idea that renewable energy technologies are competing on a 'level playing field' is probably misleading. Additional policies may be needed to specifically assist change in infrastructure, supply chains, and social receptiveness to new forms of power generation.

Looking forward, the problems of path dependency demonstrate the value of maintaining flexibility in technological and institutional structures, since there is no clear way of knowing which will be the most successful and we do not want lock-in to the wrong technology (see Nelson and Winter 2002). Thus, care needs to be taken to avoid locking the system into a single new technology, such as gas-fired generation, which may be the most favoured technology given the current technological costs and carbon price, but which may not provide a sustainable solution in the long run. The same, obviously, applies to particular forms of renewable energy (wind, solar PV, solar thermal, etc.)

Another insight that arises in the literature of institutional economics is the importance of the creation of networks for sharing both technological and institutional knowledge between innovators at the early stages of technology development, both for the direct effects of knowledge sharing and in terms of increasing shared confidence in future technological and market potential. For example, the 2005 study by Foxon et al. for the Department of Trade and Industry in the UK concluded, 'Knowledge flows are currently not adequate to provide the policy, technology, finance and demand communities with understanding of, and confidence in, the economic and environmental implications of biomass energy systems' (Foxon et al. 2005: 2130).

Furthermore, the evolutionary approach emphasises the importance of having diversity in technological options and the value of providing temporary protection to emerging technologies through subsidies and other means. Such protection may be required to give them a sufficient chance to create the positive feedbacks in the various supporting structures necessary for successful development. The idea of fostering a transition in energy technologies by supporting variation within a broad portfolio of technology platforms has been a central element of the Dutch transition management policies (Nill and Kemp 2009).

3.9 Uncertainty, Robustness and Polycentric Action

There is general agreement that climate change is an issue that involves various layers of uncertainty (Quiggin 2008). These include uncertainties relating not only to the science of climate change and its various impacts on the environment, economy, and society, but also uncertainties as to the effectiveness of the various policy responses that have been proposed to deal with climate change. However, factoring uncertainty into the planning and development of climate policy has been somewhat inconsistent and haphazard (Lempert et al. 2006). Here we mention just two implications of uncertainty for the consideration of the climate policy mix.

In the neoclassical treatment of uncertainty as risk (i.e. identified outcomes characterised by a well defined probability distribution), one of the more developed analyses on how uncertainty has a direct influence on instrument selection is in regard to mitigation cost uncertainty. In a seminal paper, Weitzman (1974) demonstrated that the expected deadweight loss between choosing a quantity instrument (e.g. permit trading scheme) and a price instrument (e.g. carbon tax) would depend on the relative slopes of the marginal abatement cost function and marginal damage function. An important implication of this analysis for rationales of multiple policy instruments has been provided in Robert and Spence (1976) who demonstrated that, under a range of realistic conditions, a combination of quantity and price instruments (or hybrid instruments) would provide a better outcome in terms of social costs than either instrument individually.

Another perspective on the role of uncertainty in the policy mix is to consider the fundamental uncertainty surrounding the performance of a chosen policy instrument. The concept of fundamental or radical uncertainty arises in a number of heterodox economic traditions, particularly post-Keynesian economics (Dequech 2000). In this case, the implication is that we are not just interested in 'known unknowns', such as the future costs of mitigation, but in unforeseen occurrences including the operation of the instrument itself. As Phase 1 of the EU ETS demonstrated, a number of unanticipated problems arose that ultimately impeded the environmental effectiveness of the scheme. Following the portfolio theory maxim of 'not putting all of one's eggs in one basket', the issue arises as to whether a diverse portfolio of instruments may provide a more robust overall climate strategy.

The idea of encouraging diversity in approaches for dealing with fundamental or radical uncertainty is common in the natural world and to modern risk management (Stirling 2003). The value of establishing a portfolio of options comes from providing a buffer zone to possible surprises and in providing greater flexibility to adapt quickly to new circumstances as they emerge.

The first advantage is illustrated by the well known benefit of having a diversified financial portfolio. On average, the negative idiosyncratic shocks of some assets in the portfolio are counterbalanced by the positive idiosyncratic shocks of others, with the net result being that the total portfolio performance is buffered from idiosyncratic risks and is exposed only to systemic risk.

The second advantage — of greater flexibility — is provided by having a wider range of options to choose from, given new information and opportunities. For example, a technologically diversified portfolio of electricity generation not only provides greater resilience to shocks such as gas or coal price hikes, but also provides greater know-how in a wider range of technologies, with an option to expand capacity as the circumstances dictate. Evidence of this can be seen in

Germany, whose investment in wind and solar power for the last decade has provided it with the technological and institutional know-how to expand such capacity in response to the decision to close its nuclear generation fleet following the unexpected Fukushima nuclear plant disaster of early 2011.

Such diversity in options may be induced by a single policy instrument, but there are analogous benefits from having a portfolio of multiple policy instruments. Policy instruments can fail unexpectedly, and having other mechanisms in operation can buffer against such failure. Furthermore, having multiple policy instruments also provides 'parallel experiments' that promote learning as to what are the most effective channels of achieving the policy objective.

This idea of developing more robust climate policy by addressing the issue at multiple scales, levels, and instruments has recently been articulated by Elinor Ostrom, the 2009 Nobel Prize winner in Economic Sciences (Ostrom 2010). Drawing upon her knowledge of collective action problems, she argues for a 'polycentric' approach to coping with climate change. Ostrom argues that simply recommending a single governmental unit using a limited set of policy instruments to solve this public collective action problem is inherently weak. The polycentric approach advocates working at various levels, including local, regional, and national stakeholders. Ostrom notes:

> Building a strong commitment to find ways of reducing individual emissions is an important element for coping with this problem, and having others also take responsibility can be more effectively undertaken in small- to medium-scale governance units that are linked together through information networks and monitoring at all levels. (Ostrom 2010: ii)

Thus, as well as providing greater total action through the summation of different sources of action, the different levels may also mutually reinforce each other (for example, engaged households, as well as providing reductions from their own actions, may be more active in supporting government actions). Ostrom also highlights the policy learning provided by experimenting with different approaches.

3.10 Political Acceptability

Another important constraint on climate policy is the political acceptability of any climate policy mix, which will hinge on a number of factors including the overall cost-effectiveness, the way costs and benefits are spread across stakeholders, and the general perception of the fairness and legitimacy of the particular instruments employed (Baldwin 2008). For example, the 'right to pollute' under an emissions trading scheme may be deemed objectionable to some parties.

In the political economy literature, Bartle (2009) has reasoned that it may be essential to have a range of policies to appeal to a wider range of rationalities. By rationalities, Bartle refers not so much to modes of behaviour but rather world views. As Compston (2009) argues:

> The idea here is that market instruments appeal to just one type of human rationality, namely that of an economic actor who responds only in a

> self-interested way to price signals, whereas in fact there is considerable evidence that individuals and organizations use other rationalities as well. Egalitarians, for example, want greater equity between humans and between humanity and nature, while hierarchicalists want better governance and planning to ensure that the natural world and its resources are better managed (Thompson et al. 1990). This suggests that messages should be formulated to appeal to each of these different rationalities, and that a combination of policy instruments needs to be put in place in order to secure wide support. (Compston 2009: 15)

3.11 Other Social Policies

Finally, mention should be made of the fact that many low carbon technologies or activities may be promoted for social objectives other than emissions reduction (Gillingham and Sweeney 2010). For example, support for renewable energy is sometimes justified as contributing to the creation of 'green jobs' and to the export benefits from international leadership in emerging technologies. Renewable energy may also provide greater security against international oil and gas price shocks. Of course, in all these cases, it is correct to say that we are no longer talking about pure climate policies but rather combined climate/industrial/security/etc. policies. Pollitt (2011) for example has critiqued recent UK renewable energy policy as being characterised by a confusion of industrial and climate policies.

Furthermore, the distributional implications of climate policy may also warrant further policies to address equity concerns. For example, it has been generally recognised that a carbon tax has slightly regressive consequences. The Clean Energy Future policy package was very sensitive to this concern and included significant tax cuts to compensate households for such effects (Commonwealth of Australia 2011).

4. Implications

The above set of market failures, system failures, and other constraints provide potential justification for further policy intervention beyond the imposition of a carbon pricing scheme. However, it still may be the case that such policy interventions are more costly than the problem they are trying to solve or result in other unintended consequences — government failure may be as common as market and system failure! Furthermore, I have not attempted to systematically go through the policy instruments listed in section 2 to determine which are appropriate in light of the policy intervention rationales. I will not do so here. However, a few comments can be made on some principles that can provide guidance.[1]

Firstly, it clearly makes sense to employ additional climate policy instruments only when they evidently address an identified market failure, system failure, or other concern (Denniss and MacIntosh 2011). Some examples were provided in the previous section, such as energy efficiency labelling schemes and smart metering to provide greater information to electricity consumers, and research grants, tax breaks, or other targeted subsidies for firms to address R&D knowledge spillovers. While the precise form and level of such intervention may be disputed, these types of policy instruments and the rationales for such interventions (in particular, knowledge spillovers and information problems) are generally acknowledged and have been accepted by the mainstream policy literature including Garnaut (2008, 2011), Wilkins Reviews (Commonwealth of Australia 2008) and the Productivity Commission (2008, 2011).

Much more challenging is the question of how to respond to those issues that are difficult to quantify (for example, the value of promoting diversity, the value of robustness from multiple policies, the significance of historical lock-in) or that cannot be addressed directly due to other political constraints (such as fossil fuel subsidies). A policy instrument such as the Renewable Energy Target may well be justified as an attempt to take account of such rationales. That is, it is necessary to 'make up' for all the residual market failures, distortions, and other policy objectives that could not be addressed more directly. However, determining what is the socially best level of support, or whether these factors are significant at all, poses questions that are difficult to answer. How does one determine whether we should have 20 per cent of our energy from renewable sources as compared to any other level? This is clearly a question for which further research is required.

Secondly, the cost of complementary policies should also obviously be examined. As mentioned in the introduction, the apparent high per-tonne cost of carbon abated for many programs in Australia and elsewhere has raised questions as to the appropriateness of such policies. However, as a number of the rationales indicate, there are both dynamic and systemic value propositions that are possibly being promoted by such policies that are not necessarily being picked up by these studies. Further research needs to be done in order to not underestimate the learning curves, capacity building, and other institutional feedback cycles that such policies are driving but which are not necessarily being accounted for in such studies.

Thirdly, it is also important to take into account the temporal structure of the market failure, system failure, or other concerns (Gillingham and Sweeney 2010). Economic theory suggests that not only should an intervention be matched to the failure or concern, but also the temporal pattern of the intervention should be matched to the temporal pattern of the failure or concern. For example, the diversity value of an emerging technology or potential value of learning-by-doing diminishes in magnitude over time and hence any policy support in these areas should similarly taper off as well. Other policy instruments, such as those encouraging fundamental R&D, are likely to be an ongoing issue and require more sustained policy intervention.

Fourthly, care needs to be taken in understanding the potential interaction among policy instruments, which may be both positive and detrimental (Sorrell et al. 2003; Oikonomou 2007). An example has already been given of the potentially muting consequences of an emissions cap in a cap-and-trade scheme for voluntary or ethically driven action. The same logic also applies to other forms of additional climate policies under a cap, such as solar PV rebates, which do not have an effect on overall emissions under a total emissions cap (Twomey et al. 2010).

5. Conclusions

In response to the original question in the introduction — is there any necessity for using other climate policy instruments once a carbon pricing scheme has been implemented? — the answer is almost certainly yes. This article has presented a broad set of reasons why the use of multiple policy instruments as part of a climate change policy package can be justified. While it may not be unreasonable to propose that the core of an effective climate policy package should involve putting a price on carbon, to argue that this should be the only instrument used is much less tenable. No single policy instrument is likely to be sufficient to effectively, efficiently, or equitably address the goal of GHG emissions reduction.

The article has also highlighted that these rationales need to include system failures and not just market failures as highlighted in the orthodox neoclassical economic literature and as contained in influential reports in the Australian climate debate such as the Wilkins Review and Productivity Commission reports. In particular, we have highlighted the importance of fundamental uncertainty, which is closely connected to the wider knowledge, institutional, and social factors that are crucial to responding to such uncertainties in the innovation process. It argues the importance of recognising multiple modes of behaviour and the value of diversity in dealing with the fundamental uncertainties that permeate the climate change challenge.

It is also important to note that many of these rationales touch on dynamic issues and often involve investments in expanding future options and capabilities. They may be difficult to quantify but should give rise to caution in uncritically accepting the results of studies that just look at current costs of emerging low carbon technologies and that fail to account for future savings and the value of flexibility options they are creating.

Nevertheless, the concern of Wilkins and others that there are probably many inappropriate and wasteful programs in operation cannot be dismissed. Indeed, the lack of integration of climate policy design and development among departments and at different levels of government gives reason to believe that the current policy mix has been built up through a series of *ad hoc* decisions. In such cases, it is entirely believable that there is not only costly duplication of effort, but also that instruments may be undermining each other. In a set of case studies of environmental problems in Europe, the OECD (2007) found that in a number of situations, the use of overlapping instruments reduced the efficiency and effectiveness of the policy outcome.

The development of any climate change strategy (including the selection of the policy instrument mix) will therefore require careful analysis. It is dependent on many contextual factors, including the source of emissions and the type of investment or behavioural change that is being targeted, and an understanding of the dynamics of the broader institutional changes that the set of policies are attempting to guide. It is hoped that this article has made clear that there is a danger of dismissing policy instruments, such as a Renewable Energy Target, on the basis of simple text-book, idealised frameworks based solely on static, technology-centric, least-cost thinking. A richer framework, including ideas from the heterodox economic traditions, can help provide a more systemic and nuanced perspective to evaluate such policies. However, future work is clearly needed in order to provide a better understanding of the significance of these wider sets of issues and provide guidance on how to develop policy instrument mixes that best address them.

Notes

1. Also see Denniss (2012) in this symposium issue for a discussion of principles for adopting complementary climate policies.

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