William Nordhaus's climate club proposal: Thinking globally about climate change economics

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1. Introduction

"Think globally, act locally" has long been a rallying cry for progressives and green activists. In this paper I want to stress the importance of thinking globally before acting locally. In other words, when embarking on political action in pursuit of some policy to be adopted by our national government, we should make sure we have a clear conception of how the proposed local action would fit into a promising global strategy.

This is all the more important when considering the outcome of the Paris conference in December 2015. Both the content of the Paris agreement, and the political rhetoric surrounding it, feels like a return to 1992 following the signature of the Rio Declaration and the UN Framework Convention on Climate Change. Then as now the air was filled with high aspirations, and declarations of political commitment, and promises of future action; but now as then, the real work of translating aspirations into effective action remains to be done. From Rio to Kyoto took five years; then the road to general acceptance that the Kyoto Protocol was a failure took another fifteen years. Having thus come full circle on climate-change policy, it is important to reflect on mistakes that were made first time around, and to draw lessons for practical policy in the coming decade.

Among the policy mistakes made after Rio, two stand out. One was to underestimate the importance of free-riding. The second was to adopt too narrow a set of options for the policy agenda. The Paris agreement tries to limit free-riding by having all countries as parties, and leaves actual policy design to countries operating under a pledge-and-review arrangement. I share the widespread via among economists that the "pledge and review" procedure leaves intact the incentives for free riding that sank the Kyoto protocol; and on the question of the agenda for concrete action, the Paris Agreement seems to me to leave a substantive policy vacuum. New Zealand, like most other countries, can continue to wait to see what everyone else does, while emphasising the absolutely correct point that we are too small to save the planet on our own. After watching this process of free riding play out over the past two decades, and after watching calls for global good citizenship fall on deaf ears – especially the bit of the story where rich nations are asked to agree to large-scale wealth transfers in favour of poorer

nations – I propose to return to some first principles from the elementary economics textbooks.

At the outset it has to be emphasised that in the absence of a legitimate, hegemonic world government to legislate and enforce policy, many of the textbook solutions for market failure have to be re-thought. As Barrett points out[1],

> The approach [to global climate policy] taken thus far has been to set economy-wide targets and timetables. This approach would be ideal were it possible to regulate the world's greenhouse gas emissions in top-down fashion. Unfortunately, however, the world's governance arrangements have to work from the bottom up. The world does not have one government; it has nearly 200. An agreement to reduce emissions must not only be attractive from the perspective of the global good. It must also be something to which countries individually want to accede and to adhere.

2. The Issue

Climate change is a problem requiring collective action in an age when the prevailing ideological climate is strongly individualist and anti-collectivist. While ideology is not helping, the real stumbling block to reaching an effective global policy regime to cut back carbon emissions is just straightforward economics. We are up against the tragedy of the commons, the difficulty of securing the supply of a public good when the individual incentive for all players is to free-ride on the efforts of others.

As Gollier and Tirole summarise the situation[2]

> Most benefits of mitigation are *global* and *distant*, while costs are local and immediate. Climate change is a global commons problem. In the long run, most countries will benefit from a massive reduction in global emissions of GHGs, but individual incentives to do so are negligible. Most of the benefits of a country's efforts to reduce emissions go to the other countries. In a nutshell, a country bears 100% of the cost of a green policy and receives, say, 1% of the benefits of the policy, if the country has 1% of the population and has an average exposure to climate-related damages. Besides, most of these benefits, however small, do not accrue to current voters, but to future generations. Consequently, countries do not internalize the benefits of their mitigation strategies, emissions are high, and climate changes dramatically

Free-riding – the basis of the 'tragedy of the commons' - is a staple topic in the elementary economics textbooks, and the textbooks quickly offer three standard solutions. Either individual incentives have to be brought into line with the common good by pricing-in all relevant externalities; or a legitimate collective or

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1 Scott Barrett, "Rethinking global climate change governance", *Economics* 3(5) March 3 2009, p.2.

2 Christian Collier and Jean Tirole, "Negotiating Effective Instruments Against Climate Change", *Economics of Energy and Environmental Policy* 4(2):5-27, September 2015, p.6.

central authority with a clear mandate and adequate enforcement powers must intervene to block or restrict any market-driven activities that threaten the common good; or some combination of the two.

3. How cap-and-trade came to dominate the options

Economists instinctively favour pricing as an essential component of any policy response because if prices are wrong, then individuals have the incentive to subvert or evade any command-and-control regulations that may be imposed, triggering the need for costly and probably ineffective enforcement measures[3].

In policy debates over climate change to date the idea of directly pricing-in the externality has generally been framed in terms of a carbon tax imposed by some tax authority. The command-and-control alternative has been framed as each country being allocated a quota limit on its emissions and required, on pain of enforceable direct sanctions, to limit its domestic emissions. The third option - a combination of the two - has been cap-and-trade, under which a command-and-control global emission cap is allocated via a market process that is designed to seek out the most cost-effective mitigation options.

A standard argument advanced by a lot of economists - including myself – at the beginning of the big climate change policy debates of the late 1980s and early 1990s, ran in three steps:

- A global carbon tax is ruled out by the absence of any legitimate global taxing authority and by the huge moral-hazard problems of having any single agency handling the vast revenues involved.
- Pure command and control is notoriously inefficient when compared to an arrangement that focuses all effort on securing the lowest-cost means of cutting emissions, so some other way of bringing market incentives to bear is needed.

[3] There is a strong stream of research led by Elinor Ostrom that emphases the power of voluntary collective action through non-price measures to solve tragedies of the commons problems, but this works well only at local level – for example, protecting local water aquifers from depletion, or allocating scarce irrigation water from a shared canal system, or managing a clearly-bounded fishery. A successful 'pledge-and-review' process following the Paris Agreement would vindicate Ostrom's position at a global scale, but would require a truly seismic shift in world politics. See Elinor Ostrom, *Governing the Commons: the Evolution of Institutions for Collective Action* Cambridge University press, 1990; Amy R. Potete, Marco A. Janssen, and Elinor Ostrom (eds) *Working Together: Collective Action, the Commons and Multiple Methods in Practice*, Princeton University Press 2010. I have discussed Ostrom's ideas in more detail in Geoff Bertram, *Green Border Control: Issues at the Environment/Economy Border*, 2013, http://www.geoffbertram.com/fileadmin/publications/Borders%20paper%20at%205%20May%20final.pdf, section 2.6 pages 10-13.

- Cap and trade looks like a way to do this, provided that a couple of obvious problems can be solved:
    - A strictly limited quantity of tradable permits must be allocated on an acceptable basis to a set of initial recipients;
    - The global permits market must meet some basic requirements of competitiveness and liquidity.

For a straightforward statement of this case I refer you to my own 1992 paper[4] in the *Journal of Development Studies*, based largely on an earlier paper that I and two colleagues wrote in 1989 for the New Zealand Ministry for the Environment[5]. Briskly abstracting from the complexity of the real world, I proposed to allocate emission permits on a per capita basis across the world's population with each permit denominated as one individual's share of the global annual carbon cap. As the cap tightened over time the scarcity value of permits would rise, but as technological progress reduced the carbon intensity of economic activity their scarcity value would fall. A well-functioning permit market would reflect these two opposing forces, and the resulting price signals would guide resources into the most cost-effective allocation consistent with sustainability of the global environment.

Seduced by the deceptive elegance and simplicity of this scheme, I was confident that the one obvious problem could be overcome: the rich countries would have to accept that giving every global inhabitant an equal right to the atmospheric commons would mean that when the permit market opened, the rich would have to buy a big chunk of transferable quota from the poor. The resulting annual wealth transfer with a $20/ton carbon price would, I calculated, have been about $50 billion in 1992 US dollars, slightly greater than the total flow of international development aid at that time, but only a fraction of, for example, global arms expenditure. A carbon price of $40/ton would transfer $100 billion per year. This seemed, I argued[6], a manageable cost to save the planet, and I appealed to the self-interest of the rich as the reason for them to accept the cost voluntarily as the cheapest way to save the earth's climate.

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[4] Geoff Bertram, "Tradable Emission Permits and the Control of Greenhouse Gases", *Journal of Development Studies*, 28(3): 423-446, April 1992, reprinted in Tietenberg, T. (ed.) *The Economics of Global Warming* Cheltenham, UK: Edward Elgar, 1997. Online at http://www.geoffbertram.com/fileadmin/publications/Tradeable_Emission_Permits_and_the_Control_of_Greenhouse_Gases.pdf .

[5] The original report, entitled *The Relevance of Economic Instruments for Tackling the Greenhouse Effect. Technical Report*, http://www.geoffbertram.com/fileadmin/publications/Bertram%20Stephens%20Wallace%201989.pdf, was reprinted as Geoff Bertram, Bob Stephens and Cath Wallace, *Economic Instruments and the Greenhouse Effect*, Working Paper 3/90, Graduate School of Business and Government Management, Victoria University of Wellington, May 1990.

[6] Bertram 1992 p.444.

There were two legs to my argument that now look, respectively, wildly overoptimistic and desperately prescient.

The wildly overoptimistic (p.435 and p. 440):

> The large industrial countries would have to shoulder an adjustment burden proportional to the scale of their existing polluting activity, since the scheme would oblige the polluters to pay the rest of the world community for their right to pollute. The leading polluters would naturally be reluctant….. However, the peoples of the rich countries have a large stake in protecting the global environment, which might well outweigh political pressures from powerful industry lobby groups.
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> …
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> The world community faces an historic chance actually to achieve the development goals to which so much lip service is paid on the diplomatic circuit, as a by-product of that community's willingness jointly to confront the greenhouse issue. The developing countries deserve no less than full partnership in this process. If full partnership is denied them, they have the ability credibly to threaten ecological disaster. Prudence, as well as benevolence, should prompt the rich to tolerate economic redistribution on a very considerable scale.

The prescient (1992 p.440, emphasis added):

> If the opportunity is lost to tackle development and sustainability as simultaneous parts of a joint problem, then the global outlook darkens seriously. Either the greenhouse effect could be held at bay by condemning the poor countries to long-term underdevelopment; or the South might grow for a generation or two without regard to the environmental consequences, exposing the entire global community to the risk of catastrophic climate change.

The rest, as they say, is history. At Kyoto in 1997 the rich countries set up a limited emissions trading regime amongst themselves, but with no global cap. In place of an authoritative and binding global cap, country-by-country targets for Annex I countries were negotiated, that never came close to consistency with a serious global carbon budget. No credible enforcement machinery emerged. Meantime the global South, including China and India, was left to roll on with business-as-usual emissions-intensive growth.

4. How and why I got it wrong

What, with the benefit of hindsight, can one say about that 1992 paper of mine? Two things stand out for me. The first is that I was far too optimistic about the ease of implementing a quantity-based system with a single overall global cap, bypassing the inevitably fraught process of specifying country-by-country carbon quotas, in the absence of a global government. Once cap-and-trade negotiations moved from a single global cap and free allocation of permits per capita across the entire global

population, to the Kyoto arrangement of letting countries negotiate their own pre-specified quantitative targets, the essential institutional architecture of my 1992 plan was dead, and with it the hope of confronting the whole global community with a uniform common incentive to abate. Thereafter, climate change negotiations bogged down in a free-riding morass as each country tried to minimise its own target and hence its compliance costs.

The second thing wrong in the 1992 paper was its incomplete listing of the options for organising a global policy regime. What I missed then (and I was not alone) was the option that has now abruptly leapt to the forefront in the current economics literature: a negotiated global price secured without imposing a global carbon tax.

5. The new policy frontier: a negotiated and enforceable global price

My 1992 paper laid out (pp.431-436) four options which I wrongly thought exhausted the possibilities:

1. *Direct regulation:* transparent and certain, but
    - administratively costly
    - hard to harmonise across many countries/jurisdictions
    - hard to enforce effectively (in the absence of a world government) or fairly (given the existing imbalance of power between large and small countries)
2. *Carbon tax:* the textbook answer, but
    - the tax would have to be specified in some currency, after which exchange rates could present a problem and could be subject to manipulation
    - no global authority exists with the mandate to impose the tax; and
    - the revenues collected would be on a huge scale even if there were a taxing authority, which would present a moral hazard problem
3. *Private litigation:* the initiative would lie with individuals, agencies and companies around the world to sue polluters through the courts of each country, but
    - wealthy polluters could stall litigation indefinitely
    - it is unclear what sanctions the courts could impose, and
    - there would be a loss of sovereignty as each country faced having its courts invaded by non-residents
4. *Tradable permits:* judged best if done as laid out in the paper, even though
    - the big wealthy polluting countries would have to swallow large wealth transfers to poor low-emission countries

- the likely attempt by large vested interests to capture the scheme by seeking grandfathered permits would have to be defeated.

Looking down that list it is obvious with hindsight that [at least] one option was missing. Because the price option was framed as a tax, rather than simply as a price, the problems of implementing a global carbon tax were allowed to sink the price option without further consideration. Cap-and-trade was the fallback means of getting a global price in place – but it failed for the same reason the carbon tax was flawed: there was (and is) no global authority with the mandate and the means to set and enforce a global cap, which left the global community negotiating national quotas in a bottom-up way.

But once one has shifted from a top-down to a bottom-up way of addressing the global problem, it is possible to think of a global price for carbon that is not secured by means of a global carbon tax. All that is required is that a global price is agreed and enforced by some coalition or 'club' of nations. This is the option that now commands growing attention and support among economists. It was the subject of the lead article, by William Nordhaus, in the *American Economic Review* for April 2015[7], and was the central theme of a heavyweight symposium in the September 2015 issue of *Economics of Energy and Environmental Policy*, with papers by Martin Weitzman[8], Joseph Stiglitz[9], Jean Tirole with a colleague[10], and Peter Cramton with co-authors[11].

The proposal runs as follows:

- all countries that sign up (thereby forming a coalition or 'climate club') agree on a price that is to apply to carbon emitted within their borders. Ideally the club would be the entire global community, but smaller coalitions can implement the scheme, and there can even be several different coalitions, each with its own price.
- each government within the club adopts policy measures to bring their internal carbon price up to that international price. They may do this by

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7 William Nordhaus, "Climate Clubs: Overcoming Free-Riding in International Climate Policy", *American Economic Review* 105(4): 1339-1370, April 2015.

8 Martin Weitzman, "Internalizing the Climate Change Externality: Can a Uniform Price Commitment Help?", *Economics of Energy and Environmental Policy* 4(2):37-49, September 2015.

9 Joseph Stiglitz, "Overcoming the Copenhagen Failure with Flexible Commitments", *Economics of Energy and Environmental Policy* 4(2):29-36, September 2015.

10 Christian Collier and Jean Tirole, "Negotiating Effective Instruments Against Climate Change", *Economics of Energy and Environmental Policy* 4(2):5-27, September 2015.

11 Peter Cramton, Axel Ockenfels, and Steven Stoft, "An International Carbon-price Commitment Promotes Cooperation", *Energy and Environmental Policy* 4(2):51-64, September 2015.

means of a domestic carbon tax, or a tradeable emission permits scheme with a floor price set at the agreed international price, or any other measure they may dream up. All revenues from a domestic tax or other scheme would remain with the national government in the first instance ('subsidiarity') and would be spent or distributed as that government chooses.

- all countries within the club impose a uniform tariff at their borders on imports from the rest of the world, both to incentivise others to join the club, and as a means of restricting carbon leakage.

Of the three components of this scheme only one single thing has to be collectively negotiated and agreed: the carbon price. The single price commitment eliminates the need to negotiate a set of country-by-country quantitative emission targets. The big advantage of going this route is "dimensionality". If the world's governments are asked to agree on (or accept a collective decision on) just one single number – the price on carbon emissions – they have only that one thing to talk about and the success or failure of the negotiations would boil down to the emergence or non-emergence of just one agreed number. (Under the Paris Agreement's pledge-and-review replacement for Kyoto, the negotiation has to produce something like 200 individual-country quantitative targets, for emission magnitudes the measurement of which is itself open to negotiation.)

As Weitzman summarises it[12],

> "A meaningful comprehensive quantity-based treaty involves specifying as many different binding emissions quotas … as there are national entities. Each national entity has a self-interested incentive to negotiate for itself a high cap on carbon emissions – much higher than would be socially optimal. The resulting free-rider problem plagues a quantity-based approach…..
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> [L]ow dimensionality argues in favour of a one-dimensional harmonized carbon price over an *n*-dimensional harmonized cap-and-trade system among *n* nations….. Put directly, it is easier to negotiate one price than *n* quantities – especially when the one price can be interpreted as 'fair' in terms of equality of marginal effort."

The detailed policies to make that price applicable are left to participating governments, as are any revenues generated. This principle of subsidiarity means that the issue of international redistribution of income and wealth is dropped from the negotiating agenda, so that absolute priority can be given to the single goal of establishing a global carbon price. (I used to think that the two goals – a carbon price and global equity – could be achieved jointly, but I now concede that the

[12] Martin Weitzman, "Internalizing the Climate Change Externality: Can a Uniform Price Commitment Help?", *Economics of Energy and Environmental Policy* 4(2):37-49, September 2015, pp.38 and 40.

myopic self-interest of the rich is an immovable roadblock, and that we simply have to work around it.)

The two greatest strengths of this approach are (i) the creation of a uniform and universal incentive across many countries to reduce emissions wherever it is cost-effective to do so under the prevailing carbon price; and (ii) an enforcement mechanism (border tariffs) that operates impersonally through the market rather than requiring legal prosecution, specific targeted sanctions, or a threat of military intervention, and which provides an incentive for non-participant countries to join the club.

Nobody thinks this approach would be simple in practice. All the economists writing along these lines agree that it faces enormous obstacles and objections, though probably less serious than those confronting the alternatives – and with far greater chances of solving the climate change problem than those more "politically feasible" alternatives.

6. Thinking Globally, Acting Locally

Start with the clear recognition that the central problem is free riding, which means conceding that the current New Zealand Government stance makes rational economic sense given the current global policy regime. For a "typical" or "representative" individual around the world, there are likely to be more penalties than rewards from living in a country that acts unilaterally to cut its carbon emissions in a world where others free-ride. The benefits of unilateral action are intangible (mainly moral satisfaction) and negligible for a small country that acts alone, since there will be no climate-change-mitigation benefits to one's grandchildren so long as free-riding by others continues. In stark contrast, whatever costs may result from living in a world that collectively puts a price on carbon, those costs pale to insignificance beside the tangible benefits from effective mitigation. It is, in short, entirely "rational" for voters to support global action but to oppose unilateral national action.

An individual citizen may have agency within their nation, but they have none at global level. To get the desired global result one still has to act through one's national government, so what is needed is a policy that can be adopted by individual nations without plunging them into unproductive economic pain, and which can then evolve into a collective global policy that provides a consistent worldwide incentive to cut back carbon emissions. We are searching here for what economists call incentive compatibility. We are looking for a national strategy that does not require premature and costly unilateral action, but that has a serious chance of providing a focal point around which international negotiations may be organised

The form of each potential club member's up-front price commitment is "I will if you will" – in other words, a single country does not bind its citizens to anything unless and until a coalition of some minimal credible size emerges. But once the coalition reaches critical mass the international agreed price would come into being. All that has to be done by the lead country or countries is to call for formation of that coalition, invite others to join, and perhaps propose an actual price as the starting point for negotiations. Painless leadership has some appeal, surely?

The second element of the strategy, provided that a viable (critical-mass) club forms, would be translating the agreed-upon price into domestic terms. New Zealand would be able to do this under the existing ETS by putting a floor price under the market for NZUs, and by blocking or taxing the import of carbon credits from any country that has not joined the club and imposed a corresponding floor price or carbon tax. Or we could move to a carbon tax as the Greens have proposed.

The third element – the crucial part of making any club stable – is excludability: imposing a meaningful cost or penalty on those who do not join the club, which provides the incentive for them to join. Central to the climate-club proposal is border adjustment: members of the club would impose a harmonised tariff to apply on all goods imported from non-participating countries. Non-membership would then mean confronting the carbon tariff whenever trading with countries in the club. The tariff would both restrict carbon leakage and provide the incentive for new members to join up.

7. Tariff Design

There are two options for this tariff design: a tariff based on the carbon content of imported goods, or a simple penalty tariff on all imports from non-members. Stiglitz and Dieter Helm have argued for the first of these, mainly as a targeted weapon against carbon leakage, but partly also on the basis that solid precedents would make it WTO-legal[13]. Nordhaus argues for the second – a uniform penalty tax on non-participants – on the basis that (i) it is simple compared with the complexity of a carbon tariff, (ii) the relevant damages to be countervailed are not so much carbon leakage as climate change in general, which non-participants are failing to address via the pricing route, and (iii) the central purpose is to incentivise club membership[14].

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[13] Joseph Stiglitz, "A New Agenda for Global Warming", *The Economist's Voice* 3(7), 2006; Dieter Helm, "A Carbon Border Tax Can Curb Climate Change", *Financial Times* September 5 2010.

[14] William Nordhaus, "Climate Clubs: Overcoming Free-Riding in International Climate Policy", *American Economic Review* 105(4): 1339-1370, April 2015, pp.1348-1349.

Are such "border carbon adjustments" (tariffs) novel, or incompatible with WTO rules, or unthinkable? Consider the TPPA, under which a group of countries led by the USA is to form an exclusive club with various market barriers to be overcome by non-members wishing to trade with the club. Whereas the TPPA is, I would argue, a negative example of club formation, with exclusion of China and ascendancy of the USA as one of its core purposes, it is certainly not incompatible with existing trade law. A carbon-pricing club would have an inclusionary rather than an exclusionary aim, and would be pursuing the global good rather than just the self-interest of members. But it would use the same essential defensive tool of a common external tariff or other barrier against non-members to ensure there is a benefit of membership and a cost of defection from the club.

Nordhaus, however, accepts that his proposal for a straightforward penalty tariff on non-participants could run counter to international law as it currently stands, and he bluntly proposes that

> an important aspect of the proposal will be a set of "climate amendments" to international-trade law, both internationally and domestically. The climate amendments would explicitly allow uniform tariffs on nonparticipants within the confines of a climate treaty; it would also prohibit retaliation against countries who invoke the mechanism.

It is probably true that whatever option was chosen for the common tariff, someone would challenge it under the GATT/WTO rules, and this challenge would have to be successfully fought – either under the GATT's Chapter XX exclusions, or by securing a change to international law. If a challenge succeeded and/or the law could not be changed, then in the worst case the carbon club would disband and individual nations would fall back to the default option of business-as-usual trade. If the challenge failed, the club would immediately gain momentum and members. My expectation and hope is that any challenge would fail, but it is obvious that defeating a challenge would be more likely the greater the number and weight of nations joining up to the carbon club at the start. In short, the downside of stepping up to the club-forming carbon-pricing proposal is no change from the status quo, and the upside is a serious and coordinated assault on global warming, using a mechanism that short-circuits the free-riding problem.

8. Conclusion

To conclude this paper I close with two quotations from heavyweights. First Weitzman (2015 p.49):

> With the failure of a Kyoto-style quantity-based approach, the world has seemingly given up on a comprehensive global design, settling instead for sporadic national, sub-national, and regional measures. These partial measures seem far from constituting a socially efficient response to the

> global warming externality. Perhaps … the Kyoto-style quantity-based focus on negotiating emissions caps embodies a bad design flaw. The arguments of this paper indicate a way in which negotiating a binding internationally-harmonized nationally-collected minimum price on carbon emissions might help to internalize the global warming externality.

And second the ever-cautious Nordhaus (2015 p.1368):

> Here is the bottom line: … without sanctions there is no stable climate coalition other than the noncooperative, low-abatement coalition. This conclusion is soundly based on public-goods theory, on C-DICE model simulations, on the history of international agreements, and on the experience of the Kyoto Protocol. …
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> [A]n international climate treaty that combines target carbon pricing and trade sanctions can induce substantial abatement. … The attractiveness of a Climate Club must be judged relative to the current approaches, where international climate treaties are essentially voluntary and have little prospect of slowing climate change.

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Appendix: Three Bits of Technical Economics

To underpin all this, let me go back to three elements in the economic literature, including the recent pieces that underpin this talk.

1. Club Theory

Start with the idea of a club. The economic theory of clubs was pioneered by James Buchanan[15] to provide a halfway house between pure public goods and private goods. In textbook terms, private goods are both rival and excludable – that is, only the individual consumer gets the benefit, and to secure the good one has to purchase it: think baked beans, petrol, or an overcoat. Pure public goods are non-rival and non-excludable: their benefits flow to everybody, and nobody can be excluded from receiving those benefits – think roads, defence, and sunshine. Club goods are excludable, but non-rival in consumption – that is, once an individual has purchased access, they share the benefit with all other members: think golf clubs, a movie at the cinema, TV broadcasts of rugby World Cup games, or a non-congested

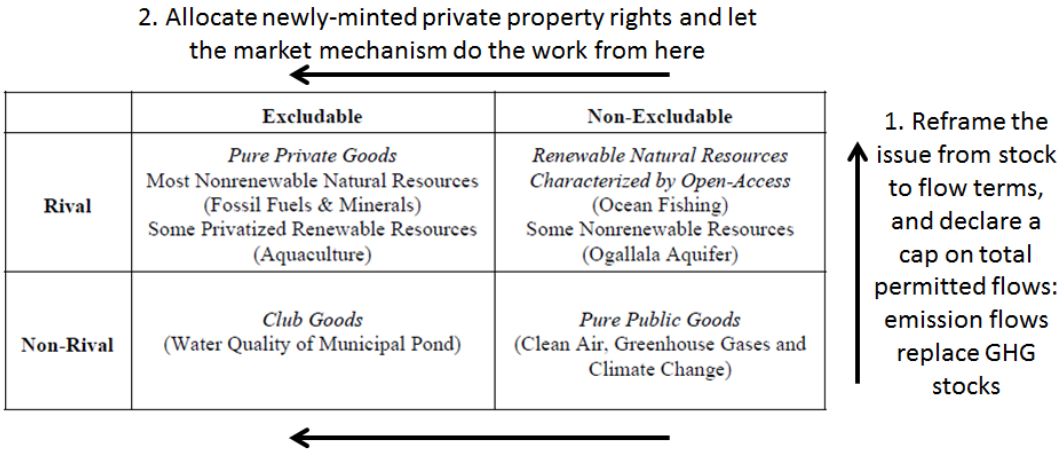
[15] James Buchanan, "An Economic Theory of Clubs", *Economica* New Series 32(125): 1-25 February 1965.

toll road. The chart below shows the conceptual set-up, including greenhouse gases in the atmosphere as a pure public bad:

	Excludable	**Non-Excludable**
Rival	*Pure Private Goods* Most Nonrenewable Natural Resources (Fossil Fuels & Minerals) Some Privatized Renewable Resources (Aquaculture)	*Renewable Natural Resources Characterized by Open-Access* (Ocean Fishing) Some Nonrenewable Resources (Ogallala Aquifer)
Non-Rival	*Club Goods* (Water Quality of Municipal Pond)	*Pure Public Goods* (Clean Air, Greenhouse Gases and Climate Change)

Source: Robert Stavins, "The Problem of the Commons: Still Unsettled after 100 Years", *NBER Working Paper* 16403, September 2010, www.nber.org/papers/w16403 .

The simplest way to get a public good is to have a government supply it. If there were a world government, it could move directly to address the public bad of greenhouse gas concentrations. But there is no such government. All other solutions involve shifting the action to one of the other cells of the diagram, where decentralised authority and market incentives can work to change behaviour on a global scale.



The cap-and-trade model seeks to move counter-clockwise round this chart, converting the public good of greenhouse-gas abatement to a pure private good by

- making emission rights rival via the issue of tradable permits, and then
- making them excludable by forcing all polluters to buy permits for their emissions

The alternative route - to club formation - involves nations directly moving clockwise to excludability – the common carbon tariff – and leaving the benefit of environmental quality to flow in a non-rival fashion as emissions are curtailed. The larger the club, the greater the benefits.

Here is Nordhaus's summary of his version of his Climate Club proposal:

> the club is an agreement by participating countries to undertake harmonized emissions reductions. The agreement envisioned here centers on an "international target carbon price" that is the focal provision of an international agreement. For example, countries might agree that each country will implement policies that produce a minimum domestic carbon price of $25 per ton of carbon dioxide (CO_2). Countries could meet the international target price requirement using whatever mechanism they choose—carbon tax, cap-and-trade, or a hybrid.
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> A key part of the club mechanism (and the major difference from all current proposals) is that nonparticipants are penalized. The penalty analyzed here is uniform percentage tariffs on the imports of nonparticipants into the club region. Calculations suggest that a relatively low tariff rate will induce high participation as long as the international target carbon price is up to $50 per ton.
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> An important aspect of the club is that it creates a strategic situation in which countries acting in their self-interest will choose to enter the club and undertake high levels of emissions reductions because of the structure of the incentives.

2. Dimensionality and Focal Points

Students of strategic behaviour have long recognised that the chances of reaching a successful outcome to negotiation increases if there is a clear issue on which the parties can focus their attention, and around which the necessary compromises can be framed. This notion of a "focal point" goes back to Schelling's classic book on game theory[16]:

> Most situations … provide some clue for coordinating behaviour, some focal point for each person's expectation of what the other expects him to expect to be expected to do….

To illustrate the idea, Schelling asked how people might arrange where to meet up as their contingency in case they get separated[17]:

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16 Thomas Schelling, *The Strategy of Conflict*, New York: Oxford University Press, 1963, p.57.

17 Schelling 1965 p,.58.

> The writer's experiments with alternative maps indicated clearly that a map with many houses and one crossroads sends people to the crossroads, while one with many crossroads and a single house sends most of them to the house…. [U]niqueness avoids ambiguousness.

The difference between one focal point versus many alternative possibilities is dimensionality – the number of possibilities to be sorted through - and this is at the heart of the new papers by Weitzman, Gollier and Tirole, and Cramton et al. Weitzman puts the issue clearly[18]:

> a uniform global price on carbon emissions can provide a focal point for a common commitment, while quantity targets, which do not as readily present such a single focal point, have a tendency to rely ultimately on individual commitments. As a consequence, negotiating a global price helps to solve the externality problem while individual caps essentially incorporate it.
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> …
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> A meaningful comprehensive quantity-based treaty involves specifying as many different binding emissions quotas … as there are national entities. Each national entity has a self-interested incentive to negotiate for itself a high cap on carbon emissions – much higher than would be socially optimal. The resulting free-rider problem plagues a quantity-based approach…..
>
> [L]ow dimensionality argues in favour of a one-dimensional harmonized carbon price over an *n*-dimensional harmonized cap-and-trade system among *n* nations….. Put directly, it is easier to negotiate one price than *n* quantities – especially when the one price can be interpreted as 'fair' in terms of equality of marginal effort.

3. Risk and Uncertainty

In the choice between a price instrument and a quantity instrument, Weitzman's classic 1974 paper[19] suggested that a government should choose whichever led to less uncertainty about outcomes, and that this boiled down to the slopes of the relevant supply and demand curves in the market being regulated. Inelastic (steep) curves would make price more volatile; elastic (flatter) ones would make quantity more volatile. An unpredictable quantity shock would produce greater price volatility in the first case, and greater quantity volatility in the second.

Weitzman has moved away from that formulation of the issue. He now argues that price riskiness is inherently more damaging than quantity riskiness, which means

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[18] Weitzman 2015 p.38 and p.40.

[19] Martin L. Weitzman, "Prices vs. Quantities" *Review of Economic Studies* 41(4): 477-491, 1974.

that fixing the price in a regulated market is the best way to confront uncertainty. He says (2015 pp.38-39)

> With cap-and-trade, total emissions are known but the price (or marginal cost) is uncertain. With a carbon tax, the price (or marginal cost) of carbon emissions is known, but total emissions are uncertain…. In the real world, above and beyond theory and numerical simulations, I think that energy price volatility is very poorly tolerated by the general public… On the other hand, it is difficult for me to imagine the broad public getting quite so upset because total emissions fluctuate.

Weitzman accepts also (2015 pp.48-49)[20] a new analysis in the 2015 symposium paper by Cramton, Ockenfels and Stoft of the riskiness for a national government of participating in an international price agreement versus an international cap-and-trade arrangement. Their argument is technical – the sort of thing one could set as an assignment for a university economics class – but very powerful in the context of any country that faces large potential emission shocks. New Zealand is just such a country, given its very high dependence on forest sinks to meet its emissions targets, because of the unforecastable possibility of large tracts of forest being unexpectedly wiped out by some natural disaster, resulting in a sharp increase in measured net carbon emissions.

The damage done to the global atmosphere by such a quantity shock is the same whichever policy regime it occurs under, but the impact on the national economy differs fundamentally. Under a fixed international carbon price, the economic-welfare cost to the nation is, as Weitzman puts it, "relatively modest second-order deadweight-loss triangles [under the carbon price arrangement] instead of the relatively immodest first-order rectangle transfers associated with tradable permits from, say, an initial assignment of caps that are equal per-capita".

Cramton *et al* make their argument verbally (2015 p.58) but I think it is easier to illustrate with a diagram[21], using their basic numbers as my starting point. Here the country's demand curve for carbon emissions (that is, its Marginal Abatement Cost curve, showing how carbon emissions will fall as the carbon price rises) is shown for a forecast year in the future – say, 2025. "Business-as-usual" emissions with no carbon price are forecast to be 100 million tonnes (Mt), while emissions with a carbon price of $20 are forecast to be 90 Mt. The "Harberger triangle" ABC shows

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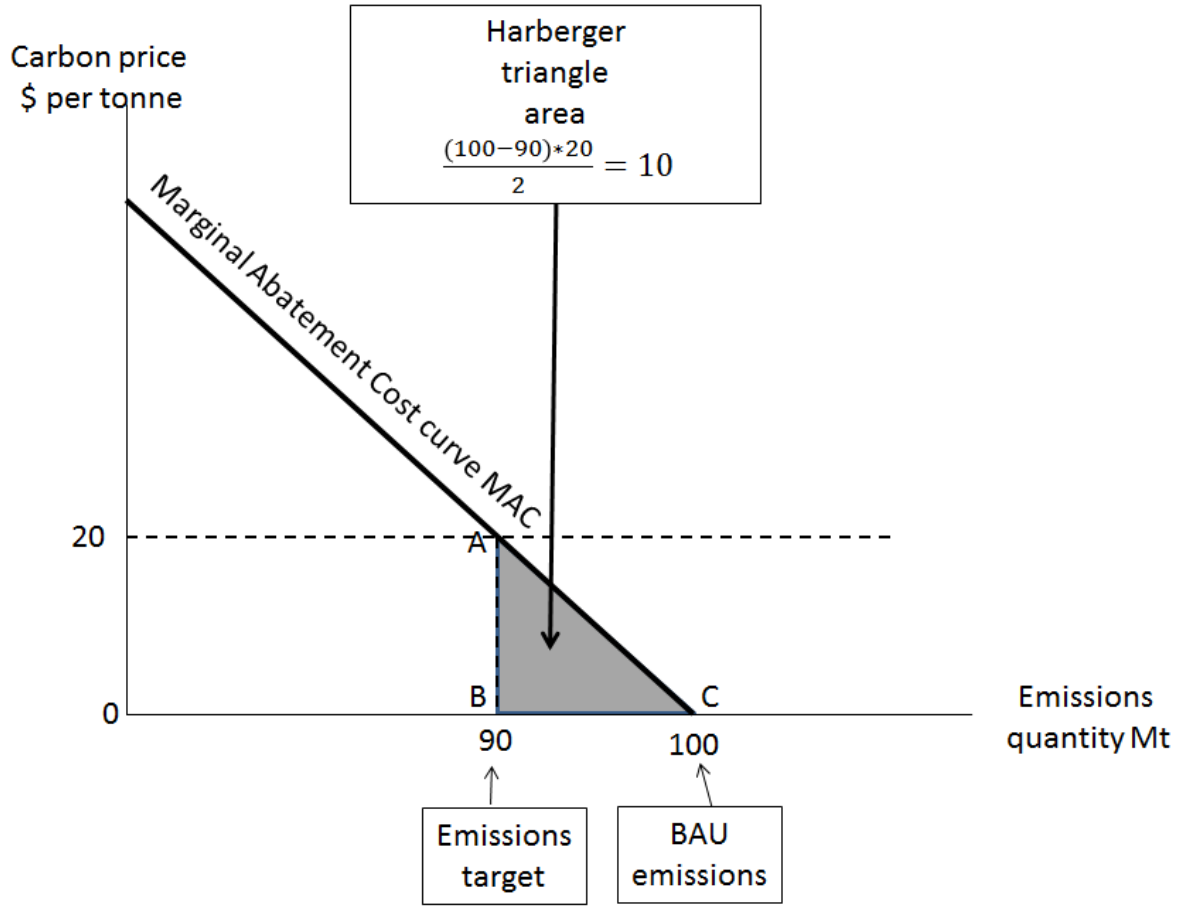
[20] See also Weitzman, M. (2015b). "Internationally-Tradable Permits are Riskier for a Country than an Internally-Imposed Carbon Price," Harvard University Kennedy School Discussion Paper 15-74, September 2015, *belfercenter.ksg.harvard.edu/files/dp74_**weitzman**-sep**2015**.pdf* .

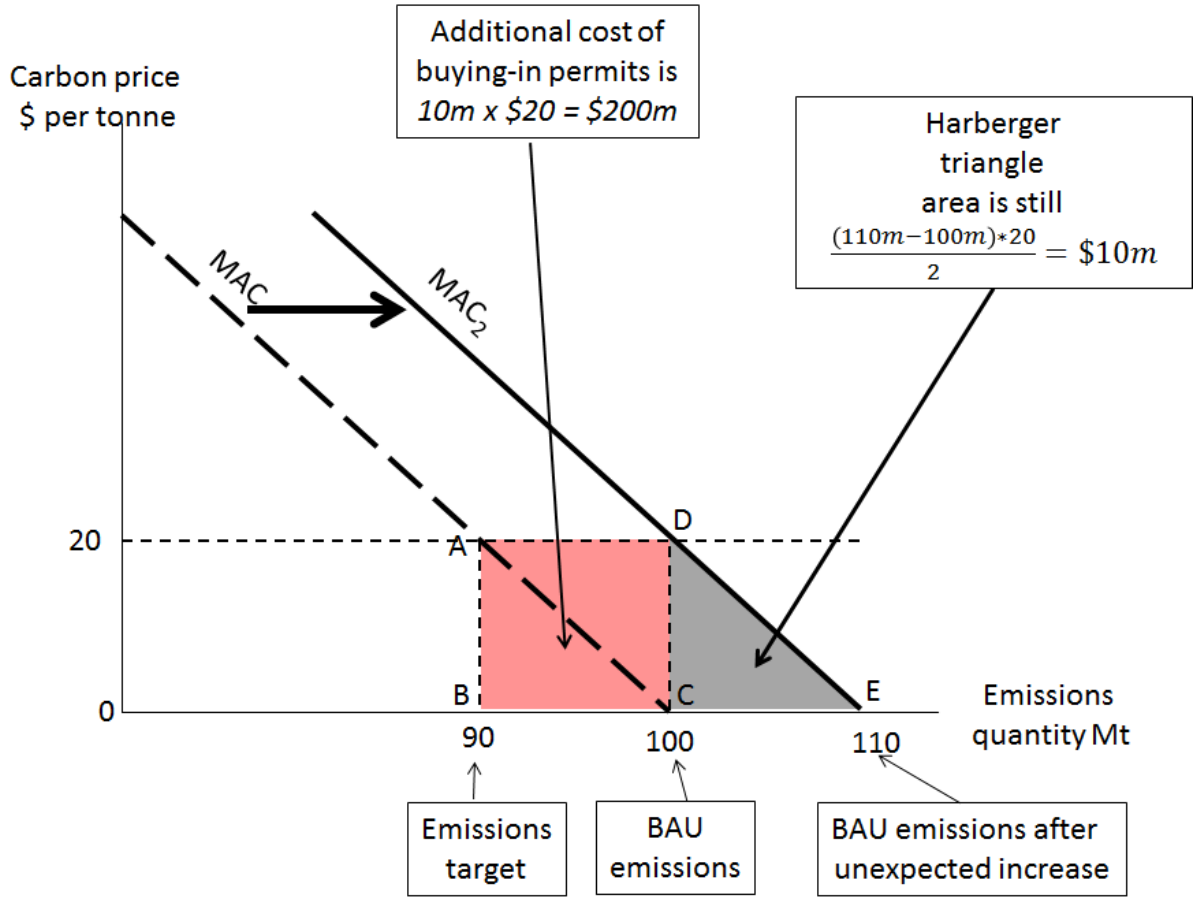
[21] In constructing this diagram I have assumed, for geometric convenience, that the slope of the MAC curve remains the same before and after the quantity shock. Cramton *et al* assume unchanged elasticity. Hence my numerical results differ slightly from theirs.

the direct deadweight loss to the economy from pushing the carbon price up from zero to $20 [we abstract here from the indirect benefits of action to reduce emissions, since those benefits are largely unaffected by any shock to the BAU quantity.]



Consider now two policy regimes to achieve the reduction from 100 MT to 90Mt. In the first, an international carbon price of $20 is agreed and enforced in all participating countries. In the second, a cap of 90Mt is assigned to our country under a Kyoto-style quantity-based regime. The predicted outcomes are identical, provided that the emissions forecast is accurate.

Suppose, however, that there is an unanticipated shock that shifts the MAC curve to the right by 10 Mt, so that in 2025 emissions will be 110 Mt at a zero carbon price and 100 Mt with the $20 carbon price. [In the New Zealand case, think of an introduced pest that wipes out large tracts of pine forest, raising net emissions by 10 Mt in 2025.]



Under the price policy regime, the deadweight cost to the national economy is unchanged – the triangle DCE, which is equal (by construction) to the original ABC. The quantity shock thus imposes no additional cost at national level.

Under the quantitative policy regime with the country's cap still set at 90Mt, the national government will have to buy-in offshore quota for 10 Mt of excess emissions. The cost (or the penalty for non-compliance) will be ABCD, an amount of 20x10 = $200 million.

The international cap-and-trade approach with country targets, thus, is far riskier than the international-price option, from the point of view of any country choosing whether to support one or the other. Correspondingly, the incentive to agree to a price regime is greater than the incentive to enter an effective, binding quantitative regime, simply on grounds of relative riskiness (the cost of unexpected shocks).