What's Wrong With Regulating Carbon Dioxide Emissions?

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Introduction

Suppose that the US decides to implement a policy to reduce CO_2 emissions. There are six basic options:

- Command-and-Control
- Voluntary Measures
- CO_2 Tax
- Auctioned Permits (Tradable permits sold at an auction)
- Cap and Trade (Tradable quotas given to existing emitters)
- Hybrid Tax-Permits Scheme

Our task is to pick the one that costs the least.

We can ignore the first one. Command-and-control is economist short-hand for any system that relies on central planning. Bureaucrats and cabinet ministers decide on targets, e.g. as of next Tuesday 15% of all gasoline must be made from ethanol. That's the "command" part. The next is the "control" part, in which an enforcement agency goes out to harangue, harass and punish private firms and citizens until they are in compliance.

Command-and-control is the most common form of environmental policy, but it has a lot of problems. Principally, central planners can never get enough information to figure out the least-cost way to achieve a target. In the case of CO_2 there are so many millions of emission points, and the costs of abatement at each point can be radically different than at other points, so any attempt at centralized micromanagement of emissions will end up being excessively costly. No matter what emissions reduction is eventually achieved it could have been done more cheaply with one of the other methods.

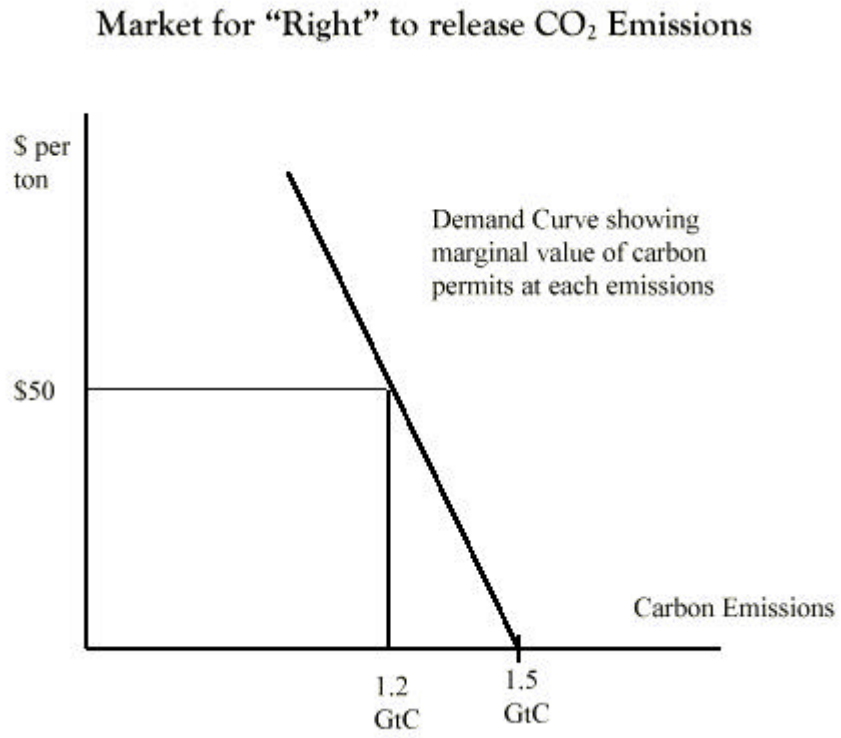
We can also ignore the second. It's a free country and anyone who wants to reduce their CO_2 emissions is welcome to do so. But you don't need regulation for that. In fact it is a contradiction in terms to seek new regulations that would "impose" voluntary controls. When the push for voluntary action comes from industry it inevitably disguises either a plea for subsidies or jockeying for the formation of a state-sanctioned cartel. We will discuss the problem of the "Carbon Cartel" below.

When the push for "voluntary" initiatives comes from government, it usually amounts to thinly-veiled hypocrisy. If the government really believes there is a problem worth addressing, why not address it fair and square with policies that apply to everyone? If they do not believe there is a problem requiring intervention, then leave it alone. "Voluntary" programs attempt to straddle the ditch, but the government just ends up falling in. It is an attempt to *seem* concerned about a problem without actually addressing it, and everyone can see through that game. In the case of global warming, if the government dismisses regulatory intervention but calls for voluntary cutbacks, then agitators on behalf of emission reductions will rightly skewer the government for its hypocrisy. If you think emissions should be cut, cut them. If not, don't waste time with confusing symbolic gestures like voluntary emission reductions.

Taxes versus Auctioned Permits

Comparing the next two, on the face of it they are identical. Under a tax an emitter pays, say, $50 per ton of emissions; under a system of competitively-auctioned permits, an emitter would pay, say, $50 per ton of emissions. In fact most analysts do not bother studying auctioned permits systems because the outcome must be the same as under a straightforward emissions tax, and the latter is a bit easier to code up in an numerical economic model.

However, a difference emerges when we take account of *uncertainty*. The following diagram shows a hypothetical demand curve for carbon emissions: that is, the marginal amount people would be willing to pay for the right to emit each quantity of carbon.



Current US emissions are about 1.5 Gigatons of Carbon (GtC). The "price" for this is zero, hence the demand curve meets the horizontal axis at this point. The US Kyoto target is about 1.2 GtC, and model simulations suggest that the carbon tax needed to get to this point would be about $50 per ton. As emissions get reduced further the marginal cost of these emissions rises as shown.

If this graph represents the demand curve, then a policy maker can pick either the price or the quantity and get the same result. If 1.2 GtC worth of permits are auctioned off, the clearing price would be $50 per ton. Or if a tax of $50 per ton were imposed, the resulting emissions level would be 1.2 Gt. Either way the outcome is identical.

But we do not actually know what the demand curve looks like. It may be steeper or less steep than shown here: these are just estimated numbers. If we pick a price (carbon tax) we will surely make a "mistake" in our forecast of the resulting emissions quantity, while if we pick a quantity we will make a mistake in our forecast of the resulting emissions permit price. These mistakes turn out to have social costs.

Economists have looked at this problem of uncertainty, and have shown that in the case where the demand curve for permits is relatively steep, but the damages due to emissions accumulate relatively slowly (both of which hold true for CO_2), the costs of mistakes associated with picking *quantities* are much higher than those associated with picking *prices*. That is, given the uncertainty inherent in carbon dioxide emissions policy, the costs of mistakes associated with tradable carbon permits are much higher than those associated with carbon taxes.

A study by Resources for the Future (Pizer 1997) used a climate-economy simulation model and estimated that going with tradable permits, given the current uncertainty about costs and benefits, would be about 5 times costlier than implementing a carbon tax, even when both systems are designed to achieve the same level of emissions control.

So we can rule out Auctioned Permits. Whatever they accomplish, a carbon tax could accomplish more cheaply.

Where does that leave us? Our options list now looks like:

- ~~Command-and-Control~~
- ~~Voluntary Measures~~
- CO_2 Tax
- ~~Auctioned Permits~~
- Cap and Trade
- Hybrid Tax-Permits Scheme

Cap'n Trade to the Rescue?

Permits do not have to be auctioned. In the case of SO_2, most are given away to a group of existing firms who were the big emitters before the policy was implemented. In the same way, carbon emission permits could be given away rather than sold at auction. This system is called "Cap and Trade": the government sets the overall "Cap" and then allows firms to trade their emission allowances, in search of efficient reallocations of abatement activity.

This system has a very important but subtle disadvantage in comparison to pure auctioned permits and carbon taxes. To understand it we need to look again at the market demand curve for emission rights.

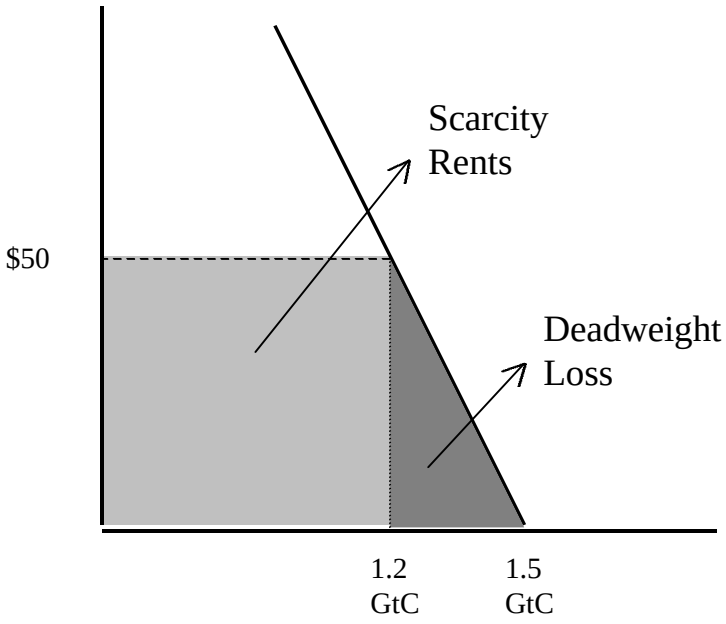
In the figure below, the area under the demand curve and below the price of $50 is divided up into two sections. The dark triangle is called the *deadweight loss*. It is a permanent loss of economic value-added associated with reducing CO_2 emissions. That is, it represents an unrecoverable reduction in real incomes arising from the policy.

The lighter-shaded square is called the "scarcity rent". If emissions are controlled by tradable quotas, this creates a new, artificial scarcity in something that hitherto had been free: the right to release CO_2. Because this right is valuable, people are willing to pay to get it. Regardless of whether the rights are auctioned or given away, a market will emerge in which they are traded and priced out. The holders of permits will end up with a new type of asset, with a total market valuation of (in this case)

1.2 Gigatons @ $50 per ton = 60 Billion US dollars.

Where will this money come from?

It is not new money. It represents the capitalized value to existing users of fossil fuels of the right to emit CO_2 at no charge. This value is already counted into balance sheets, investment portfolios, collateral for loans, etc. all through the economy. Any policy that puts a price on CO_2 emissions (including free permit distribution) extracts that money from its current use and hands it over to the beneficiaries of the policy.



Who are the beneficiaries? *The Carbon Cartel.*

The Carbon Cartel consists of whomever is lucky enough to have received a free initial allocation of permits. If the US contemplates its own domestic tradable permits system, the US Carbon Cartel will likely consist of the major fuel-using energy utilities. In the current structure of Kyoto, it is proposed to allow international permits trading, and the Cartel would primarily include Russia and the Ukraine who have a lot of extra allowances at the moment.

Ordinarily it is illegal to create a cartel. In the case of Cap and Trade policies, the government would bless the new cartel and make its shareholders very wealthy by handing over the carbon permits.

By contrast, under a carbon tax, the scarcity rents go to the government treasury.

Economists sometimes call the Cap and Trade system a "virtual tax". Even though it doesn't look like a tax, its effects are very similar to carbon taxes:

- Energy costs rise
- Consumer prices rise
- Real wages fall
- Output and employment fall

In a numerical model simulation, a Cap and Trade outcome is identical to that with a carbon tax when the revenues are handed out in a lump-sum to an arbitrary group of recipients.

Taking Account of Pre-existing Distortions in the Tax System

But there is an important difference between Cap and Trade and a carbon tax. Under a carbon tax, the government collects revenue which it can use to offset the negative impacts of the policy by reducing other taxes and lessening the deadweight losses associated with them. This so-called "revenue recycling" made possible by carbon taxes can substantially reduce the costs of carbon abatement policies.

Under cap and trade systems, the government collects no new revenue. In fact its total tax revenues must go down. Some commentators (e.g. a recent *Wall Street Journal* editorial) have erroneously pointed to the rising income taxes paid by the Carbon Cartel as if it were new money for the state treasury. But they forget that the increasing consumer costs caused by the tradable permit system cut real wages everywhere else and reduce the total income tax base. Overall the government must end up collecting less revenue than before, a point confirmed in recent general equilibrium simulations (e.g. Parry et. al. 1999).

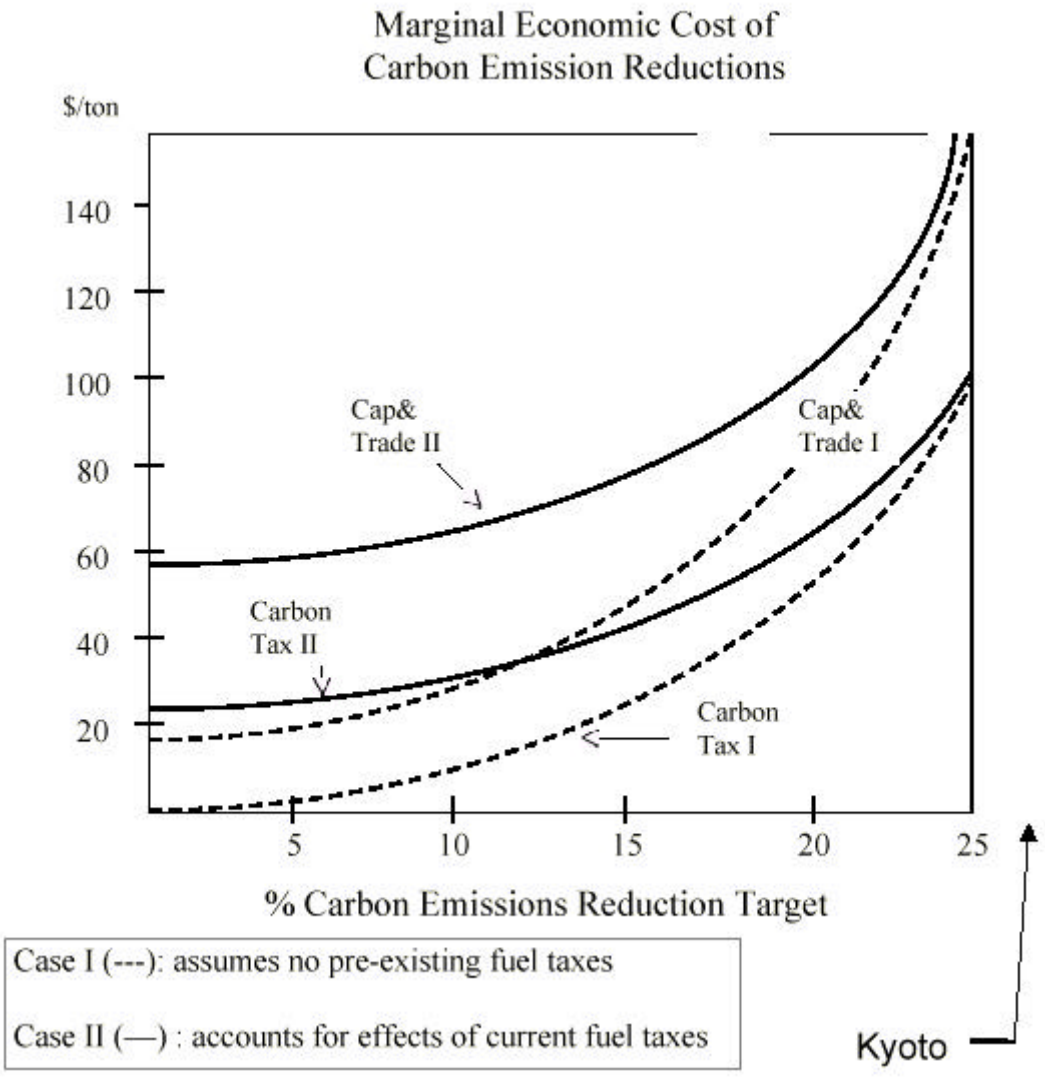
The lack of potential gains from revenue-recycling turn out to matter immensely in carbon dioxide emissions policy because of the large scarcity rents involved. A recent study by economists from Resources For the Future and Stanford University (Parry, Williams and Goulder 1999) found that for Kyoto-level emission cuts, a Cap and Trade system would cost at least double what a carbon tax would cost. This cost differential is not reduced by aiming for a smaller target: in fact the cost ratio increases as the emission reduction target falls. Reducing US carbon emissions by 5 percent with a cap and trade system would cost 10 times as much as if a carbon tax were used.

Hence we can rule out using a Cap and Trade system. Whatever it achieves could be done at a lower economic cost with a carbon tax.

The following diagram summarizes results in the Parry, Williams and Goulder (1999) study and Bovenberg and Goulder (1996). The horizontal axis shows the percentage emission reduction target. The vertical axis shows the marginal cost to the economy (in $US per ton) at that emissions reduction level.

The Kyoto Protocol would require cuts of between 25 and 30 percent, somewhere off the right end of the graph.

Case I refers to a model that assumes the only other tax in the economy is on labour income (at 40%). Case II is from a model (Bovenberg and Goulder 1996) which captures more detail about the tax system, including the existence of prior taxes on fuels. Both taxes and tradable quotas (Cap and Trade) are much costlier once we take account of the pre-existing distortions. This is called the "tax interaction" effect. Studies by, e.g., Nordhaus and others used models that lacked a proper treatment of the tax system and failed to count the tax interaction costs.



Under realistic assumptions about the existing tax system and its distortions, the first ton of emission reductions under cap and trade will cost at least $55 per ton to the economy, rising thereafter.

Our options list is now

- ~~Command and Control~~
- ~~Voluntary Measures~~
- CO_2 Tax
- ~~Auctioned Permits~~
- ~~Cap and Trade~~
- Hybrid Tax-Permits Scheme

What About the Hybrid Tax-Permit Scheme?

A recent book (Victor 2001) has proposed a combined Taxes/Cap-and-Trade system, suggesting that it would be cheaper than either one alone.

The idea is to distribute permits as under a Cap and Trade system, but promise to sell more at a pre-determined "escape valve" price. The scheme was originally suggested by Roberts and Spence (1976), whom Victor cites. But the Roberts and Spence paper, which was published in the *Journal of Public Economics*, not the *Journal of Environmental Economics and Management* as Victor erroneously states, does not yield the cost-reductions Victor claims.

First of all, their scheme only has the potential to reduce costs if the marginal damages curve is upward-sloping, but all economic studies indicate that, over the relevant range, the marginal damages curve of CO_2 is flat. In this case the hybrid scheme reduces to a simple carbon tax. Furthermore the hybrid scheme only reduces the *expected* welfare costs associated with uncertain implementation, but not the *realized* cost. Once implemented, the hybrid scheme reduces to either a Cap and Trade system or a carbon tax (or subsidy) and costs the same as either one.

The likely source of confusion here is that Victor cites some work by Pizer (1997) who looked at a hybrid scheme in the context of a Nordhaus-type model. Since his model does not include a tax system it does not capture tax-interaction effects and thus yields low cost-estimates for a Cap and Trade system. Since the hybrid scheme reduces to a Cap and Trade model in practice the lack of detail in Pizer's tax system model creates the appearance of cost savings that are attributed to the "hybrid" plan. These cost savings are not be in the more realistic models of Parry *et. al.* (1999) or Bovenberg and Goulder (1996).

Conclusion: *The Hybrid Tax-Permit system is no cheaper than a carbon tax, and in practice is as expensive as a tradable permits scheme.*

Our options list is now

- ~~Command and Control~~
- ~~Voluntary Measures~~
- CO_2 Tax
- ~~Auctioned Permits~~
- ~~Cap and Trade~~
- ~~Hybrid Tax-Permits Scheme~~

That leaves the CO_2 or carbon tax as the clear winner. So what level should it be set at?

The Optimal Carbon Tax

In general the appropriate tax on an emitting substance is at the value of marginal social damages due to those emissions. Nordhaus proposed a $5/ton carbon tax a few years ago on the grounds that this is likely the highest level at which we can realistically peg marginal social costs of CO_2 emissions.

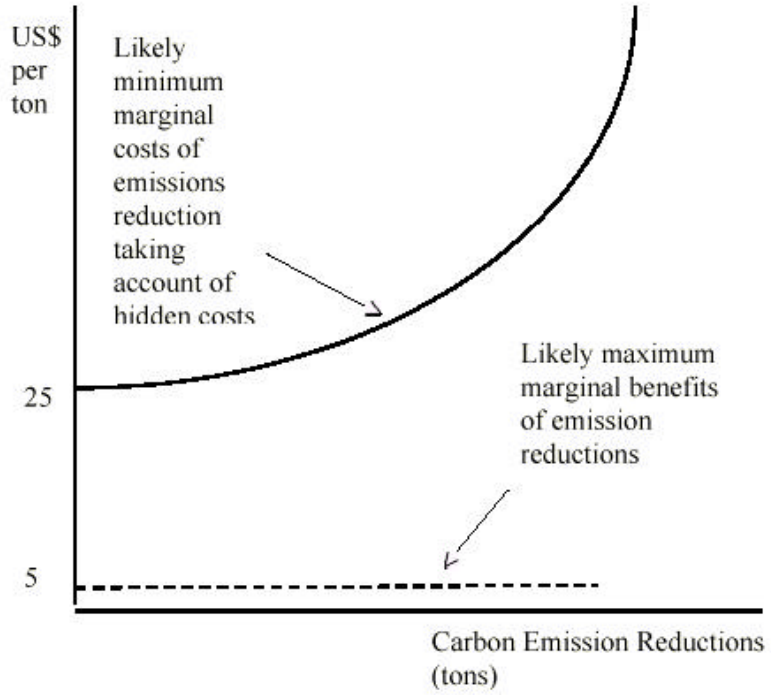
But there are two problems with this. First, the early cost studies did not take account of peoples' ability to adapt to changing agricultural and forestry conditions. Later studies (Mendelsohn *et. al.* 1994, 1999, 2000) that empirically model such adaptive behaviour have found the costs to the US and to the world as a whole are positive in some places, negative in others and on balance less than zero at the US and global levels.

But even if the damages were $5, or even $10 per ton, the theme of emissions tax modeling in the last few years has been that the marginal social cost of carbon taxes is quite a bit higher than the tax rate itself. Bovenberg and Goulder (1996) show that a $5 per ton carbon tax would yield emission reductions of about 4 percent (i.e. trivial) but would entail marginal welfare costs of nearly $25 per ton. A Cap and Trade system set to yield a market price of $5 per ton would entail marginal social costs of about $65 per ton–13 times the permit price!

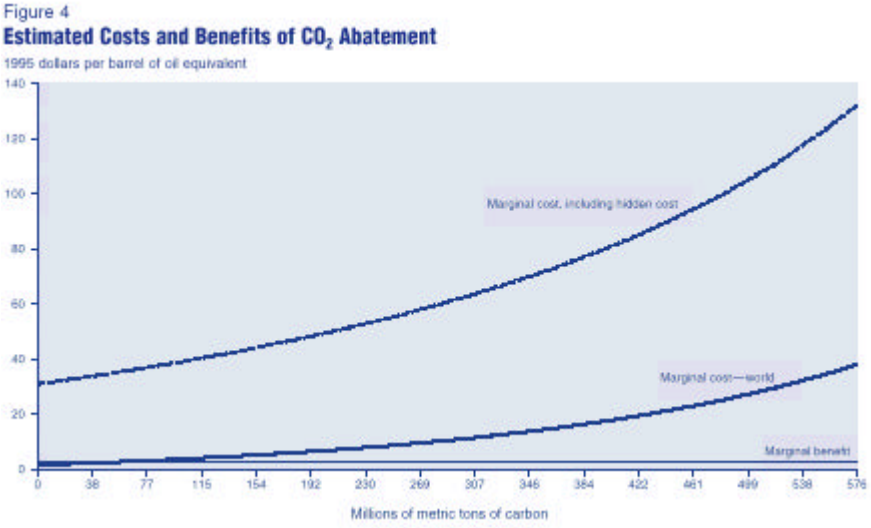
The marginal social costs of emission reductions using a carbon tax *begin* at about $25 per ton, regardless of the emissions target. Since we expect the marginal social costs of CO_2 to be at or below $5 per ton, the costs of emission reductions exceed the benefits for any target, however small. For that reason the optimal carbon tax is zero. (Bovenberg and Goulder even suggest that the optimal carbon tax may be negative–i.e. we should subsidize CO_2 emissions!)

This was also the conclusion of Brown (1998) who compiled information on the market structure of fossil fuels and converted global warming policy cost and benefit estimates into "barrel of oil equivalent" measures. He found that the costs of CO_2 abatement, including the hidden costs of policy implementation, begin at about $30 per barrel, while the benefits are at best around $3 per barrel. Again, the costs exceed the benefits for all emission reduction targets.

Bovenberg and Goulder (1996):



Brown (1998):



Kyoto: *A Good First Step*?

As for the Kyoto Protocol, everyone agrees that it will accomplish nothing. (At least everyone who has even elementary knowledge about this issue, but not apparently many of the world leaders who are pushing Kyoto in the mistaken belief that it is a "solution" to global warming.) The emission reductions are too small to change the rate of accumulation of CO_2 in the atmosphere by more than a trivial amount. Some respond to this: Yes, but it is a *good first step*. The real effects of emission reductions will become apparent with subsequent policies that force even bigger cuts in emissions.

This is a fallacious argument. It ignores the fact that as emission cuts deepen, costs rise too: indeed faster than the benefits. If Kyoto fails the cost-benefit test so do all subsequent steps of the same kind. Therefore it is not a good first step, it is a serious mistake, and a prelude to even costlier mistakes.

Kyoto: *An Insurance Policy*?

Some people concede that Kyoto is useless and fails the cost-benefit test, etc. etc., but nevertheless we should cut CO_2 emissions because doing so is a sort of "insurance policy". In fact one of my critics wrote a letter to the editor of our campus newspaper asking me if I have insurance on my house, and if so, why would I oppose Kyoto?

My answer was this. Kyoto costs a lot, does nothing to prevent calamity, and pays no compensation in the event of loss. If my insurance broker offered that sort of policy, I would not carry insurance. Instead what my broker offers is a policy that costs a little and pays full compensation in the event of loss. If someone wants to propose *that* as a policy on global warming, I'm all in favour.

How would such a global warming insurance policy work? Take a small amount of money: say 5 billion dollars. Put it at arm's length from the government and invest it in a fixed portfolio consisting mainly of bonds and stock market index funds. Then leave it for thirty years. At that point it will be worth about 40 billion (assuming a real return of 7% per annum). Offer it as a compensation fund for anyone who can prove he or she was injured by anthropogenic global warming. Chances are no one will be able to make a credible claim after thirty years. Maybe after 100 years someone could, at which point the fund will be worth 4.3 trillion dollars (after inflation). That should be more than enough to pay all the damage claims.

At this point we can see one of the difficulties of global warming policy. The compensation fund managers must be able to distinguish between people who had to adjust to natural weather changes and those who had to adjust to changes wrought by CO_2 emissions. Suppose there is some net drying in Idaho over the next century. Was it natural or was it caused by anthropogenic global warming, or a bit of both? Chances are we would never know. So we have to ask: if we do not expect to be able to identify the effects of global warming *even after the fact*, then on what grounds are we trying to design policies decades in advance to address those effects? It's hard enough to find a needle in a haystack, just imagine trying to find a specific piece of hay in a haystack.

Conclusions

The list of global warming policy options looks like this:

- ~~Command and Control~~
- ~~Voluntary Measures~~
- CO_2 Tax = $0.00
- ~~Auctioned Permits~~
- ~~Cap-and-Trade~~
- ~~Hybrid Tax-Permits Scheme~~

The optimal policy is to leave CO_2 emissions unpriced and unregulated.

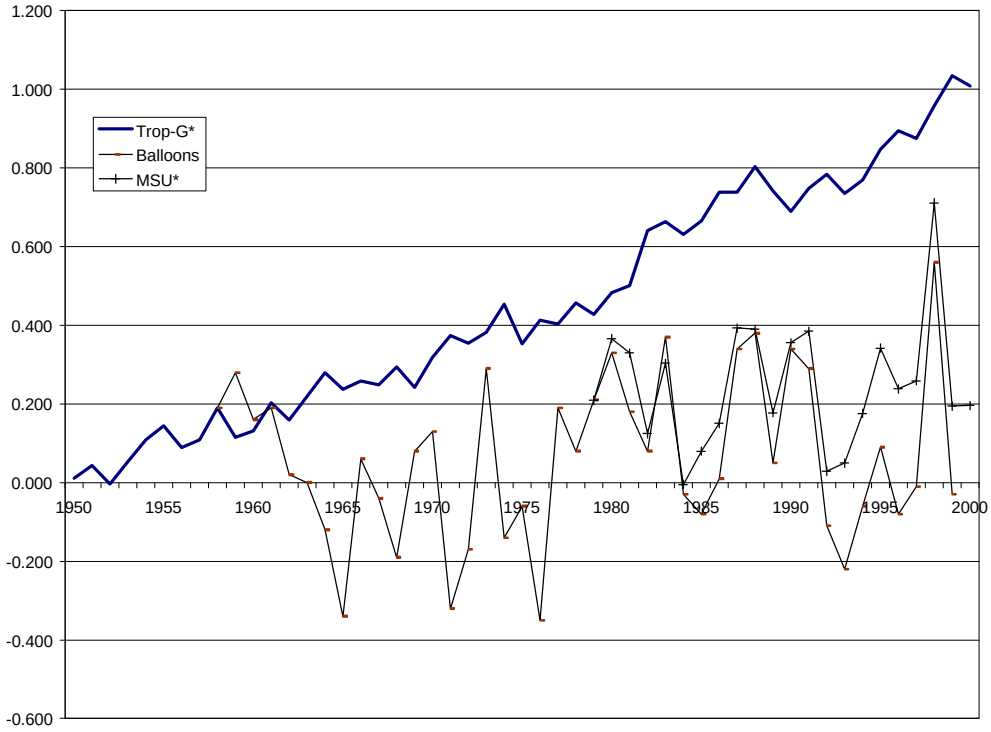
Caps and pricing systems have very high economic costs. The evidence suggests that CO_2 does not entail social costs anywhere near as high as the costs of reducing emissions, regardless of how big or small an emissions cut we have in mind.

As for the question of policy development, what is the rush? Time is not pressing. This is a complicated issue. Let the scientific work proceed. Take whatever time is necessary to think through what, if anything, is the right policy response. If we must do something, set up a small compensation fund and let it grow. Let economic growth work for us not against us. That's the closest we can come to an insurance policy.

What about Kyoto...?

For some reason it's no longer called a "Protocol", now it's called a "Process". The Process consists of a lot of artificial deadlines, i.e. the Hague, Bonn, Marrakech.... These create the illusion of urgency. Don't fall for this. The fact that "Marrakech" is fast approaching is irrelevant. The laws of physics are not about to change. Set your agenda by what's happening in the atmosphere not by what is happening the artificial world of Kyoto.

And just what is happening in the atmosphere? The diagram on the next page contrasts the predicted warming of the troposphere since 1950 with actual tropospheric temperature data from weather balloons and weather satellites.



The Trop-G line was generated by a leading climate model, the Goddard Institute for Space Science coupled Atmosphere-Ocean General Circulation Model, forced with CO_2 and sulphate emissions since 1950. The Balloons line is from Angell (2000) and the MSU line is from Spencer and Christy (1990).

Even taking global warming predictions at face value, economists find little evidence of significant economic costs, and ample evidence that the costs of CO_2 abatement exceed any benefits. Furthermore, it is becoming apparent that models overpredict warming. This only strengthens the case against CO_2 regulation.

In sum: sound reasoning rejects all forms of regulations on CO_2 emissions for the foreseeable future.

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