

## **"What Kind of Research on Climate Change Economics Would Be of Greatest Use to Policy-makers?"**

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Proceedings of Workshop on Climate Change and Economic Modeling:  
Background Analysis for the Kyoto Protocol  
OECD Headquarters, 17-18 September, 1998

### **Abstract**

I have tried to identify the questions on which research could be of the most immediate use in the policy-making process, while recognizing that this is not the only sort of research that is important to pursue. Between now and Buenos Aires, many of the most urgent questions concern international trading of permits, such as the effects that limits would have. Thereafter, important questions include participation of developing countries in a growth-target-and-trade system. My advice to modelers is to focus on effects on the price of carbon in the year 2010. It is critical, when reporting results to the general public, to make very explicit what is the policy experiment that is assumed; otherwise non-economists suspect that models are "of little use because they all say different things."

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The economics of climate change policy is a fascinating topic, in part because it involves so many different kinds of actors, and draws on so many different fields of learning. I know that the OECD has done a lot of important work in this area in the past. So it is not a question of starting from zero, but rather of ramping back up the level of activity, and I am glad that is doing so.

My comparative advantage at this point may be to identify the questions on which research could be of most use in the current policy-making process. To do so, it helps to make a distinction according to the extent to which research is to feed directly into the current process on a short-term basis, in which case current institutions and politics must be taken as given, versus research that is intended to have a longer-term payoff. I hope nothing I say about what is of most immediate interest to policy-makers will be taken to mean I think that this is the only sort of research that is important to pursue.

## Long-term theories vs. short-term realities

I have heard all kinds of interesting proposals for the ideal architecture of an international agreement on climate change, some of which have some attractive properties. But many are not consistent with the political, historical, and institutional realities of the policy-making process as it currently stands. I *am* prepared to argue that the negotiators at Kyoto did a good job, if you take as given the conceptual and political gulfs that separated some of the key countries and interest groups, and that Kyoto is a good foundation on which to build. The standard critique of arrangements for Quantitative Emission Limits and Reductions (as opposed to an internationally agreed price instrument, or other common Policies and Measures) was always that it would be politically impossible to agree on the assignments. I must admit I had some doubts along these lines myself. But at Kyoto we did manage to agree on the assignments among Annex I countries. Whatever one thinks of the merits of the Kyoto Protocol -- or whatever one thinks of its odds of enactment -- the Protocol is clearly the framework within which policy-makers are going to be addressing this subject for some years to come. Thus any research that is to be useful to policy-makers in the short-term has to take as given such features of Kyoto as quantitative targets.

This does not mean that everything has been decided. Far from it; the Kyoto Protocol is a "work in progress" with many key aspects still left to be negotiated. Economic research can make a difference in the way the agreement comes out, and in how well it works.

I would suggest that, to be useful to policy-makers, modelers ought in their presentations to emphasize the economic effects in the five-year budget window centered on 2010. This is the period featured in negotiations at Kyoto and Buenos Aires. I realize that any cost-benefit analysis has to look far out into the future. The Integrated Assessment models that attempt such an analysis go out one or more centuries, because that is when the more serious climate effects begin to show up. But ten years is already a long run for the typical politician, who will not be in office in 100 years.

In theory, forward-looking firms' decisions regarding technology, investment, and extraction, in a given decade, depend crucially on their expectations as to what energy prices will be after 2012. The omniscient omnipotent policy planners will want to choose an optimal long-term path for emissions targets that fully takes such intertemporal dimensions into account. But the Parties to the treaty are not negotiating targets post-2012; nor would such numbers be completely credible even if they were to be negotiated. In practice, politicians cannot commit their successors to a specific sequence of actions. Thus a path of emissions to 2100 is not as relevant to today's decisions as you might think.

I certainly do not mean to downplay the Integrated Assessment models. They are uniquely qualified to address the longer-run questions. And even on the ten-year question, they have as much claim to the interest of policy-makers as do those models that are designed to look *only* at that horizon. My point is simply to urge modelers to report results for 2010, or for the 2008-2012 window, and to warn them that these are the numbers that are going to be of greatest interest to policy-makers at this juncture.

### **Priority topics for economic research: emissions trading**

I will now enumerate some questions that are of greatest concern between now and the Buenos Aires meeting in November, and then progress to those that will be of most interest in future years. [I realize that two months is too short a span of time to write a grant proposal, let alone complete a new research project. But much of what I will suggest is already being studied. And anyone who is working along these lines should rest assured that these topics will remain of interest in the future as well.]

Many of the topics that will be of greatest interest for Buenos Aires concern international trading of emission permits. Such trading is of course a central feature of the U.S. position and of the Kyoto Protocol. Economists probably agree on the virtues of trade, in general, more strongly than on anything else, and the case for the gains from trade applies as much to emissions as to conventional goods and services. I have been pleased that economists' ideas regarding the virtues of trading, along with other market-mechanisms and kinds of flexibility ("where," "what," and "when" flexibility) have been reflected in the US position and in turn in the Kyoto Protocol.

But not every government has the same orientation. Some countries, particularly the EU, are not completely convinced of the case in favor of trading. They insist that trading should be only supplemental, by which I fear they mean that the United States must accomplish most of targets (relative to the Business as Usual path) through domestic reductions, rather than purchases. Some Europeans may be driven by a primitive distrust of trading in general, analogous to those who believe that everybody should grow his or her own food. Others are in effect protesting the allocation of emission rights at Kyoto, believing the US and FSU allocations to be too generous. This is what it must mean to complain that the US needs to make more of a domestic sacrifice, or that Russia shouldn't be allowed to sell hot air.<sup>1</sup>

In any case, some Europeans want to place **quantitative limits** on how much countries can buy. Such limits would operate as import quotas do for trade in agricultural commodities and other goods. They have the same drawbacks: they would artificially raise the price of emissions in the buying country, they would introduce an extra degree of complication, government bureaucracy, and rent-

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<sup>1</sup> Although they may not realize it, Europeans need trading more than Americans, under any of three definitions: (1) In the absence of trading, their carbon price would be much higher, (2) in the presence of trading, they would buy more from abroad, and (3) a moderately high limit on the percentage of reductions to be achieved through purchases might be binding on the EU while not on the US.

seeking into the marketplace, and they would generally impede efficiency. The US has said that it will not agree to trading limitations at Buenos Aires.

We have estimated that such limits could raise the cost of compliance substantially for the United States, and even more so for Europeans and others. A 50% limit rule could raise the price of carbon by an estimated 157 % for the US, 243 % for the EU, 474 % for Canada, and a whopping 587 % for Japan. More stringent limits could raise prices by tenfold for the United States, and correspondingly more for other industrialized countries.<sup>1</sup> These estimates are based on an application of the SGM model of Battelle Labs, under the direction of Jae Edmonds. (The estimates, unlike those of some others, assume the regime to which we aspire: participation and trading among key developing countries in addition to Annex I.) But it would be useful to know what other models have to say about the effect of trading limitations.

To study these questions it is desirable to have models designed to handle, not only international trade in emission permits, but also trade in goods and services, preferably at some level of disaggregation. Some models, at least some in the United States, do not do this. It is also desirable for the model to handle international capital flows -- one cannot talk meaningfully about trade and current account deficits otherwise -- and that not simply be modeled as exogenous or a residual.

Another area for research concerns the implications of different combinations of **countries that might participate** in trading: Annex I, the umbrella with and without Eastern Europe, developing countries, and so forth. As you may know, the U.S. response to the EU's aversion to trading has been to say "we would rather have you inside the club, with specific rules agreed upon to govern trading; but if you don't want to play, the rest of us who are interested in trading will just have to go ahead without you." We have made our own estimates about the implications for economic costs, but we would like to see others' estimates as well.

It has been pointed out that a large seller of permits might be tempted to exploit **monopoly power**, intentionally withholding some emission permits in order to drive up the price and reap more revenue. I would be very interested in estimates of the degree of monopoly power held by the largest potential sellers, and the results that would follow if they were to exercise it.

There is also a host of questions regarding design of **trading institutions** for which the big models might not be appropriate, but where other kinds of research would be useful. These issues include: transactions costs in trading, liability issues (buyer versus seller), trading among governments vs. among firms, and the potential role of intermediaries.

After the various aspects of "where flexibility," specifically international emissions trading, the next most urgent research priority is various aspects of "what flexibility." Specifically, we need much better models of the role of all **six gases**, and of **sinks**, which are potentially very important, but have been relatively neglected up until now.

## Some longer-term issues

After the trading issues are resolved, I view **participation by developing countries** as the most important topic for the next few years. It will be difficult to persuade developing countries, and it is hard to be optimistic about the odds of doing so in time for the Buenos Aires meetings. But President Clinton has said he will not submit the treaty for Senate ratification until developing countries agree to meaningful participation.

US Senators say we need LDC participation because otherwise the United States will lose **competitiveness**. I would rather not use this way of describing the reason we need the developing countries. It is true that if the price of energy goes up in industrialized countries and not in others, energy-intensive manufactures will lose competitiveness. But other sectors will gain competitiveness. It is not clear that the overall effect will be negative. To answer this question requires a trade model that disaggregates industries into carbon-intensive and non-carbon-intensive. It is even less clear that the trade deficit will get larger, which is what some people apparently have in mind by “competitiveness.” Indeed, if we are buying emissions from abroad, elementary application of the **transfer problem** framework says that our trade balance in goods and services should improve.

The reasons we need the LDCs are, rather:

- (I) they are the fastest-growing emitters,
- (ii) without participation by the developing countries problems of free-riding and leakage would render an agreement ineffective at its environmental goals,
- (iii) their participation is needed to reduce economic costs of compliance by an estimated 80% for the US, and
- (iv) the Senate will not ratify a treaty without them.

The problem of **leakage** is another area where we need more quantitative research. Leakage is defined as the possibility that reductions in emissions in the industrialized countries under the agreement would be partly offset by increases in emissions in non-participating developing countries.

What are reasonable **targets** for the developing countries? There is a strong case for growth targets, perhaps BAU in 2008-2012 (though this is not an official US position). This kind of participation would have economic as well as environmental advantages for the developing countries (they would get paid to make emissions reductions that they can make more cheaply than the world price, and such reductions would have ancillary benefits such as cleaner air). And at the same time it would have economic as well as environmental benefits for the industrialized countries (it would cost much less than making all the reductions at home, and the cap on LDC emissions would forestall leakage).

Next question: could a **formula or indexation** approach to developing country targets help

guard against uncertainty (both inadvertent stringency and inadvertent tropical hot air)? Other questions concern other ways that developing countries could be asked to participate, besides commitments to target and trade. These include JI and **CDM**. I have always been attracted to the idea of a global **ban on fossil fuel subsidies**; the industrialized countries would have to lead the way, but the big gains (environmentally, economically, and fiscally) would come in the developing world.

Moving beyond the developing countries, I find proposals for a **safety valve** or escape clause based on the price of carbon to be worthy of study. Another longer-term issue is of great importance is **targets and timetables** beyond 2012 (in particular, 2013-2017 and 2018-2022). Also, many firms will not make serious adjustments until they know for sure what the new policies are going to be. How much do costs go up if the Kyoto Protocol does not enter into force until 2002? 2003? 2004? And so on.

Finally are questions concerning **domestic implementation** under a system of tradeable permits (which is how the U.S. plans to implement):

- Where should the emission requirement be imposed: upstream or downstream?
- How should permits be allocated: grandfathered, auction, by incidence, performance-standard?
- What is the best way to design an Early Action Credit program?
- What other implementation strategies are countries planning to pursue?

### **Most significant uncertainties?**

The biggest uncertainties with regard to a full-blown cost-benefit analysis are the **discount rate, risk-aversion, probability of catastrophe**, etc. (That these uncertainties are so great is one of the reasons we decided not to do a full cost-benefit in the Administration Economic Analysis released in July, but rather contented ourselves with estimates of the costs of attaining the emissions objective agreed at Kyoto and how to minimize them.<sup>2</sup>) These uncertainties are so great that resolution is unlikely for the foreseeable future. My advice for the researcher who wants to feed directly into ongoing policy-making might be, as I have indicated, to focus on the shorter term.

The biggest uncertainty *that feeds directly into what policy-makers want to know* concerns the determinants of **technological change**. A tremendous amount of disagreement and confusion goes under the name of technology, and much goes under the heading of the appropriate value for the "AEEI" (autonomous rate of improvement in the energy efficiency index), although that in itself is a confusion in my view. A goal of research should be endogenizing technological progress. Can the Energy Efficiency Index be decomposed into the effects of:

- (i) new technological discoveries

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<sup>2</sup> Another reason is the absence of post-2012 numerical targets.

- (ii) dissemination of existing technology, and
- (iii) demand-side response such as conservation?

Can the pure autonomous component be distinguished from such policy effects as:

- (i) price
- (ii) deregulation, such as the freeing on natural gas prices twenty years ago, or today's restructuring of the electric power sector (e.g., to encourage marginal cost pricing),
- (iii) R&D subsidies or tax breaks, and
- (iv) moral suasion from leaders?

It is said that bottom-up modelers are technology-optimists. But I think the only sense in which they are necessarily optimistic is with regard to how much of an improvement one gets in the absence of price changes. There is a tendency that I like to caricature by the proposition that one predicts a change in individual behavior caused by the act of leaders' signing a treaty. The top-down economic models are potentially more optimistic about what are the effects of a given price change on Autonomous Energy Efficiency Improvement. The reason is that they can predict from historical data changes in behavior in response to prices without needing to know in an engineering sense what are the specific technologies that will come into use.

### **Which economic results are of most interest?**

Large econometric models generate hundreds of numbers. There are many possible economic variables of interest to report. But -- the limited attention-span and time-availability of policy-makers being what it is -- the question of what variable to report to them front-and-center merits some care. I generally recommend, again by the criterion of utility to policy-makers, a focus on the **price of carbon** as the single most important summary statistic of the economic implications of various policies. I realize that the price of carbon is very different from the correct measure of economic costs (various measures of foregone resource costs, or the present discounted value of consumption), and is very different even from more user-friendly measures (effects on national income or national output). These other measures of economic effects are very important and should be reported in the complete set of results. But my experience is that model results that choose these quantities for premier emphasis are somewhat less likely to play a useful role in the policy-making process.

The reason, I think, is that different models give different answers -- some, for example, reporting positive effects on income and some negative. These differences reflect such issues as whether the model assumes full employment at a horizon of ten years, what is the precise accounting definition of income, what price index is used to deflate income, whose welfare to look at, whether it is assumed that government revenues are generated and then recycled in a way that stimulates investment, and whether there is a positive double-dividend effect or a negative effect in the form of secondary resource costs. We economists can happily spend a day long seminar going through a set of model results and figuring out from where the differences come. But in a policy context, such machinations simply sidetrack attention from the most important issues, such as the magnitude of the emission targets,

the extent of international trading, and the set of countries participating. The danger is that the lessons that the models have to offer on these important issues fail to get through to the policy-makers. Model results that highlight effects on the price of carbon tend to differ less widely, and the differences can more readily be identified in the discussion of alternative policy options that needs to take place in any case.

Of course, an equally important way of addressing this problem of differing assumptions is to have a set of models participate in a common forecasting exercise, where assumptions are clearly specified in common. Such exercises have been carried out by the Stanford-based Energy Modeling Forum as well as the International Energy Association. Perhaps the model results to be presented later on in today's workshop will fall into this category. In any case, meetings like the current one, and research like that by participants here, are very useful as we add to our stock of knowledge, and work toward the common goal of addressing the serious problem of global climate change in an economically efficient way.

Let me conclude by warning that we all face a common foe: the suspicion among non-economists that models are of little use because they all say different things. The feeling is that results vary widely, and that the differences depend on the policy preferences of the modeler. The assumption is that someone who is "green" will find low costs to meeting stringent environmental targets, while someone who is "brown" will find high costs. My view is that the mainstream economists' models differ in their predictions far less than one might think. To be more precise, when modelers report very different estimates for economic costs, it is more likely to be the result of asking different questions than of a fundamentally different model structure. If one modeler asks the effects of the Kyoto targets without international trading and another with, then they *ought* to get different answers, because those are very different questions. Or one modeler might include a role for all six gases plus sinks, and another not. My observation is that the models give rather similar results when they are answering the same question. So it is important when reporting results to the general public to make very explicit what is the policy experiment that is assumed.

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