B.A.(Hons)Economics VI Sem

ENVIROMENTAL ECONOMICS

Namrata Yadav

Designing Climate Mitigation Policy

Joseph E. Aldy, Alan J. Krupnick, Richard G. Newell, Ian W. H. Parry, and William A.Pizer

Discussion of the main issues, and controversies, in the design of climate mitigation policy.

Paper discusses how much action to reduce greenhouse gas emissions at the global level is efficient under both the cost-effectiveness and welfare-maximizing paradigms.

Also issues in the implementation of domestic emissions control policy, instrument choice, and incentives for technological innovation.

Also alternative policy architectures at the international level.

Global warming is one of the most critical, and also most daunting, challenges facing policymakers in the twenty-first century, (e.g., World Bank 2010). Assessing a globally efficient time path for pricing or controlling greenhouse gas (GHG) emissions is difficult enough, with huge scientific uncertainties, disagreement over the ultimate goals of climate policy, and disagreement over which countries should bear most responsibility for emissions reductions.

Emissions Pricing to Stabilize Global Climate

The cost-effectiveness approach to global climate policy uses models of the economic and climate system (known as integrated assessment models) to estimate the emissions price trajectory that minimizes the discounted worldwide costs of emissions abatement, subject to climate s stabilization

Target and possibly other, practical constraints like delayed developing country participation. These models range from bot- tom-up engineering–economic models with considerable detail on adoption and use of energy technologies to computable general equilibrium models with a more aggregated and continuous structure that better represents demand responses, capital dynamics, and factor substitution. Many models are hybrids containing substantial technological detail in the energy sectors and more aggregate representation in others.

The choice of model structure is generally less important than assumptions about future baseline data and technology options. Future mitigation costs are highly sensitive to business-as-usual (BAU) emissions, which depend on future population and GDP growth, the energy-intensity of GDP, and the fuel mix. They also depend on the future availability and cost of emissions-saving technologies like nuclear and renewable power, carbon capture and storage, and alternative transportation fuels.

uncertainty surrounds all of these factors.

Refer to table 1 on page 906 of your readings

Global carbon dioxide emissions from fossil fuels have grown from about 2 billion tons in1990 to current levels of levels of about 30 billion tons and, in the absence of mitigation policy, are projected to roughly triple 2000 levels by the end of the century .

terrestrial biosphere while the remain- der enters the atmosphere and is removed by the ocean and terrestrial sinks only very gradually .

Most economic analysis has focused on climate stabilization targets that are approximately consistent with limiting atmospheric CO2 concentrations to either 450 or 550 ppm (with other GHGs included, CO2-equivalent concentrations stabilized at approximately 530 and 670 ppm respectively). The studies in table 1 examine globally cost-effective pricing of all GHGs that are approximately consistent with these goals.

one striking feature in table 1 is the considerable price variation across models within a stabilization scenario, reflecting different assumptions about future BAU emissions growth and future costs of carbon- saving technologies. The other striking feature is the dramatic differences between the 550 and 450 ppm CO2 stabilization targets. In the 550 ppm case, CO2 prices are $3–26 and $10–99 per ton in

2025 and 2050 respectively, with global emissions 17–41 percent and 13–56 percent above 2000 levels at these dates, respectively. In the 450 ppm case, CO2 prices are 3–16 times those in the 550 ppm case to mid century, while emissions are 3–14 percent and 36–47 percent below 2000 levels in 2025 and 2050 respectively.

a key qualification to the studies in table 1 is that they assume globally efficient abatement policies. More likely, particularly given the “common but differentiated responsibilities” recognized in the Kyoto Protocol, participation in global mitigation efforts among major developing country emitters will be delayed, causing marginal abatement costs to differ across regions.

There is a large difference in the appropriate starting prices for GHG emissions, depending on whether the ultimate objective is to limit atmospheric CO2 concentrations to 450 or 550 ppm—targets that are approximately consistent with keeping the eventual, mean projected warming above preindustrial levels to 2.7 and 3.7oC respectively (assuming non-CO2 GHGs are also priced). The 450 ppm target implies emissions prices should reach around $40–90 per ton of CO2 by 2025, while the 550 ppm target implies prices should rise to $3–25 by that date. Securing early and widespread participation in an international emissions control regime can also be critical for containing costs under the 450 ppm target, while under the 550 ppm target there is greater scope for offsetting the effect of delayed participation through greater emissions reductions in the latter half of the century. Given the considerable difference in GDP losses at stake between the two targets ($8–43 trillion in present value under cost-effective pricing out to 2050 compared with $0.4–12 trillion), it is important to carefully assess what starting prices might be justified by avoiding climate change damages.

Welfare-Maximizing Emissions Pricing

Estimates of the marginal damages from current emissions begin with a point estimate of total contemporaneous damages from warming, usually occurring around 2100. Total damage estimates from a number of studies are roughly in the same ballpark for a given amount of warming. According to representative estimates in figure 2, damages are

In the range of about 1–2 percent of world GDP for a warming of 2.5oC above preindustrial levels, though some estimates are close to zero or even negative (the prospects for negative costs diminishes with greater warming). For warming of about 4.0oC, damage estimates are typically in the order of 2–4 percent of world GDP. However, similarities in aggregate impacts mask huge inconsistencies across these studies, which reach strikingly different conclusions about the size of market and nonmarket damage categories and expected catastrophic risks.

Differences in marginal damage estimates are largely explained by fundamentally different approaches to discounting rather than differences in total damages from a given amount of warming (Nordhaus 2007). However, the valuation of catastrophic and no catastrophic damages is also highly contentious.

Discounting. The descriptive approach to discounting argues that we can do no better than using observed market rates, typically assumed to be about 5 percent.9 According to this approach, market rates reveal individuals' preferences, as best we understand them, about trade-offs between early and later consumption within their lifecycle, as well as their ethical or intergenerational preferences. And they reflect the return earned by a broad range of private and public investments—the opportunity cost against which other, even intergenerational, investments ought to be measured. Proponents of the descriptive approach view discounting at market rates as essential for meaningful, consistent policy analysis and to avoid highly perverse implications in other policy contexts.

Although on a different scale than catastrophic risks, controversies abound in the valuation of noncatastrophic damages. These include agricultural impacts, costs of increased storm intensity and protecting against rising sea levels, health impacts from heatwaves and the possible spread of vector-borne disease, loss of ecosystems, and so on. Box 1 pro- vides a very brief summary of attempts to value these damage categories (see Michael Eber and Alan J. Krupnick 2009 for a more detailed discussion). However, due to the rapid outdating of prior research, daunting methodological challenges, and the small number of economists working on aggregate damage assessment, the valuation literature remains highly inconsistent and poorly developed, as a few examples illustrate (W. Michael Hanemann 2008).

damages are convex in atmospheric GHG accumulations the prospect of future learning reduces the optimal near-term abatement level, to the extent that the damages from near-term emissions can be lowered through greater abatement in future, high-damage scenarios. Moreover, to the extent that current abatement involves (nonrecoverable) sunk investments in emissions-saving technologies, there is another source of option value, from delaying long- lived emissions-saving investments until more is known about the benefits of emissions reductions (Charles D. Kolstad 1996a). For these reasons, theoretical analyses suggest that the prospect of future learning justifies less near-term abatement (Kolstad 1996b; Fisher and Urvashi Narain 2003; Pindyck 2007). However, as already noted, the critical exception to this is when there is a possibility of crossing a catastrophic thresh- old in atmospheric concentrations prior to future learning, which is essentially nonreversible given the nonnegativity constraint on future emissions.

Regulations

Domestic programs that fail to cover embodied carbon in products imported from countries with suboptimal or no emissions controls may cause significant emissions leak- age. The problem is most relevant for down- stream, energy-intensive firms competing in global markets (e.g., chemicals and plastics, primary metals, petroleum refining), where reduced production at home may be largely offset by increased production in other countries with higher emissions intensity than in the United States. According to some models, as much as 15–25 percent of economy- wide U.S. CO2 reductions could be offset by extra emissions elsewhere, although the majority of the leakage stems from changes in global fuel prices rather than relocation of footloose capital (Sujata Gupta et al. 2007; Mun S. Ho, Richard Morgenstern, and Jhih- Shyang Shih 2008; Carolyn Fischer and Alan K. Fox 2007, 2009). Possible policy responses to the latter source of leakage include imposing taxes, or permit requirements, according to embodied carbon in product imports (and symmetrical rebates for exporters) or to subsidize the output of leakage-prone industries (e.g., through output-based allocations of free emissions allowances). However, all these approaches may run afoul of international trade obligations.

The implications for emissions control policies of preexisting tax distortions in factor markets have received considerable attention in the broader environmental economics literature (e.g., A. Lans Bovenberg and Goulder 2002), though these distortions are typically not integrated into energy–climate models. This raises two issues: to what extent is there a cost saving from policies that raise revenues and use them to offset distortionary taxes like income and payroll taxes, and to what extent do models that ignore prior tax distortions produce inaccurate estimates of policy costs?

The efficiency gain from recycling revenues in other tax reductions (relative to returning them lump sum or leaving policy rents in the private sector) is simply the amount of revenue raised times the marginal excess burden of taxation. Although there is uncertainty over behavioral responses in factor markets, a typical assumption is that the marginal excess burden of income taxes (with revenue returned lump sum) is around $0.25 for the United States, or perhaps as high as $0.40 if distortions in the pattern of spending created by tax preferences (e.g., for employer medical insurance or homeownership) are taken into account. For modest carbon policies, the efficiency gain from revenue recycling can be large relative to the direct efficiency cost of the policy, or Harberger triangle under the marginal abatement cost schedule. For example, if a $30 tax on U.S. CO2 emissions (currently about 6 billion tons) reduces annual emissions by 10 percent, the Harberger triangle is $9 billion, while the revenue-recycling benefit is roughly $40–65 billion per year.

Price Volatility

Another reason CO2 taxes and cap-and- trade systems may produce different out- comes stems from uncertainty over future abatement costs reflecting, for example, uncertainty over energy prices, technological advances, and substitutes for fossil fuels.

Price Versus Quantity Instruments in their Pure Form. If the goal is welfare maximization, abatement cost uncertainty strongly favors emissions taxes over cap-and-trade systems in their pure form. This is most easily seen in a static setting where the marginal benefits from abatement are constant. In this case, a Pigouvian emissions tax automatically equates marginal benefits to marginal abatement costs, regardless of the position of the marginal abatement cost schedule. In contrast, when emissions are capped to equate marginal benefits with expected marginal abatement costs, ex post abatement will either be too high or too low depending on whether the marginal abatement cost schedule is higher or lower than expected .

Stabilizing Allowance Prices. Emissions price volatility under cap-and-trade systems can be contained by allowing firms to bank permits when permit prices (and marginal abatement costs) are low, and borrow permits from future periods when prevailing prices are high. In fact, if banking and borrowing were completely unlimited and costless, expected allowance prices would rise at the interest rate, and the system would be largely equivalent to that of an emissions tax growing at the interest rate.

Promoting Technology Development and Diffusion

Basic Research

Appropriability problems are most severe for more basic research, which is largely conducted by universities, other nonprofits, and federal labs, mostly through central government funding. While it is not practical to assess the efficient allocation of funding across individual programs, Newell (2008, p. 32) suggests that a doubling of U.S. federal climate research spending (currently about $4 billion a year) is likely warranted, based on plausible assumptions about the rate of return on such spending. To avoid crowding out, this should be phased in to allow a progressive expansion in supply of college graduates in engineering and science.

International Policy Design

Proposed architectures for international emissions control regimes can be loosely classified into those based on bottom-up versus top-down (i.e., internationally negotiated) approaches and cap-and-trade systems versus systems of emissions taxes (e.g., Joseph E. Aldy and Stavins 2007). There is disagreement over which type of architecture is most desirable, and most likely to emerge in practice. In the bottom up approach, norms for participation might evolve from small groups of countries launching regional programs that progressively expand and integrate, or by explicit linking of domestic cap-and-trade programs (e.g., Carraro 2007; Judson Jaffe and Stavins 2008; Victor 2007).

The most daunting challenge is designing an architecture that encourages participation among some three or four dozen of the world's largest GHG emitters—the Kyoto framework failed to do this as non- Annex 1 countries, including China, Brazil, South Africa, Mexico and Indonesia, had no emissions control obligations, while the United States withdrew from the agreement.

Research Priorities

Some of the biggest challenges facing cli- mate economists are to develop, and apply, methodologies for valuing the wide array of market and non-market impacts across different regions, time periods, and scenarios for climate change (ecological, health, and extreme sea level impacts in particular, are poorly understood). However, in terms of shedding more light on whether there is a solid economic basis for aggressive, as opposed to more moderate, near-term emissions pricing, the most critical issues in need of study appear to be the nature and magnitude of damage risks from extreme warming scenarios and the extent to which the possibility of future, mid-course corrections, and deployment of last-resort technologies, in response to future learning, lowers the near- term emissions price. More research on dis- count rates might also be valuable, especially in trying to reconcile different approaches

References are provided at the end of the your readings