YALE CENTER *for the* STUDY OF GLOBALIZATION

Global Harmonized Carbon Pricing: Looking Beyond Paris

Yale Center for the Study of Globalization, International Conference, May 27 and 28, 2015

Proceedings

CONTENTS

Preface

This document contains presentations made at a conference on global harmonized carbon pricing held at Yale University in May of 2015. The conference was organized by the Yale Center for the Study of Globalization with participation by some of the world's most renowned scholars and experts on key aspects of the topic.

In these edited transcriptions, you will find powerful arguments, careful analyses and wide-ranging discussion about the elements necessary to build an international agreement for climate change mitigation based on harmonized carbon pricing. Our aim was not only to update the rationale of global carbon pricing versus global cap and trade, but also to explore in greater detail the issues of negotiating that alternative and the details of the key aspects for its implementation. Our overall goal is to identify the key points that can be considered for a future Additional Protocol in the form of a term sheet. We hope very much that the COP21 in Paris will yield a new Protocol, but it remains uncertain whether the emission reduction commitments embodied there would be sufficient to render the optimal mitigation strategy. Thus, it seems prudent and timely to be ready with a term sheet — a guide to envisioning the next steps toward achieving an international agreement leading to the desired mitigation. We plan to update this document when the results of COP21 are known.

Acknowledgements

We wish to thank the participants for their enthusiastic response to our call to action and for their efforts in joining us in New Haven and following up by editing the transcription of their presentations. We wish to thank the International Bar Association, and its current president, David Rivkin (Yale College '77, Yale Law '80) for agreeing to work with us on this project and for arranging for his colleagues with their expertise in international law to join us. Sebastian Serra spent many hours and much effort helping with the conference and the transcriptions while attending to his duties as a student and holding a full-time internship over the summer. We thank him very much for his service in this project.

Finally, we extend special thanks to the Citi Foundation, Santander Bank and Swiss Reinsurance America whose support has made this project possible.

CONFERENCE PARTICIPANTS

FRONT ROW, RIGHT TO LEFT *Ernesto Zedillo, Yale Center for the Study of Globalization and Former President of Mexico; Adele Morris, Brookings Institution; Zhongxiang Zhang, Tianjin University; Kate Brown de Vejar, International Bar Association (IBA) and Curtis, Mallet-Prevost, Colt & Mosle; Kenneth Gillingham, Yale University/White House Council of Economic Advisers; Haynie Wheeler, Yale Center for the Study of Globalization.* SECOND ROW *Dale Jorgenson, Harvard University; Gabrielle Marceau, WTO and University of Geneva; Silke Goldberg, IBA and Herbert Smith Freehills; Matthew McCullough, IBA and Curtis, Mallet-Prevost, Colt & Mosle; Matto Mildenberger, Yale University/UC Santa Barbara; Carolyn Fischer, Resources for the Future; Scott Shapiro, Yale Law School.* THIRD ROW *Richard Cooper, Harvard University; Robert Schmidt, Humboldt University, Berlin; Scott Shelton, Fiscal Affairs Department, IMF; Kurt Van Dender, Tax and Environment Unit, OECD; Ian Parry, Fiscal Affairs Department, IMF; Thomas Sterner, University of Gothenburg.* FOURTH ROW *Sebastian Serra, Harvard and Stanford Universities; Massimo Tavoni, Fondazione Eni Enrico Mattei - FEEM; Robert Repetto, International Institute for Sustainable Development; William Nordhaus, Yale University; Scott Barrett, Earth Institute, Columbia University; Gilbert Metcalf, Tufts University; Santiago Rubio, University of Valencia; Barry Nalebuff, Yale School of Management.* BACK ROW *James Stock, Harvard University; Jason Bordoff, SIPA Center on Global Energy Policy, Columbia University; Eric Toder, Urban Institute; Grzegorz Peszko, Climate Policy Team, World Bank.*

Introductory Remarks

I am Ernesto Zedillo of the Yale Center for the Study of Globalization, and I want to start by expressing our gratitude, on behalf of Haynie Wheeler and myself, for your attendance and participation at this conference.

Let me recall that almost ten years ago, in the fall of 2005, our center organized a conference which we called "*Global Warming: Looking beyond Kyoto*." That conference was inspired by the work of some of you, and we thought that it would be timely, and hopefully useful, to bring together a significant number of experts, not only to discuss the science of climate change, but also to go into more detail on questions about policy.

There was a significant degree of skepticism about the Kyoto Protocol in that conference. Early on, many of you had already explained why Kyoto did not have a good chance of success. But it was interesting to have one more discussion about that in 2005. And one conclusion from that conference was that by 2012 we would need to start thinking seriously what should come next given that countries would most likely not comply with their committed reductions in emissions or simply had failed to ratify those commitments, as was already the case for the United States. The irony is that although the fear that was held in 2005 by a number of serious thinkers was confirmed, the international community has continued to work essentially along the Kyoto framework to deal with the crucial global public good of climate change mitigation.

If you review the draft protocol that is being prepared for COP21, to take place in Paris at the end of 2015, apart from some voluntarism towards universal participation, and also after looking at the details of the few carbon pledges that have been submitted, it is not an exaggeration to say that at the end of the present cycle of negotiations, not much progress towards a truly effective international agreement is likely to be accomplished relative to where we were ten years ago.

Since our conference in 2005, all of you along with many other researchers have continued to work assiduously in this field. The result is that some of the crucial insights on how to go about dealing with climate change have been reinforced not only by more robust theoretical and numerical modeling work but also by practical experience.

That work of many of you — which I appreciate enormously — as well as my fear that although the Paris COP21 may not end in practical failure as the Copenhagen COP15 did, most probably it will deliver something that falls far short of what is needed to address climate change effectively, is what has motivated us to organize this gathering at our Center to think about what should be done after Paris. I think in the same way that we were trying to envision what should happen after Kyoto, we felt that it was our duty to think about what happens after Paris.

Needless to say, by embarking on this task at our Center, we claim no originality whatsoever. I insist that we are being inspired by the important work of practically all of you. If there is any merit to our endeavor, it is to call upon and bring together people who have continued to advance the economics of climate change since our 2005 conference, not least Bill Nordhaus, Marty Weitzman and others present in this auditorium. Your enlightening research has stimulated us to focus on the question of how to go about building an international regime for climate change mitigation based essentially on carbon pricing. As we indicated in our invitation, our aim is not only to update the rationale of global carbon pricing versus global cap and trade, but also to explore in greater detail the issues of negotiating that alternative and the details of the key aspects for its implementation.

Of course, we are leaving out of this discussion other important questions that must be part of a holistic endeavor. In this conference we are not dealing with GHG emissions neither do we intend to tackle the challenge of adaptation, an aspect where I am hopeful some progress may be achieved at the COP21 if at last the long announced US 100 billion dollars per year facility is finally funded.

When insisting that this conference is just about international carbon pricing, I have to be very transparent in admitting that probably this posture, in the eyes of some, is not consistent with the principles of absolute academic freedom guiding this as well as your own institutions of higher learning. For I have asked you, in the conference's terms of reference, to ignore other approaches, including the failed Kyoto global cap and trade framework.

Put plainly, this is a gathering for truly converted Pigouvians. And if any of you are not already converted to the indispensability of a regime based on an international price on carbon, I will be begging you over these two days to be converted and to help us to think as someone who is converted. I know that at least one of my mentors in this field, Scott Barrett, notwithstanding his early work, has become skeptical of whether an international agreement with carbon pricing as its focal point will ever be adopted. But still, I will try to push Scott and other skeptics scattered throughout the room momentarily to abandon their pessimistic mindset and help us think about such a regime as if they were converted.

I should mention that around the time of the conference in 2005 we also had Nick Stern visit Yale to talk about his then ongoing research. After Nick finished his landmark report (the 2006 *Stern Review on the Economics of Climate Change*), he came back to the United States and presented it, and debated

in a few places. Luckily he was gracious enough to accept our Center's invitation to discuss his admirable work here. We had some of you at that discussion in 2007, including Bill Nordhaus and Scott Barrett. Interestingly Marty Weitzman was part of the audience for he had come to Yale that day to present a paper. I recall that although everybody endorsed Nick's eloquent call for action to mitigate climate change effectively, there were voices of skepticism regarding some of the essential arguments he used for making such a call. Bill Nordhaus, in particular, observed earlier than others how dependent Nick's policy prescriptions were on the choice of a rather low discount rate. It was fascinating that at the same time, Marty Weitzman, precisely in the paper he had come to discuss that day at Yale, had produced some theoretical arguments that ended up somehow supporting Nick's policy prescriptions without relying on Nick's artifice of using a near zero rate of discount for "ethical reasons."

But in any case, we are here now for a conference that is, I insist, violating good academic principles. This is a conference for the converted — or people pretending to be converted. And my objective is that at the end of the two days, we will have achieved some clarity about what it would take to have an international agreement, having as its focal point carbon pricing. I think the fact that the international community has stayed on the track of Kyoto has discouraged some members of our profession [economists] from going into further details. But happily some of you, notwithstanding that, have done important work that now should be put together.

An innovation at this conference is the fact that we have invited some lawyers who think seriously about international law, particularly international trade law. A couple of years ago Mary Robinson, my colleague and very dear friend from the Elders, challenged the International Bar Association to make a review of the legal covenants existing in international law that would affect climate policy. And the International Bar Association took the challenge and produced an excellent volume, *Achieving Justice and Human Rights in an Era of Climate Disruption* (2014).

And that inspired me to call another Yalie, who is now president of the International Bar Association, David Rivkin. We have three wonderful colleagues of David's who are here, and hopefully this will

allow us to have a very insightful dialogue on the fundamental questions of how to go about achieving and enforcing participation in an agreement of this nature. And we will be discussing something, which at least for me, as a diehard free trader and true believer in the multilateral trading system, is very hard to do. I can already see my free trader friends calling me a traitor because in our conference's program there is a discussion of whether the trading system should be used to achieve the necessary participation and enforcement of a serious climate agreement.

At the end of this conference, I would like to have some key points that could be considered for a future additional protocol in the form of a term sheet. I think there will be a protocol in Paris. If there isn't, it's going to be a disaster, politically and geopolitically. It will be another failure, like Copenhagen. And so I think they will produce something. But once some of you run the models, your integrated models will come back and say this will not do the trick. And when that moment comes, we should be ready to suggest that maybe a more restricted group of countries should consider an additional protocol, just as was done with the non-proliferation treaty.

So that's the general idea for the next two days, and with that, I want to invite Bill Nordhaus to take the chairmanship of the first session.

Global Harmonized Carbon Pricing: Looking Beyond Paris

Yale Center for the Study of Globalization, International Conference, May 27 and 28, 2015

Session One:

Why insist on an international carbon price?

Presentations and Discussion

PARTICIPANTS

Martin Weitzman, Robert Schmidt, Massimo Tavoni

MODERATOR

William Nordhaus




Session One — Why insist on an international carbon price?

This discussion is intended for reviewing in a distilled way the theoretical and experiential arguments leading to the presumption that an effective international regime to mitigate climate change would be one in which the parties agree on a harmonized carbon pricing trajectory rather than the global cap and trade pursued so far. Ultimately, we wish to have those arguments articulated in a way that could be effectively conveyed to policymakers, other informed readers or interlocutors and usable for the "term sheet" mentioned below.

Presentations

William Nordhaus

First I'd like to offer my own welcome to those of you who have come from near and far. This is a conference that those of us who are at Yale see from time to time. It is a conference that only Ernesto could organize, which takes a topic of great importance and thinks carefully about who around the country and around the world would make the most contribution to it and then brings them here. So those of you who've come, we're very, very grateful to you for coming. And we're very grateful to Ernesto for organizing this.

I want to start with some short introductory comments, and then say something about the logistics, how I propose we run the session. Ernesto gave you an overview of his vision of what he would like to do over the next couple of days. I will just give some substantive introduction about how I see the state of play. Taking the larger view of where we are in the area of climate change, climate change economics, climate change policy, politics, and negotiations, I see four topics that we have been, and need to, grapple with to make progress and to really tame the beast, so to speak.

The first one is climate science. That's something with which many people in this room are familiar, but there are few climatologists in the room. My own view is that this is a mature science. It's controversial; it's also extremely complicated. It's a system that is full of very interesting but also complex nonlinear dynamics, and so much of it continues to be poorly understood or at least imperfectly understood. As a mature science, it's one that we have to take as the baseline for what we do, and there always will be critics, and I think critics need to be listened to and addressed. But I think on

the scientific side, we've got a serious group of scientists who have spent decades and decades on this, refining the basic conclusions and modeling. It will go on and will continue to be improved.

A second area, which is getting closer to the topics we will deal with here, moving into the economics and related areas, is the subject of the costs of slowing climate change, on the one hand, and the impacts of not slowing climate change on the other; the costs and benefits, if you like, of taking steps to slow climate change. This also is an area, that's not quite as mature as the climate science is, but in which people have been working for perhaps 30 years.

My own view is that on the mitigation and abatement side, it actually is a pretty mature discipline. It grows out of energy economics and energy science, which have been around quite a while. And so while I think there are obviously uncertainties about mitigation costs, I think that we have several reasonable models. Dale Jorgenson is here, just to point one finger at one person who has been working on this for many years in many countries and many sectors. His work has been particularly fruitful in illuminating abatement costs.

The work of Dale and his associates is one side of this; the other side of this is the impacts/damages. I think this has proved much more difficult, much more elusive. And I think we have perhaps order of magnitude estimates, but those are much less certain. So I think that's an area where we are still

thinking about issues such as what the damages are, the non-market damages, what are the fat tails of these damages, and what the whole shape of those looks like. We have numbers, but I think we're much less sure there.

The other two areas are ones that I think are central to this conference. First, the question of instruments and what kind of policy instruments should be used to implement policy. And the second is the problem of global negotiations, and the global free riding problem. On the first one, which is central to the topic as Ernesto introduced it, is what kinds of instruments we should use.

For strange historical reasons, the quantitative approach of tradable emissions allowances took center stage in the late 1990s. And you can see the reasons. It's not important to talk about right at this moment, but you can see the reasons that it did what it did. And it's really held center stage the entire time, both domestically in the U.S., and in the only system that really is working now, which is the EU system. It's a system that has flaws, some of which are pretty bad, but that works. It's a system that at least has been out on the track, and it runs.

The other system, which also has been operating in several countries, is the carbon tax system. And that's the central focus of this conference. So when I think about the first approximation of these, they are the same. They both raise carbon prices if they're implemented on a universal basis. And that's really what we need to do. We need to raise carbon prices everywhere in a durable and credible way. So to a first approximation, they do the same thing. But it's actually the second approximations, or the second order effects that we'll talk about today and tomorrow, that are the crucial differences. And I think at least the domestic differences between carbon taxes and cap and trade are one central reason why carbon taxes look in the long run to be a better solution.

And then the fourth area is how are you going to get countries together to act and to participate. And not just to participate in the sense of signing a piece of paper, but participate in the sense of going beyond what would be in their own national self-interest; what would be beyond a non-cooperative solution, in the language of game theory, to a cooperative solution which would involve almost surely deep and costly emissions reductions.

How are we going to get countries to go from the non-cooperative to the cooperative solution? I think it's undeniable that what we've done to date has not been successful. Aside from the fact the Kyoto Protocol has died, even when it was in place it had relatively shallow emissions reductions. And the countries that were called on to make deep emissions reductions, like the U.S. and Canada, dropped out.

So I think the one attempt to have an international agreement clearly failed the free rider test, the test of avoiding free riders. My view is that's the key issue that we have been unable to address in our international negotiations. And as far as Paris is concerned, I don't even need to read the newspaper because I know what's going to happen. It cannot succeed. It cannot succeed because it doesn't

have the incentives for countries to go beyond their non-cooperative, nationalistic, to use a pun, interest. I'm going to talk about that more tomorrow.

To tie these together, I think these two last points about the instruments and the need for international agreements are very, very closely entwined. You need to think how you're going to overcome the free riding problem, but you need to think also about what kinds of instruments you can use to do that, what kind of measures you can use to do that. And that's where the very, very strong logic of carbon pricing, and carbon taxes in particular, comes into the picture to mesh with the need for overcoming free riding. This last interaction between the instrument and the need for overcoming free riding is a subtle and important aspect that we need to address because it's not just one or the other. It's actually how you're going to make the two work together.

That's my warm-up. I suggest that the speakers come up one by one and then we will go for approximately an hour. Each of the speakers can take 15 minutes, no more than 20, then we'll bring the panel up here, and we'll open it up for general conversation. So again, Ernesto, thank you for convening us. And we'll welcome to the podium Martin Weitzman.

Martin Weitzman

I'm going to go through some classical and non-classical arguments in favor of prices or taxes as opposed to tradable caps. I'm not going to spend any time on where the global warming public goods problem now stands. My feeling is that we've not made much progress. The spirit of Kyoto really hasn't carried over.

There are classical arguments (I'm calling them classical only because they're not new) for a harmonized tax or price over tradable permits. There are three points that I think are most salient.

First, stabilizing a price seems like it may be more important than stabilizing a quantity. There's a theoretical prices-versus-quantity type argument on the marginal benefit-flow of a stock externality. In any given period of a year or ten years, the marginal benefit curve is likely to be flat. And the classical theory tells us that in those situations, prices should be favored over tradable permits. There have been computer simulations that seem to show this.

There's also a political economy, practical argument that relates to strong public aversion to price volatility, and which is probably more important. The public doesn't tolerate price volatility in important commodities like energy and everything that emanates from energy. And what I fear here is that if we went to cap and trade or a quantity system, the prices are likely to fluctuate. That's what we seemed to see in the past. And I can imagine a worst-case scenario where this price volatility sours the public on any economic approach to curtailing greenhouse emissions. I can just see what would happen now. The price spikes up; it comes down. Wall Street firms have taken a position on these quantities. And there'll be all kinds of looking for whose fault this is. And it could set back the cause of using either economic or any economic approach. So this strong public aversion to price volatility is an important argument for harmonized prices through a tax.

Second, is that tradable permits inherently involve large international transfers of revenues across borders. There'll be a very big multi-billion, multi-hundred billion-dollar transfer from the U.S. to China, or from one part of the world to another part. And I don't think that's very well tolerated. The tax or price has its own problems, but it's internally retained in these schemes, including mine. And it could be used to offset other, less efficient taxes. It might even be a benefit if it's used to offset taxes that are more distortionary.

Third and finally, I believe that an internationally harmonized tax price is administratively more transparent and less prone to corruption or stealing of valuable permits than international cap and trade. This is not so powerful an argument within the U.S. or within the Western European countries, but it's a big issue when it comes to including the whole world, including China and India and other countries. These permits are valuable, and it just requires more administration to keep track of them and to make sure somebody is not stealing.

Now there also exist arguments favoring cap and trade over harmonized prices. I'm not going to go over them because I don't have much time. These arguments could reverse some of my conclusions here. I think these three arguments carry the day over other arguments in favor of cap and trade.

I now want to add some relatively new, I'll call them game theoretic, arguments in favor of negotiating a minimum carbon price that's internationally harmonized but domestically retained. I'm going to try to argue that a core issue is that it's more difficult to negotiate N quantities where N is some moderately big number than it is to negotiate one price. This argument is going to be incomplete. I'm not satisfied that I've gotten it, or anybody has gotten at the core essence of this. But I do think it is very important, this issue of N negotiating instruments versus one negotiating instrument.

So let's go back to basics and look at the two leading candidate instruments we are discussing: cap and trade and internationally harmonized prices that are domestically collected. There are three desirable properties in any instrument. One is that they induce cost effectiveness. I don't have to convince an audience of economists that this is an important issue.

A second property is that this instrument is centered on a single natural focal point. We're trying to facilitate an agreement with relatively low transactions cost. I could try to cite the spirit of Coase with transaction costs and say they're larger for N parties than they are for N instruments than they are for one instrument. Or Thomas Schelling, who popularized the idea of negotiating a salient focal point. One of the problems I'm running up against is what is a natural focal point? I think that a natural focal point is what people think is a natural focal point. It's very hard to push it further in terms of some information content or something like that. And so there's inescapably some sort of subjective element in deciding what is a focal point.

And the third point, maybe the most important, is that you want the instrument or instruments to give an incentive to internalize the externality. You want the thing set up with an instrument so that not everybody wants to push it as big as possible or as small as possible, but they're doing some internal balancing.

Now here comes a series of subtleties about how to set this problem up and how to think about it. If you negotiate N caps with or without tradable permits, at best you're going to satisfy cost effectiveness. Every country wants a low cap, and there's a free rider problem. I don't have to dwell on that here. There's no incentive, the way this is set up in my mind, to internalize the externality; in fact, just the opposite. Everyone wants the free ride off the externality.

Now let's consider a binding agreement to adhere to a uniform minimum carbon price, which is then negotiated. How do you ever get everyone to agree to a uniform minimum carbon price? Suppose you have gotten everyone to agree to this uniform minimum carbon price. It's negotiated or it's voted on, or something like that, and each country keeps these tax-like proceeds. You've now reduced the problem to one dimension, arguing about a single price. Of course it also has cost effectiveness.

It has a third property also, because if we're voting on, or negotiating on a single uniform price throughout the world, then when I do my voting or negotiating, I don't necessarily want this uniform price to be as low as possible. If the price is lowered, then it's advantageous to me because I don't have to spend so much money on alternative technologies. On the other hand, if the price is lowered, then that means that everybody else is going to be emitting more emissions, and it'll come to hurt me on the benefits side. So there's a kind of an internal balance where I lose this property of just wanting it to go in one direction.

I've worked out, with a bunch of other assumptions, what the mechanics of this internalization look like. And if you put enough extra structure on the problem, what you can get is that basically when you're negotiating one price, and let's say you use as a model majority voting, that the majority voting will get the mean of the marginal benefits throughout the population. But with voting you'll get the median. So this is coming close enough in my opinion. There's something good about this. It's capturing the median marginal benefit. It should be capturing the mean, but maybe there's not that much distinction.

I want to finish up by bending over backwards to try to talk about how a quantity system, a cap and trade, might be forced into this same kind of a framework. I'm going to conclude that it's harder to do with cap and trade. But much of that argument has to do with what is a focal point. Okay, so is this unfair to cap and trade? You could imagine the way I first set up the cap and trade, there were N negotiations to be agreed upon. But suppose that you restructured the cap and trade so that everyone votes or negotiates the total emissions level, given proportional reduction coefficients.

So it's like each country has a share of the abatement. Each country has a share of emissions, a fraction of emissions. These fractions add up to one, but then the countries negotiate the total emissions level. There's an analogy here for those who know it with the Icelandic fishery, ITQ, individual tradable quotas, and TAC, total allowable catch system. The way that works, and it's worked really quite well over 20 or 30 years now, is that there are individual catch coefficients, so if you have a chit, you're entitled to 1%, let's say, of the total allowable catch. These individual transferable quotas were set on the basis of historical catches in the early 1980's. And you're free to trade them. The government though sets the total allowable catch. It's this one-dimensional thing the government is doing.

And then it automatically divides down among the various nations according to what coefficients they're assigned. If you thought of a system like that, you're reducing the quantities to one dimension. But you have the same free riding problem, and there's stage one, assigning of these N proportional CO2 reduction coefficients. Iceland did, as a uniform government, but it's hard to see how this would be done in an international context.

Now let's bend over backwards to be even more fair or comparable. There's one price, and in a certain sense it's natural to think of one price of carbon, one uniform price. It's symmetric. You could think of an analogous symmetric allocation of quantities where everyone throughout the world is given the same per capita emissions coefficient. And you negotiate the total emissions level, and that's symmetric; everyone's being treated the same. They get the same allocations per capita of emissions, and then they vote on, or negotiate the total emissions, knowing it will break down this way. Now again, that has properties two and three. There's one dimension centered on this natural focal point of the total emissions. And also there's a countervailing force there, because when I want the emissions to be low, they're going to be high to save me money. I don't want it to be high for everybody else because that'll hurt me on the benefit side. So it's got this property. In some rigorous sense, this is more distorting than a price system.

So why is a uniform price a more natural focal point than a uniform per capita permit coefficient assignment in a cap and trade system? I can't lay out an argument from first principles why price is more salient than quantity. But I believe that's the case. If you have a uniform price, you're getting an equality of marginal effort. If you're giving everyone the same breakdown of emissions, you're ensuring what you might call equality of endowments.

And here's another point going against me, or against us who believe that overall a harmonized price system is superior. Here's a criticism of what I've been doing and saying. Any agreement probably requires some sort of a transfer to induce certain countries to participate. You could argue you're probably going to need some side payments. But now I wonder does that put the prices and the tradable permits on the same level of ultimately requiring the agreement of N parties; so does that negate what I said before when I was assuming that they were already in compliance? Maybe the N versus one argument applies as well when you recognize some side payments — again I don't think it's quite the same — but I can't find any argument from first principles that's doing that. And I think the transfers under this green fund for a uniform price would be less then. You can show that by fiddling around. Charging yourself a price, you're getting triangles of welfare loss. Having tradable permits, you're losing or gaining rectangles of welfare. So does it put prices and tradable permits on the same level of ultimately requiring the agreement of N parties? I don't know. I think so, but I can't back it up.

My own conclusion, which it has to be admitted relies on subjective elements, is that when all is said and done, it's plausible to conceptualize cap and trade as involving one more layer of N party negotiations on the N caps than a uniform price. If that's the case, then this one versus N argument holds water. But again, I admit on a theoretical level it's difficult to make this case from first principles.

So my conclusion would be that it's difficult to get nations, sovereign nations, to agree on any framework. But it's relatively easier for the reasons I went though, including some of these subjective aspects, to agree on one uniform price than N quantity caps, maybe because the distribution issue is somewhat diffused. It's not front and center as it is with tradable permits.

William Nordhaus

Thank you, Marty. That got us off for a good start. I actually think this is a really brilliant and important contribution. And I think in a way Marty understates its importance; the importance of moving to a single variable, we just go back to simple Arrow-like reasoning on voting mechanisms. As it's likely that countries have single peak preferences over that one instrument, then you have a hope of getting some decision or getting an answer. When you start introducing another dimension, say the distributional dimension, then one thing we know is that then any chance of getting single peak preferences is gone. So I think this is, aside from all the other points, really a central one in Marty's discussion. I'll talk about this a little bit more tomorrow but I think this is a really useful opener. Next we're going to move to Robert Schmidt on his presentation.

Robert Schmidt

As you all know, there's a long tradition in environmental economics to compare taxes with the policy instrument of cap and trade. Economic theorists, including me, often tend to be interested in kind of subtle issues, issues that are not obvious from the start, and you can use theoretical models, formal models, trying to analyze these issues. However, those subtle issues are not always at the core of the decision, so it is not always those issues that are most decisive in terms of policy making. I think we should try to make an effort from time to time to highlight those issues that are the most crucial ones,

even if they are not necessarily those that are the most interesting ones for economic theorists.

The purpose of this talk is to step back and try to have a look at those issues that, at least in my opinion, are the most important issues for policymakers, the first order effects. And then in the second half of this talk, I will also briefly sketch my own vision for climate negotiations.

A few arguments in favor of a carbon tax. Obviously, climate change is a complex issue. There's a lot of uncertainty surrounding this problem about damages of emissions, abatement costs, and low carbon technologies. However in my opinion, a complex disease doesn't necessarily imply a complicated treatment. There is an inherent property in CO2 emissions that I think is often being overlooked and this property makes it easy to address this problem from a policy perspective. Namely virtually every ton of carbon that is extracted from the earth's crust eventually ends up in the atmosphere in the form of CO2. That one-to-one ratio of carbon extraction and CO2 emissions makes the problem potentially easy to deal with from a policy perspective as it allows us to not tax the emissions. Instead, we can simply tax the carbon when it is extracted from the ground, or imported into the country from another country that charges a lower carbon price.

Let me point towards two specific reasons why I think that the extraction of carbon should be taxed rather than the final CO2 emissions. The first one is coverage. With an extraction tax, almost 100% of all CO2 emissions in the country are automatically covered, and that comprises emissions from electricity generation, production, transportation, consumption, services, anything. Every source of CO2 emissions is automatically covered because the price is essentially "in the carbon itself". And then it's passed on from producer to producers and to the consumers. As a result, goods and services with higher embedded emissions become relatively more expensive.

By contrast, under a cap and trade scheme, coverage tends to be lower. And that's related to the fact that there are a vast number of emitters. For instance, in the EU ETS, coverage amounts to only about 45% of all CO2 emissions. Therefore, other instruments are required to regulate those emissions that are not covered, if they can be regulated at all. By contrast, there's only a small number of extractors or importers of carbon.

That leads me directly to the second reason why the extraction of carbon should be taxed rather than the emissions. When you tax the CO2 emissions or when you implement a cap and trade scheme, then every single emitter needs to keep track of its emissions. For small emitters or households, that's basically not feasible, and there are significant welfare losses in the form of bureaucratic or transaction costs. By contrast, these costs, I believe, are virtually negligible in the case of an extraction tax. Under an extraction tax, firms and individuals don't even need to know their CO2 emissions. They simply respond to price signals and shift consumption and production patterns towards lower emissions. So these arguments, I believe, favor a carbon tax over cap and trade when the carbon tax is implemented in the form of an extraction tax.

But there are further reasons why I believe that a carbon (extraction) tax is a more suitable instrument to address the problem of global warming than cap and trade. They are related to the uncertainty about permit prices inherent in a cap and trade scheme. Let me put it very simply. If the permit price is high, there are considerable economic risks. It can lead to job losses, firm relocation, even to an economic crisis in the worst case. Conversely, if the permit price is low, as is currently the case in the EU ETS, then society is obviously not exploiting its potential to reduce the emissions further at a low cost. And last but not least, a volatile carbon price creates an unfavorable environment for investments into low carbon technologies.

In sum, both upwards and downwards shocks in the permit price are undesirable, and the obvious way to prevent both of them is to fix the price by implementing a tax. But can we achieve the two-degree target with a carbon tax? I believe we can. Of course, despite the low coverage, cap and trade could potentially deliver more certainty about short run emissions. However in my view, short run emissions are not decisive for climate change. What really matters is cumulative emissions because climate gases accumulate in the atmosphere and in the oceans over time. What countries need to do is to limit their cumulative emissions over the next decades in order to reach the two-degree target with a sufficiently high probability.

In my view, cumulative emissions can be adjusted much more easily with a carbon tax than short run emissions. For instance, if the emissions reduction under a carbon tax turns out to be lower in the short run than was anticipated, the price path can simply be adjusted upwards without any drastic changes in the tax rate. On the other hand, emissions might also decline more rapidly than anticipated. In that case, the tax rate might be raised more slowly over time. So implementing a carbon tax and readjusting it over time allows us to learn about the responsiveness of the economy to a price signal. Of course similar learning can occur also under cap and trade; but the tax has the advantage of a more stable price signal.

I now come to the second part of this talk with my own vision for climate negotiations. A uniform global carbon tax and ideally implemented in the form of an extraction and import tax is, in my view, the most efficient policy instrument available to combat climate change. However, I believe that a uniform carbon tax leads to unequal welfare costs across countries, and that makes it rather unlikely that

it will be implementable in the near term. A possible way out of that dilemma could be transfers, but these would have to be overwhelmingly high, and hence are also probably not implementable.

It turns out that the climate change problem itself has yet another intrinsic property that can be exploited here – namely, what we are facing is in fact a double public goods problem. On the one hand we have the global public good of stabilizing the climate, which means we need to reduce greenhouse gas emissions. But on the other hand we are facing the global public good of providing low carbon technologies, which at least to a large extent has public good properties because of knowledge spillovers. That suggests the following way out of the dilemma. If there's a country that suffers less under the uniform global carbon tax, or is perhaps unable to implement the carbon tax for some political reasons, that country could simply contribute more to the other global public good, technology provision.

My vision is to balance countries' efforts in climate stabilization by focusing on a fixed percentage cost of GDP for countries' total efforts which comprise both direct mitigation costs and costs of providing low carbon technologies. I believe that this suggestion has some nice fairness properties also. Namely, poorer countries pay less in absolute terms because they have a lower GDP. Furthermore, these balanced efforts can be achieved even when carbon prices (initially) differ across countries.

Marty argued that any useful proposal for climate negotiations should ideally focus on a one-dimensional target, and in addition, it should embody a countervailing force against narrow self-interest. Let's consider the balanced efforts approach. Here, countries do negotiate about a one-dimensional target, in this case the total effort cost of a country, as a percentage of its GDP. Of course that requires some pre-commitment to identical efforts, as a focal point here, for all countries. By contrast in Weitzman's paper, the focus is on an identical price. But it also requires that pre-commitment to negotiate only about the level of this one-dimensional target. In terms of countervailing force — I didn't check it formally and don't have a model on that — but I believe that there wouldn't be an interest for any country to vote for an excessively low effort cost target as a percentage of GDP because this would then imply that other countries will also exert a lower effort.

I have tried to highlight in this talk that a carbon tax, ideally implemented as an extraction and import tax for carbon, is the most efficient policy instrument available to combat climate change. From an efficiency perspective, all countries should implement a uniform carbon price. However, I'm afraid that this is not realistic because at least in the nearer term it might lead to large differences in welfare across countries. And furthermore, some countries may simply be unable to implement a tax for political reasons.

Does that mean we cannot cooperate? Or that a country that is willing to cooperate but cannot immediately implement the same carbon price as the other countries has to be excluded? I think it does not. We can balance countries' effort costs in climate stabilization via differentiated investments in low carbon technologies. And the message is quite simple: ask those countries that suffer

less under a uniform carbon tax, or perhaps cannot implement a tax, simply to invest more in low carbon technologies, which is the second global public good which we are facing here.

William Nordhaus

You didn't use up all your time, so could I just ask a follow-up question, which I was unclear on? In your carbon tax proposal, you suggested a production tax rather than a consumption tax, a tax on the production of fuels rather than consumption of fuels. Could you just spend a minute on that? Because I think that's actually a pretty big difference between some of the proposals.

Robert Schmidt

That's exactly right. So if I'm a company that drills oil from the ground, or which extracts coal, then I will have to pay the tax in proportion to the amount of carbon that I have extracted from the earth's crust. Or if I'm importing natural gas, say, from Russia, then I will have to pay for the amount of carbon I am importing. The tax would be levied either at the point where firms are extracting the carbon from the ground or where firms are importing the carbon from other countries.

William Nordhaus

So the only difference there is the trade component? Is the idea that if a country is a coal producer — Australia for example — they would levy a tax on coal extraction. And is the idea they would then rebate it on exports, and it would be taxed in Japan when it was imported? Because another way to do it would be just to do it at the point of consumption. I just want to make sure I'm clear on that.

Robert Schmidt

If the country that is extracting the carbon is part of a treaty, and all countries in the treaty ideally have the same carbon price, there's no need to reimburse or rebate anything.

Ernesto Zedillo

What about the question of carbon leakage? Because looking at Saudi Arabia exporting oil, let's say Saudi Arabia starts to develop petrochemical, cement, and aluminum industries. They will not be exporting oil but they will be exporting other goods that obviously have a high carbon content. I think you need to think about that next step.

Robert Schmidt

That leads to the issue of border tax adjustment, which was not part of my talk, but it's an important issue. I think we should discuss in greater detail about that later during the conference. Let me nevertheless point out already at this point that I am personally convinced that BCA (border carbon adjustment) measures will play a key role in reaching any agreement among a limited number of countries that are willing to move forward in climate protection, while others are still reluctant. Indeed, the fear of a loss of competitiveness (and a loss of jobs in particular) is probably one of the main reasons why many countries seem so reluctant to step forward with unilateral climate policy measures. BCA allows individual countries or groups of countries to do that and contribute to the global public good

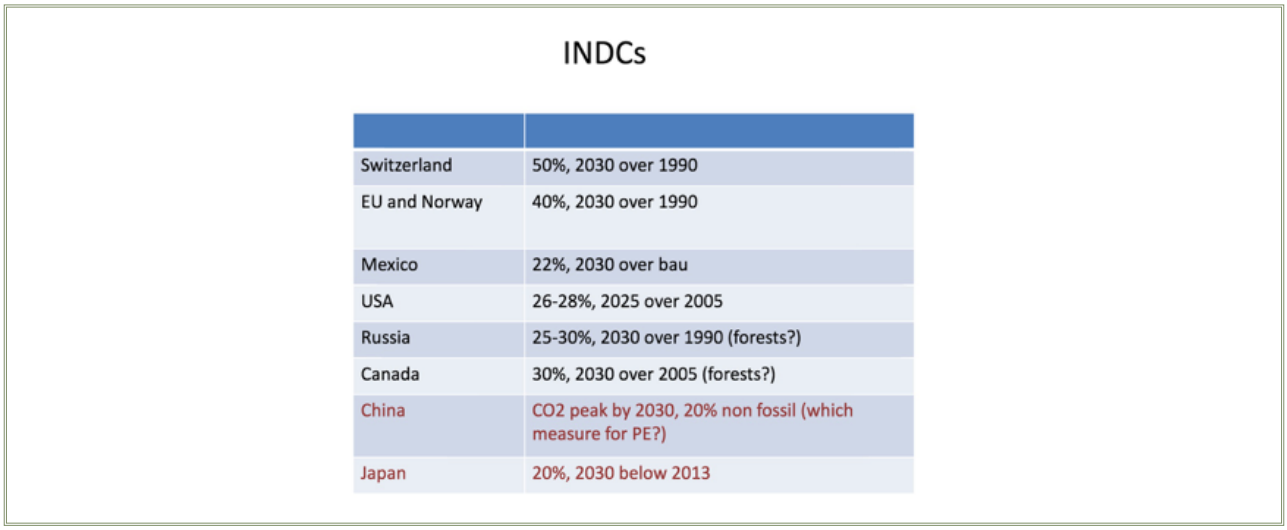
of climate stabilization without being "punished" disproportionally due to competitive disadvantages and job losses related with their unilateral efforts. The importance of BCA measures is, thus, hard to underestimate, and should deserve a lot of our attention during this conference.

William Nordhaus

Thank you very much. Our final presenter this morning is Massimo Tavoni.

Massimo Tavoni

Let me thank first of all Ernesto, Haynie, and Bill for having me here. I'm going to provide some more quantitative policymaking, some numbers, for quantitative analysis. Most of my work is actually on integrated assessment modeling, so I will have to translate some into formal arguments. Actually the title is Modeling INDCs (Intended Nationally Determined Contributions), but I actually won't do a lot of that because there's not much to model yet. I was checking the website the other day about which INDCs have been submitted so far. There's a bunch of them, and this is not even a complete list.



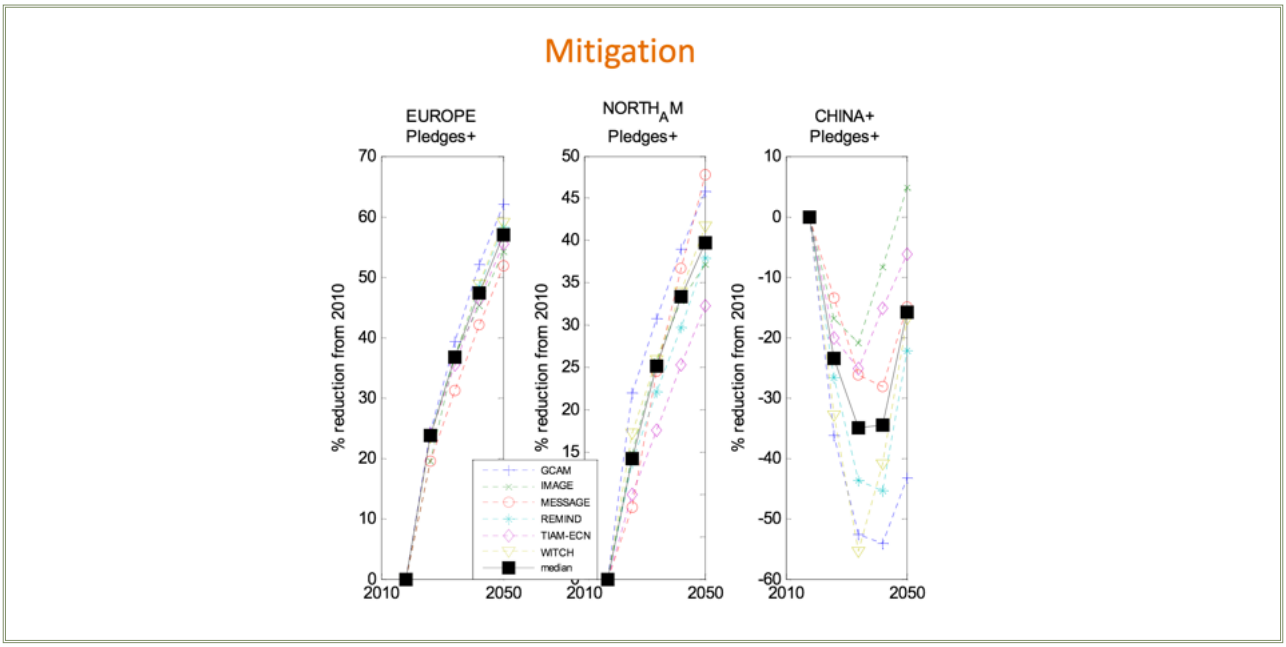
They also vary quite a bit in terms of reference points as you can imagine. But the most notable maybe are the European, 40%, 2030 over 1990, which is about 35% over 2005 in 2030 in terms of greenhouse gas emission reductions. The US has 26 to 28%, 2025 over 2005. Then Russia has put forward some proposals for the discussion, as well as Canada, about to what extent carbon sinks will actually be used to meet their targets. That obviously has big implications. Mexico has put forward also a target, this time, however, against business as usual.

And then of course there's China. The discussion about China, although this is not yet formally submitted, is about emission peaking by the year 2030, in addition to a target on how much fossil energy should be in the primary energy mix. This is looking to be about 20%, although it's not exactly clear to me what kind of metric will be used (e.g. final or primary energy).

Of course some important things we know already, and some big emitters are already there. I'm going to focus on the things that we more or less know a little bit about with the caveat that things will probably change over time. With regard to integrated assessment models, I'm going to focus on one example, where six models participated, and we looked at two different pledge scenarios under different cooperative scenarios, and also three different bargain sharing schemes, including a tax, a per capita convergence and equal costs, like the one Robert described, which is basically what allocation would equalize mitigation costs across countries.

I'll focus also a little bit on the results for the IPCC Working Group III, which has put forward a big database with almost 1,000 scenarios. Now some of these databases are part of each other, but some of these databases are publicly available. So if you're interested in playing with numbers and calibrating some of the formal theories of some of the models through these large modeling examples, there's a wealth of data out there that has only been partially explored so far.

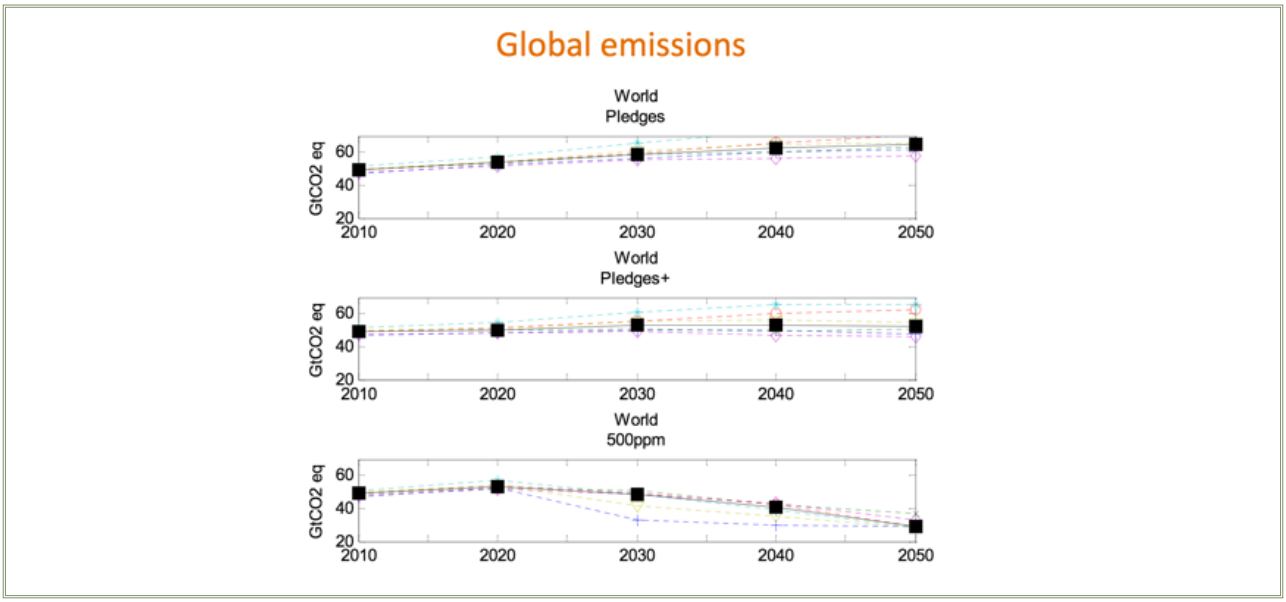
With that said, let's get into a little bit about numbers. This chart shows the mitigation efforts with respect to 2010 over time, between now and 2050, for three regions, which are Europe, North America, and China. For this scenario that we named "pledges plus" at the time, we extrapolated what were the pledges for 2020 forward, especially focusing on carbon-intensive targets for China and commitments for emission reductions in Europe and North America.



It turned out that those pledges plus were relatively accurate in terms of what the INDCs look like. So Europe, for example, in 2030 you're talking about emission reduction with respect to 2010, which is slightly below 40% — about 35%. This is not far off from whatever Europe has discussed and then increasing over time. For the US, about 25% over 2010, so more or less in the same ballpark, although the official reference point for the US is 2005. It turned out also that China, extrapolating what we thought could be reasonable for the 2020 carbon intensity target of China forward in time actually led to a peak in emissions, which is indeed around 2030. So again, you can see differences across models here because the carbon intensity target depends very much on what's the assumption about economic growth.

But across models, the peak is often around 2030. Now the question obviously is at what level will emissions in China peak. Again, the scale is reversed because we see it's a reduction from 2010, meaning emissions are higher than today's level. But again as you see, some models have peaks, which are 50% above today's. And some models have emissions which are maybe 30% above today's. All are compatible with the peaking of CO2 emissions in 2030 and the gradual return to today's emissions maybe by mid-century. But the extent to which the peak will be, that obviously matters a lot for carbon prices and for cumulative emissions.

Now obviously you can build from the INDC upward and try to understand what are the global emissions implications of all the INDCs. This is a chart showing the world global emissions over time for two of these pledging scenarios, the "pledge" and "pledge plus" scenarios that I told you about.



Depending on the extent to which all countries, not just Europe, North America, and China, but most notably also key emitters such as Indonesia and Latin American countries and the Middle East and other countries, will actually participate in any agreement or will actually commit to different levels of INDCs, the total outcome will be different. We're talking about emissions which either maybe at best stabilize or slightly increase from today's 45 billion tons of CO2, maybe to as high as 50 billion tons of CO2 by 2030 with stabilization of emissions afterwards. If other countries do not commit to INDCs as stringent as we have, the ones that we designed in this "pledge plus" scenario, then emissions would keep rising and maybe exceed 60 billion tons of CO2 by mid-century.

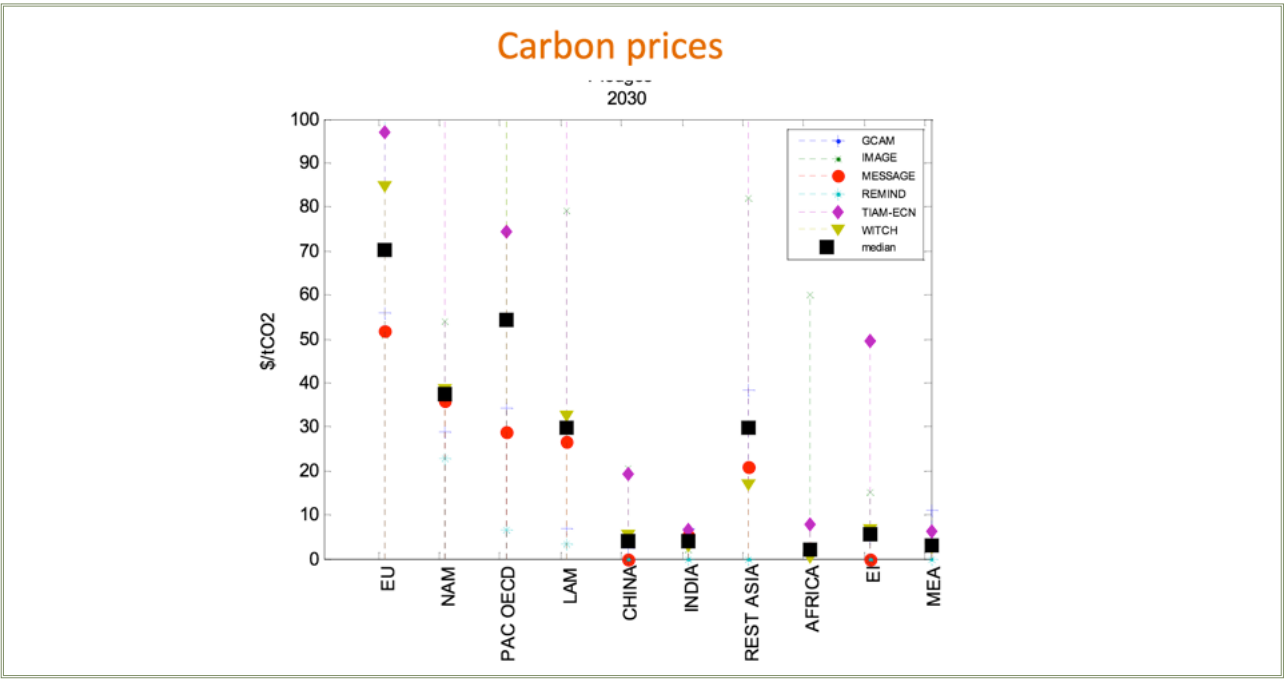
In all cases, this is different from what we were supposed to do or what we would need to do cooperatively if we were to stabilize concentrations. The lower panel shows the global emission profile over time for a target on concentrations, about 500 parts per million CO2 equivalent concentration. So we're talking about a policy that gives you 2 degrees with 50% chances.

With the world pledges, you get towards 600 parts per million, or towards the 600s or even a little bit more, depending on the pledges maybe 100 parts per million more. But that depends very much on what happens post 2050. But 2050 is a good horizon to focus on cumulative emissions. And if you do the same, the two start to diverge pretty rapidly already in 2030. And remember this is not even 450 parts per million. 450 parts per million will have a much more drastic reduction in global emissions. So I think this is no surprise. In a way, the pledges that we are seeing and that have been discussed do not have a level of emissions that one would need to have for each target, not 2 degrees but maybe not even 2.5 or 3 degrees.

This doesn't come as much of a surprise to me. In the short term, what you really see is that emissions would maybe pass this 50 billion tons of CO2, which is a little bit of a critical threshold for

being able to meet 2 degrees afterwards. They would essentially be not really compatible with 2 degrees. But that's part of the game, and that's, I think, the reason why we are here. We're trying to think about ways that will get us a little bit farther toward deep emission reductions than the INDCs would otherwise achieve alone.

Now obviously you get carbon prices from INDCs implemented without any harmonization. And this is a chart showing carbon prices in the year 2030 across ten regions. Again, focus on the median marker here because there's a lot of variation across IA models. This is just to say obviously these numbers depend very much on the target itself. Actually they are completely driven by the target itself. There's no trading whatsoever.



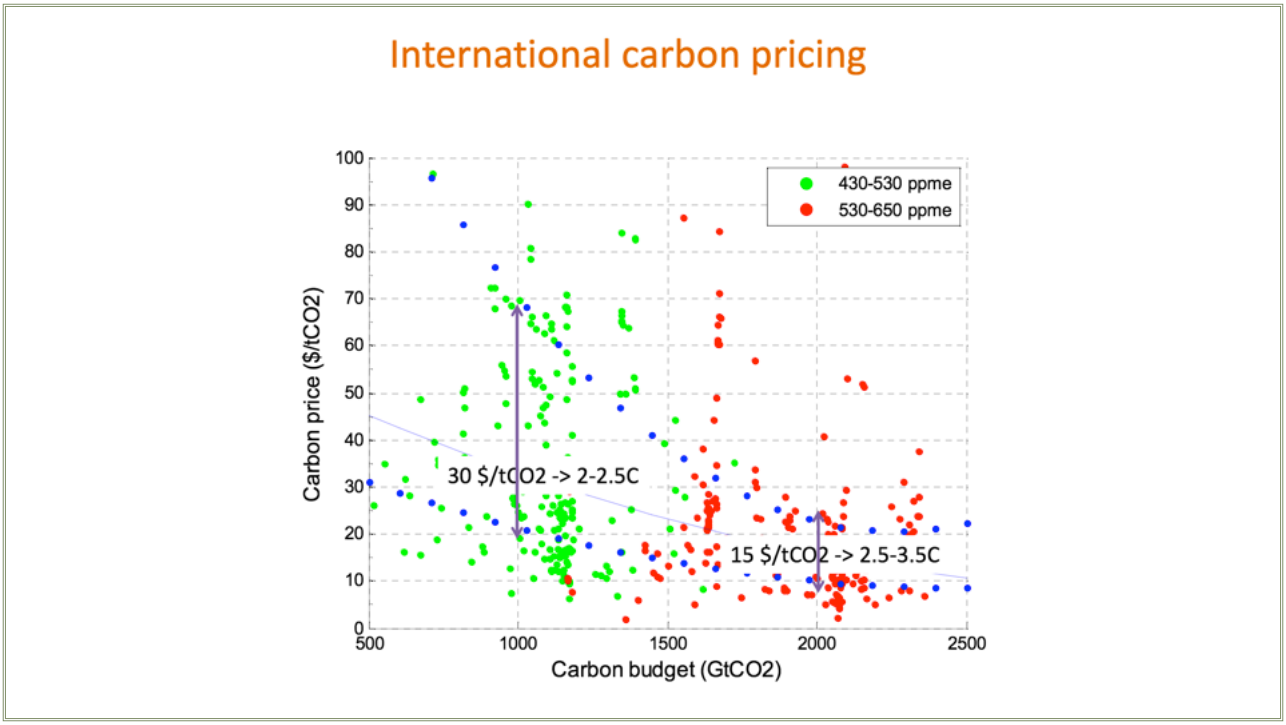
We see carbon prices higher in Europe and in North America, maybe between 40 and 70. Europe is a bit high, higher actually than what the Commission expects prices to be by the year 2030 with the target that they have put forward. And indeed that might be the case, especially given the very low emissions of Europe so far. We see carbon prices in China with the kind of target that led to a peak in 2030, which is greater than the Euro in the year 2030, but not so much different from the Euro — maybe a few dollars per ton of CO2. But again, that depends also on what kind of peak are we talking about. For some models, it could be as high as $20 per ton. It depends on where it will peak, not only on when it will peak.

In general though, you see a lot of different carbon prices. You will see other different carbon prices, generally speaking low carbon prices in most of the developing world. You have some exceptions here for the countries that have a lot of CO2 in the forest sinks, so Indonesia and Latin America, where we thought they could put forward some aggressive targets. You see a lot of inefficiency if you

want to go back to the argument about efficiency in terms of why the differentiated carbon prices, maybe on the order of several times one or the other.

So what's the alternative? And I guess the alternative is why not focus on one carbon price. Now the point though is what carbon price, at what level should we negotiate this? It could be an out and out negotiation, but it should also be grounded in science a bit more.

This is a chart showing some modeling from the IPCC. You see a lot of dots. Each dot is a model scenario. They're from several models; there are several scenarios. The same models run in more than one scenario.



On the X-axis, you see the carbon budget, which I think is a very important indicator. The carbon budget is cumulative emissions throughout the century, CO2 integrated over the century. Temperature is linear in carbon budgets. Climate science more or less is clear about this.

What you see is obviously that lower carbon budgets consistent with 2 or 2.5 degrees, 430 to 530 parts per million have higher carbon prices. Carbon prices here show a net present value carbon price, the price that you would have in 2020, and in international agreement after 2020, let's say in 2025, rising at 5% every year: so a price that would increase over time at the same rate, at 5% over time. It depends very much on what kind of policies we are thinking to implement. And if you're thinking about implementing policies, these green ones, which are about 2.5 degrees or so, then we're thinking maybe a net present value carbon price starting at $30 a ton of CO2, rising at 5% per year. And then

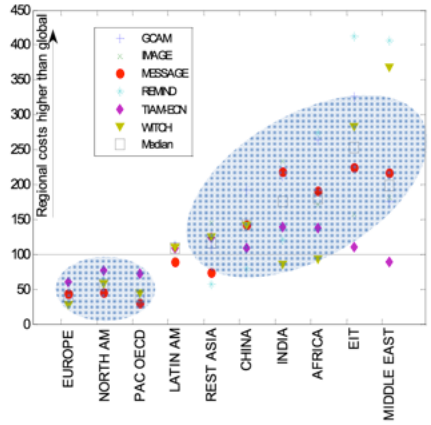
if you're thinking about targets that go throughout 3 degrees, or 3.5 degrees, then you deal with an initial price of $15 per ton of CO2 rising again over time.

Now there's a lot of uncertainty. I agree with Bill Nordhaus that we know mitigation more than we know the damages. But even in mitigation, there's huge uncertainty. The lines in the chart show the 25 to 75% percentiles fit, and you can see the ranges. The ranges increase the more stringent is the climate policy you're considering, just because the margin abatement cost curve is complex. So as a result, you have a bigger spread depending on assumptions, depending on the model, but also depending on whether the technologies will work to the extent that is foreseen.

These models are perturbed along many dimensions, including technology, with ranges between maybe 20 and 70, and for lower level emissions, actually this range is much more than 25. The price ranges between maybe $10 and $25 per ton of CO2. Still, there's a lot of uncertainty on what is actually the appropriate level of carbon pricing this would get you to, given a stabilization target. And obviously we talk about climate, so we need to connect a little bit more I think, even when we talk about prices. At least we need to know what are the consequences for temperature and climate.

Looking at the distribution of mitigation costs of input price, if we do price carbon equally, then what the models indicate is that some countries, and actually these are the wealthiest countries, would pay a lower cost than some other countries. This is the result of modeling emissions in terms of distribution of cost relative to the average across these ten regions. What you see below is that essentially we have a group of countries here that have relatively lower costs than average, specifically Europe, North America and Japan. Then you have a group of countries that actually have higher costs, especially energy-exporting countries, which are Russia and the Middle East, that have significantly higher cost than global average.

The distribution of mitigation costs under equal pricing



This is the ratio of country cost to the global average cost. Suppose that stabilizing at 2 degrees cost you globally 2% of GDP. If this ratio is 3, it means that this country pays 6% of GDP. If it's 50, it means that it pays 1% of GDP, so that's all in relative terms towards the global cost.

I had a discussion over email with Bill Nordhaus, and he encouraged me to look at the elasticity of income with respect to cost, using the original mitigation cost as percentage point of GDP lost by the policy, and the per capita income. As you can see in the table, it turns out that across models, these are the estimates of the elasticity across models. Policies for carbon pricing would be regressive.

Burden elasticity of income $\frac{\partial \ln(cost)}{\partial \ln(pc\ income)}$

Discount / Policy	5%	3%	0%
450 ppm eq	-0.48 (0.08)	-0.44 (0.09)	-0.34 (0.12)
500 ppm eq	-0.44 (0.13)	-0.36 (0.14)	-0.24 (0.15)

The extent of regressivity depends on the stringency of the policy, with more stringent policies being more regressive than less stringent policies. And also of course on the extent to which we discount future cost with lower discounting leading to lower regressivity. But in general, you see regressivity, which is non-trivial, for policies that are ambitious. Here I'm focusing on 450 to 500, which are pretty ambitious climate agreements with international carbon prices as we saw before on the order of $30 per ton of CO2 growing at 5%. For these kinds of policies, the regressivity effect would be significant.

And in the same project we looked at what would it take to make sure that that regressivity goes to zero. What kind of transfers or green funds should we establish to make sure that these numbers are zero? And the numbers that come out are relatively large, so we're talking about relatively big transfers. We're talking about transfers maybe on the order of less than other schemes, but on the order up to 100 billion USD per year by the year 2030. So it's relatively big. Of course, it depends on the carbon price. 450 parts per million has a higher carbon price, so the transfer would be bigger. Lower emissions would have lower transfers. But it's not easy to devise.

Discussion

William Nordhaus

I'll first turn to the panel and ask if they have any reactions to what they heard.

Robert Schmidt

On the issue of leakage, I think there was some confusion about my proposal. I'm not sure, but I think the issue of leakage, it's very much the same whether you apply the carbon tax more upstream or more downstream. I don't think that my proposal makes any difference in terms of carbon leakage and the necessity for border tax adjustments when there are some countries that are not going along and not implementing the carbon price.

Massimo Tavoni

Maybe going back to Marty's point, if you care about this regressivity, and we think this is serious enough, and you were suggesting that you would need to have a green fund that would essentially lead to two focal points, meaning for example a carbon price together with either some transfers of some sort of financial or technology-related transfer, would that be a big case against carbon pricing?

Martin Weitzman

I'm not sure. I really am not. It would've been nice to see a side-by-side comparison of the domestic cost increase under uniform carbon price versus the transfers that are involved. I did some back-of-the-envelope calculations that seem to show that the transfers were much bigger under cap and trade. I don't know what to answer to the point you're raising. It is disquieting that it's regressive, of course, so there would be some transfers. In theory, that could unscramble all the N dimensional versus one dimensional. But I do somehow have the feeling that there's still an N dimensional argument stuck in one more layer of the cap and trade than there is in the layer of uniform price.

Massimo Tavoni

Just to clarify why is it regressive? It's two things. Mostly it's carbon intensity in business-as-usual, so developing or lower income countries tend to have high carbon intensity to begin with. But also, a lot of regressivity is driven by the energy exporting countries who would lose big revenue. So now if you think about an international pricing that would not include the energy exporters, then one would need to re-compute the regressivity without that subset of countries, and that probably is much lower.

William Nordhaus

I'll just comment on that graph also. Massimo and I have talked about this before. One point is that it excludes damages. So in a way it excludes the whole reason we're doing this. And most people think that damages are regressive. But I think you've actually done some calculations in the modeling that mitigates some of the regressivity, but not all of it. The other point, which I actually hadn't appreciated until today, is that these carbon taxes are growing very rapidly. They're probably growing faster than the economies.

So you have to fold the discount rate into that as well. But it might be that what you're capturing is regressivity which is way in the future. And it's a pretty calculated computation. I just know that in some of the stuff that I've done, I didn't get the same results. I think it's a complicated calculation, particularly because of the dynamics. Let's open it up to questions from the floor. Glibert, you were first.

Gilbert Metcalf

These are great presentations to start us out. I had a couple of minor questions/comments for Robert. On this issue of immutability, I think that breaks down with natural gas if you have methane leakage along the way. But you could address that with a deposit refund system. So for example, if you're collecting a carbon tax at the wellhead for natural gas, but then putting in a leaky pipe so the methane is coming out, which has a higher global warming potential, that's a problem. But I think a deposit refund system would address that.

But I think the immutability is an important point, about the flexibility of where you put a carbon tax. The point that Bill raised for you about how are you handling where the tax is levied, I think this issue of whether it's a destination, a production basis versus consumption basis of a tax. The carbon tax in the country where the carbon comes out of the ground versus where it's consumed does make a difference in terms of who gets the revenue, so I think that's worth thinking about.

And for Marty, particularly in terms of some of the results from Massimo's presentation, why do we think a single price will be a focal point? Why wouldn't we think that the negotiations could devolve to end prices, particularly when side payments are introduced? We already know that climate negotiators are negotiating over lots of things. We're negotiating over adaptation, finance, mitigation, technology transfer. So that just concerns me that whether we're making it too simple to think that we can really get this to focus on one thing.

Robert Schmidt

Let me comment on that issue about upstream versus downstream taxation and the revenues. If you think about an idealized system where you compare my proposal to tax the extraction and import of carbon-containing fuels, if you compare that with an idealized system where you can tax all the CO2 emissions at the end, I don't think it makes a big difference in terms of revenues. I think, if I'm not mistaken, it should be the same. So if you're able to catch all the CO2 emissions at the end, it shouldn't make any difference.

In terms of revenue, I also think it doesn't make a difference. If you tax the extraction in your country, and you tax the import of carbon as compared to a system where you tax the emissions, that should also be the same. I want to think about it some more, but on the first shot I would say that it doesn't make a big difference. I think the question is then what to do with the revenues. That's an obvious question which is independent of whether you tax upstream or downstream. There are many things that could be said about keeping it revenue-neutral. Lowering other taxes is something that makes it easier for voters to accept the system, so that could be one obvious suggestion.

Martin Weitzman

To Gilbert Metcalf's central question, why is a single price a focal point when you think of side payments being involved, I don't have a good answer. I think Dale made some good points that this is an internally charged tax or price, so in principle, it could even be beneficial if it offsets other very distortionary taxes. But I think the point of departure would be that it's neutral in and of itself. What it does is really an internal transfer. And this does fit in quite well with the story that Bill wants to tell, that if you had a climate club, they've already got some sort of sharing of interest to get together on this. And maybe it's not so much of an extension to think of them getting together on one price.

Dale Jorgenson

I'd like to emphasize a point that Marty essentially added as kind of a throwaway, which is that a central part of his analysis is the idea that with a carbon tax, the countries would determine what the proceeds would buy. I think that's a very key idea, because that can be used to reduce the cost essentially to zero for many of the leading countries — the US, China, and India, for example, which account for about half of the total emissions. And therefore there are no side payments involved.

The second implication, though, is that with no side payments, you can simplify a story about clubs, which Bill is going to enlighten us about, as he did in his presidential address to the American Economic Association, to essentially a uniform price for the members of the club, and a border tax that would be imposed on non-members. And since that would be one-dimensional, you would have basically a two-dimensional story instead of a two-by-N-dimensional story. So it seems to me, Marty, if you incorporate a club story in your analysis, then you tip the scales very markedly in favor of a carbon tax, much more so than you suggested.

Richard Cooper

I have a question for Mr. Tavoni, which picks up on Dale's first point, and a general observation. The question goes to the chart that showed the costs. I've worked a lot on China. I was surprised to see such a big cost in China. My specific question is what assumption did you make about the disposition of the revenues from the tax? Because as Dale points out in his work and other work shows, how the revenues are used is critical in assessing the social costs of this. You can actually construct scenarios in which an appropriate use of the revenues actually makes the cost negative. But you made some assumption, and it would be interesting for you to tell us what assumptions you made about the use of the revenues.

My observation has to do with the international system as a whole. This conference is focused on one dimension, which is climate change. But there are many other dimensions of the international system. One in which I'm especially interested is the trading system. I'll just stipulate and involve a whole separate set of arguments that the trading system we've had has been a tremendous benefit to the world over the last half century. I assume that will continue to some extent, and therefore how and what we do in the name of climate change influences other parts of the system, are entirely relevant for policymakers.

Concretely, the difference in carbon charges, or carbon prices, whatever you want to call them, across countries, is going to raise the issue of competitiveness. And here I make a political economy point. Countries — many important countries — are not going to be willing to tolerate imperfect competitiveness arising from different climate change regimes and different implicit prices. This seems to me a compelling argument for a uniform carbon charge across the world, because it neutralizes completely the argument about competitiveness, which I think in the real world is actually going to be an extremely important argument if in fact carbon prices differ from country to country. My main point is that we need to look at a wider agenda than just climate change.

Massimo Tavoni

I think I mentioned here that the recycling was just through a lump sum. We made no assumption about changing other distortional, or reducing other kinds of taxation, for the class of models that, for simplicity, were involved here. It would make a tremendous difference had we done so, and indeed there were other model comparison studies that were actually focused on this. And there the results, you can get pretty much everything you want depending on how intelligently and smartly you can actually recycle the revenues. But it seems to me this is a bigger political issue, so I understand that it does make a big difference, and it would make a difference across countries, not just for China.

William Nordhaus

I think that's important. We shouldn't forget how these revenues are used. It's particularly important in a carbon tax, less important where you give away the revenues in a cap and trade system, because in a way it doesn't make any difference there.

Gabrielle Marceau

I'm a lawyer, so I may be missing something from Robert's presentation, but if an amount of coal is extracted and taxed there, and then taxed again on importation by the importing country then there's double, you tax it twice. And if you don't, then you need border adjustment.

Robert Schmidt

No, the double taxation wouldn't happen. Of course if you import carbon from a county in the form of natural gas, which has already levied a tax, say on extraction for instance, then you would only tax the difference. Ideally if that other country which has extracted the carbon has already levied the same tax, you wouldn't add any tax at all. You would just take the difference. Border tax adjust-

ment for me is more on the product side. If you import final goods, then you tax to the amount of embedded carbon emissions. Border tax adjustment I associate more with final products, or intermediate products. But raw materials like coal and natural gas, are those also border tax adjustments? I don't know.

Carolyn Fischer

Just as an observation I want to throw out for the session, I think especially what Marty raised in his talk, these are very intriguing ideas, being able to focus on a smaller set of things to negotiate over. And a carbon price would be, economically speaking, a great one. But you also mentioned within the cap, you're arguing for a rules-based negotiation approach. We could do the same thing with cap and trade.

But the problem is we have to agree on what the rule is, and we haven't been able to do that. What is an appropriate allocation of effort? Is it per capita; is it historical? In the international framework, we have not been able to agree upon that. I think there are complexities that we haven't been raising in this framework. One thing that could come out of the framework that is evolving is this opportunity for a collection of countries, a club of countries, afterwards to mutually negotiate what their commitments are going to be. And that could be a carbon price.

But I would like to hear from some of our political experts too. Fundamentally it will come down to will the US be able to ratify a treaty mandating a minimum carbon tax? The institutions involved and who is going to have to implement this policy is a pretty important complication that we should think about.

I also have a question a little more specific for Robert because you raised this interesting aspect of another option of effort in terms of the contribution to global public goods in terms of low carbon technology. Maybe you could explain a little bit more how that works and how that would be measured, that you're contributing to the global public good and not just committing to using a lot of low carbon technology deployment as your measure of effort, because that is a lot more expensive than using cost-effective carbon pricing.

Eric Toder

I'm going to assume that a carbon price, a uniform carbon price as you proposed, can be established. And I have just a couple of simple questions about tax incidents that haven't been answered even though Gilbert asked one of them. When countries have different profiles of consumption and production, a tax like this inevitably is going to redistribute income among countries. And how it does that depends on who gets to keep the revenues — that is, whether it's an origin-based or a destination-based tax, which is going to determine who collects the revenues, and therefore who can recycle it within their countries. The second thing it's going to depend on is whether you think this is going to raise the price of carbon to consumers or lower it to producing nations, and how much of

each. I would like to know what the assumptions are that are behind the distribution assertions and conclusions that have been reached, and how we should think about this.

Massimo Tavoni

I hope we're going to have sessions through the next couple of days to think more carefully about these issues of transfers and equity and actually they depend to what extent they would be implemented, what you're going to do with the revenues, and what other areas they're coming from. I think that the biggest thing there is mostly a political issue. You can do a lot with models, and you can actually turn our results upwards and get completely different results by just simply changing the recycling of the revenues, thus with little information for policy. That's my concern.

Robert Schmidt

I have two comments here. One is historically if you look at the negotiations, the focal point has always been emissions. This country should emit that much, and that country should emit that much — basically forcing countries to a certain limit on emissions, which can be quite restrictive and quite dangerous in terms of economic costs and risks. The proposal that we are discussing right now exchanges the quantities by the prices; but otherwise it's kind of similar, forcing every country to a single tool, like in that case not a quantity but then a price. I feel kind of uneasy about that.

If you have a club of countries that are willing to act here and to move forward, I don't know if it's really such a good idea to force countries into a single tool or instrument or target. Why not allow a country which says okay, domestically it's impossible for us to implement a carbon price, but we could do other things. We could invest in low carbon technologies. Why not allow for that diversity? Why not allow for more flexibility? And then compare more on the efforts, like more on the cost side and say okay, that effort, even though it looks quite different, it's comparable to this effort.

This is basically where I'm coming from, and it leads me also to the other question that I wanted to answer. How does it work with the low carbon technologies, how can you make that comparable? If a country like Germany has a feed-in tariff system, you can estimate the amounts of the economic costs involved in that feed-in tariff system. And just make that part of the total contribution of the country, not just plain mitigation costs, but also including the efforts that Germany or other countries have invested in that dimension.

Martin Weitzman

I had comments more directed toward Robert than the audience. First of all, this idea of introducing more flexibility — flexibility is a two-edged sword. You have some good aspects of it because countries that wouldn't otherwise join or cooperate then can get some tailored special plan for themselves. But you're opening up this can of multiple negotiations without a focal point. So it cuts both ways, and I'm tending to think that you really want this thing pretty streamlined on a focal point, admittedly maybe something subjective.

The other thing is about tax incidents. Whatever plan emerges, somehow the people of the world have to be sold on it. The idea that the polluter pays is a strong psychological argument that you're labeling these countries who are big users of carbon, you're naming them as the polluters, which indeed they are. They are the ones who have somehow to internally readjust. I also worry that if you tax carbon at the source, countries like Australia or Saudi Arabia are going to have a tremendous amount of internal adjustment to make. And somehow it doesn't look very symmetric or feel very symmetric.

William Nordhaus

I would say we've learned a lot this morning, both about the modeling aspects and some pretty impressive theory and different approaches. One key point I'd like to emphasize is that if we're going to do something that makes a difference, a 2-degree or even a 3-degree target, most countries won't want to do it. Most countries will not want to take the necessary actions. They're not going to want to do it on their own because it's expensive, and most of the benefits accrue outside the country.

And that's a key point to build in, because what it means is you need something that is agreed upon in the negotiations. First it has to be clean, it has to be simple, it has to be easy to verify. It has to be easy to measure. You've got to put together those two things. The countries don't want to do it, and therefore you're going to have to have something that's easy to measure and easy to define and easy to negotiate on, and hard to wiggle out of. I think a carbon tax meets that, but I think it requires a little more thought, and I found some pretty convincing discussion on that today.

Global Harmonized Carbon Pricing: Looking Beyond Paris

Yale Center for the Study of Globalization, International Conference, May 27 and 28, 2015

Session Two:

The national interest argument for pricing carbon

Presentations and Discussion

PARTICIPANTS

Dale Jorgenson, Zhongxiang Zhang, Thomas Sterner, Gilbert Metcalf, Adele Morris

MODERATOR

Ernesto Zedillo

Session Two — The national interest argument for pricing carbon

Beyond the global public good dimension, in this part, the argument for carbon pricing will be made for reasons of strict national interest (for each of the key players) such as economic growth, fiscal consolidation, and tax efficiency.

Presentations

Ernesto Zedillo

The title for this session is *The National Interest Argument for Pricing Carbon*. What we are trying to explore here, and this I think is particularly focused on some specific countries or geographical areas, is the question of whether, before we go into the global public good dimension of climate change mitigation, there is a case to be made either on economic growth, fiscal consolidation, and/or tax efficiency for choosing carbon taxes rather than other instruments. This is of course important in terms of our objective if we find some common ground between the national interest argument and the global public good argument. So I would suggest that we be very attentive to this kind of consideration. Let me start by asking Dale Jorgenson to begin with his presentation. I will follow Bill Nordhaus's approach, calling one presenter after the other and only at the end will we put them all together.

Dale Jorgenson

Welcome back. I would like to address a point that we have already begun to debate, which is what is the burden of the kind of carbon tax that might emerge from some kind of international agreement? Later on we're going to put this into the framework that Bill Nordhaus has developed. I alluded to this briefly before, which is the idea of a club in which there will be participants who will share a common price for carbon. And then there will be non-participants who will not price carbon for various reasons and will have to pay a penalty. And that penalty will be, to make it simple, a border tax, which would be uniform across commodities and across countries. So that would be the two-dimensional negotiation that would evolve out of Marty Weitzman's argument.

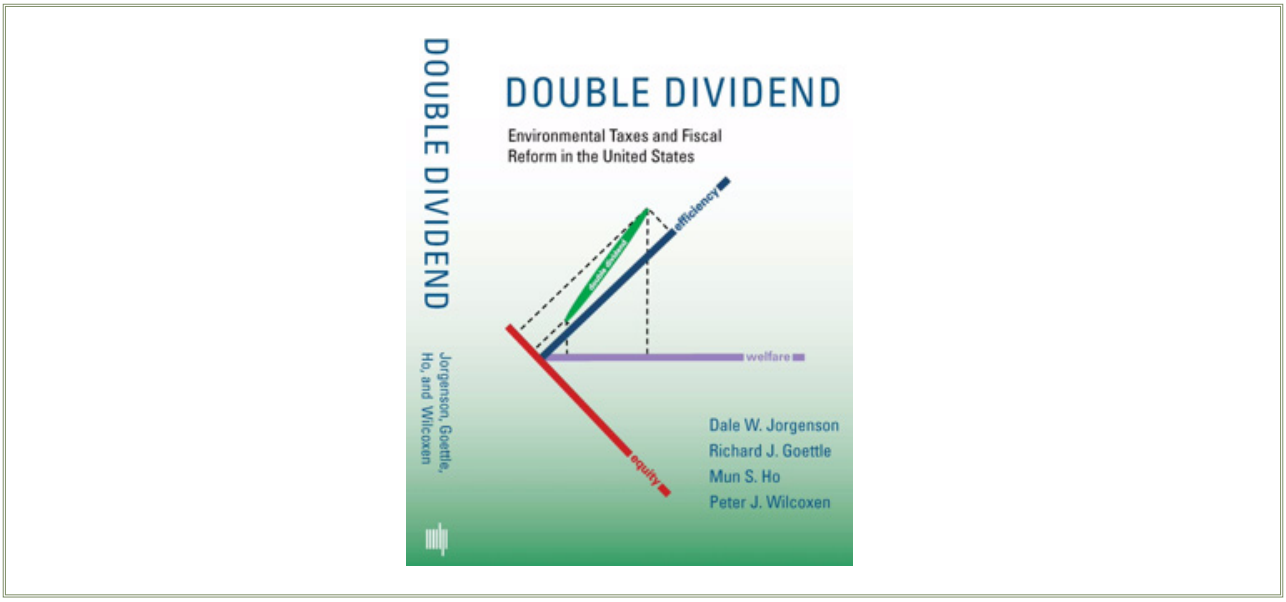
Now we have to confront the point that Marty raised, which is what is the consequence of considering the revenue that is raised? And obeying the rule that he proposed, which is that each country would dispose of the revenue itself. That's an alternative to some kind of system of transfers, which

as we have already debated, could turn out to be a very complex thing to try to negotiate. So what I'd like to do is to consider the consequences of a uniform tax that would be levied on members of the club, and I'm going to consider the example of the U.S. as a member of the club and allude also to China and to India. For all three, there is a double dividend.

This is an old idea in environmental economics. The basic idea is that you can achieve environmental goals by selecting instruments appropriately while yielding a second dividend, which would be an actual reduction in economic cost, not an increase. So the idea that there's going to be some kind of a burden is then set aside in favor of the idea that participants in the club will include those for whom the costs are either low or negative. And that will include these major polluters, the US, China and India.

Now of course that's an empirical matter, whether or not you can achieve a double dividend. So I'm going to illustrate the case of the U.S. and draw on a book that I published with Richard Goettle, Mun Ho, and Peter Wilcoxen through the MIT Press. If you go to my website at Harvard, you can get full details about the book and its contents. But for this purpose, I'm just going to concentrate on what I call the double dividend here. And I'm going to try to persuade you that this does exist for the U.S. But it's not simply a matter of any old thing. You have to design the instruments and the use of the revenue very carefully.

This diagram, which is from the cover of the book, illustrates the idea of the double dividends.



That's the cigar-shaped locus of different points on the efficiency equity plane. So the efficiency/equity plane has two coordinates. It has efficiency in blue, and it has equity in red. And what this shows is that welfare, which is the simple arithmetic sum of the two, can be increased by an appropriate choice of environmental taxes, namely a uniform carbon tax and appropriate use of the revenue. And I'll describe exactly how that has to be done.

I'm also going to illustrate a number of cases where you can combine an environmental tax with uses of the revenue that will not produce a double dividend. So this is the favorable case, and what it shows is that welfare, which is the objective here, increases. But that efficiency is the main reason for that because there is a slight negative offset of loss of equity, or regressivity of the tax system. Well that's my theme, and so this illustrates the idea of the double dividend. Now to calculate this for any particular country is a challenging objective. We have lots of climate models. We have world climate models, we have country climate models, we have combinations of models and so on.

But none of them meet the requisite that they include not only a discussion of environmental taxes, but also the entire fiscal system, along with a whole economy. And in this case, we have developed a model of the U.S. that essentially projects future economic growth over the indefinite history going forward and does that with a multiplicity of consumers, and a multiplicity of producers which is necessary to capture the effects of the taxes. But all of this is linked by a price system that is incorporating the entire tax structure at the state and local, as well as the federal level in the U.S. So you can imagine what would be involved in constructing models like that for individual countries. But that is obviously what's going to be required to implement an idea like this.

So how do we evaluate policies? This is Economics 101, as we say. We look at a base case, which is future US economic growth in this example. And we look at an alternative with an alternative tax system. That alternative tax system has a uniform carbon price. But the carbon price is something that starts in 2016 and rises at 5% a year until 2050 and then is flat forever, assuming that there's going to be another negotiation for what the future path should be at some point. So that's the idea of a tax, and I'm going to label the different rates of the tax as essentially the levels in 2020, after the tax has been enforced for approximately five years. Then I'm going to compare the base case with alternative cases where we levy the tax and then dispose of the revenue in a specific way. What I hope to convince you is that it is possible for the US to have a double dividend.

So this is the standard story. Remember that global models, unlike a model for a single country, have to focus a lot of attention on benefits and therefore Bill's work, the work of the Stern report and so on spends a lot of time on benefits. That's very important. This focuses only on the cost, because the benefits for a single country are relatively modest. So I'm going to focus only on the cost. However,

if the country involved, in this case, the U.S., is part of an international agreement, then it would receive the benefits that would be associated with forming and belonging to the club.

Now the question is whether it's possible to use the revenues in such a way as to improve economic performance and achieve a double dividend. This slide shows how we define social welfare. Let me just interpret this for you briefly.

SOCIAL WELFARE

Social Welfare Function:

$$W(u,x) = \ln \bar{V} - \gamma(x)\left[\frac{\sum_{k=1}^{K} m_0(p,A_k)|\ln V_k - \ln \bar{V}|^{-\rho}}{\sum_{k=1}^{K} m_0(p,A_k)}\right]^{-1/\rho}$$

Utilitarian Case:

$$\ln \bar{V} = \frac{\sum_{k=1}^{K} m_0(p,A_k)\ln V_k}{\sum_{k=1}^{K} m_0(p,A_k)} = \ln p'\left(\alpha_p + \frac{1}{2}B_{pp}\ln p\right) - D(p)\frac{\sum_{k=1}^{K} m_0(p,A_k)\ln\frac{M_k}{m_0(p,A_k)}}{\sum_{k=1}^{K} m_0(p,A_k)}.$$

Egalitarian Case:

$$\gamma(x) = \left\{\frac{\sum_{k=1}^{J} m_0(p,A_k)}{\sum_{k=1}^{K} m_0(p,A_k)}\left[1 + \left[\frac{\sum_{k=1}^{J} m_0(p,A_k)}{m_0(p,A_k)}\right]^{-(\rho+1)}\right]\right\}^{1/\rho}$$

where:

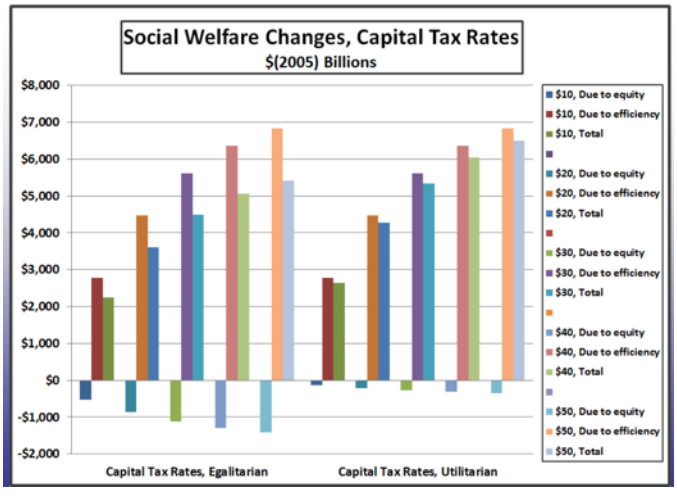
$$m_0(p,A_j) = \min_k\ m_0(p,A_k),\ (k = 1,2,\ldots,K)\ .$$

Social Expenditure Function:

$$\ln M(p,W) = \frac{1}{D(p)}\left[\ln p'\left(\alpha_p + \frac{1}{2}B_{pp}\ln p\right) - W\right] + \ln[\sum_{k=1}^{K} m_0(p,A_k)].$$

The social welfare function obviously depends on the welfare of individual consumers, so you have to weight the individual consumers' K by appropriate weights and get a social welfare function W. I'm going to consider the case where only mean individual welfare matters. That's the utilitarian case. But I'll also show you the results of a more egalitarian view. And then I'll translate everything into monetary terms so that we can talk about it in terms of dollars.

So here is an example of double dividend.



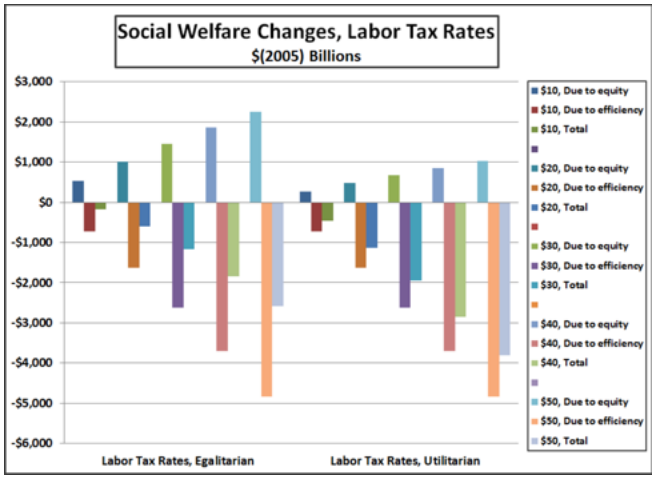
We're looking at the difference here between the base case, which is no tax change, no carbon tax, no participation tax in any international agreement, and a case in which the US joins a club that agrees on a uniform tax. So the taxes here that I consider are 10, 20, 30, 40, and $50 in 2020. You can focus attention if you like on the $40 case, which is going to come up later. That is a case that Bill talks about a lot in his new book on climate and also is the EPA's estimate of the social cost of carbon in the U.S.

So we could focus on the $40 case. And let's focus on the utilitarian case first. We can look at here on the right hand side the utilitarian case for different tax rates. This is the $40 case. And here is the interpretation of the color scheme. And equity is represented in blue. Efficiency is represented in orange, and welfare is represented in green. So this is the criterion here. And you can see that as the tax increases, welfare increases. So this is not the optimal rate, so to speak. But it indicates how large is the gain. Now that gain consists of two parts. It consists of efficiency, which you can think of as the discounted value of GDP forever. And that's offset against the loss in equity, which is associated with redistribution under the tax regime.

The tax regime consists of imposing a carbon tax at $40, again increasing at 5% a year, and offsetting that by reducing capital taxes. This is the point at which it's necessary to define what a capital tax is. So I want to assure you that this is a very comprehensive definition. It's not a corporate tax; it's not a capital gains tax alone. It's all the taxes that are levied on capital, including property taxes, income taxes, capital gains taxes, all the rest. And so we reduce all those taxes in proportion. And we find that there is a double dividend. Efficiency increases by more than the value of the double dividend. And that has to be offset against equity. How large is the gain? Well the gain here, if we trace it for the entire future of the US economy, is $6,000 billion of 2005, $6 trillion. Now that's not large by comparison with GDP, but it's a pretty good-sized number for any economic policy. So this is a very, very sizeable gain.

Okay, that's our basic story of the double dividend. What we have done is to increase the efficiency of the economy, in other words raise economic performance, at a modest cost in terms of a loss in equity, and the gain in welfare is sufficient to produce a double dividend. What's a double dividend again? It's the improvement in economic performance plus the benefits to the US and the world from belonging to a club that levies a tax, reduces carbon emissions, and increases welfare.

All right, well that's the success story. Now the next question is what happens if we choose some other way of using the money. We consider a variety of different possibilities in the book. But here what we're going to do is take all labor taxes and offset the revenues for let's say the $40 case by reducing labor taxes. What happens? Now you can see that welfare decreases.



You have a very sizeable burden in this case. We conclude that there is in fact a double dividend, and that it means that it is possible to reduce the cost of imposing a carbon tax to zero, or actually to have a gain in economic performance.

How does this idea apply to some of the other major participants? For example, how it would apply to China? China has a revenue system that is different. But it has another very important feature that makes this double dividend idea work. And again, I've published another book on this subject that I'm not going to have time to give you more details about. That secondary benefit turns out to be again something people are very familiar with. And that is that the air in China is very dirty. It's not the only country for which there is dirty air. And they have done very little to ameliorate that. I don't mean they've done nothing. But they certainly have great opportunities.

It turns out a carbon tax cleans up the air. Why? Because it reduces the use of coal, which is the source of 80% of the energy used in China. Coal is very dirty, and it's something that has widespread costs in terms of mortality and morbidity and so on. Same argument applies to India. I haven't written a book about that, but I have two Ph.D. theses where this has been shown. India is in essentially a similar situation at a lower level of economic performance. And so for all three countries that make up half of all the emissions of greenhouse gases in the world, there is the possibility of a double dividend.

So what we need to do, according to this logic, is begin to focus on the centrality of Marty's point about allowing the individual countries who are participating in an international agreement decide what to do with the revenues. The point that we have to add in order to capture the very important features that I've emphasized here for China and for India, they're quite different from the US, is that secondary benefits may turn out to have an enormous economic value in addition to the increase in economic performance that is due to appropriate use of the tax revenues.

The good news then is that it is possible to begin to think about a carbon tax of the sort that Ernesto has asked us to consider here as part of an international agreement, and we'll discuss this more tomorrow, in which there is a club of participants, take say the US, China, and India as the core of the club, accounting for 50% of the total emissions in the economy, in the world economy. And to induce them to participate in an international agreement by demonstrating to them that the cost to them is essentially zero.

Now the cost to the community of economists is not zero. Why is that? Because building one of these models is very difficult. It's one thing to build a model of the climate with a schematic version of the world economy. It's another thing to have enough detail so you can represent all the features that would be relevant in designing and implementing a carbon tax, which is something that we're going to be discussing in some detail. But that is the cost, and we not only have to look at essentially the equilibrium of the economy at a particular point. We have to look at the whole future history. Furthermore, in order to capture the heterogeneity that is characteristic of these different economies, we have to represent the technology of each economy as it actually exists. And that requires a very, very data-intensive modeling process. To capture the difference between efficiency and equity, we need a great deal of detail with regard to the impact on specific consumers. Again, this is very, very data-intensive.

So this is not a trivial transformation to begin to think through the implications of the double dividend. But I think that it's so central to the negotiation that might take place over a uniform carbon tax with a club kind of structure that I've described, that it should be the central focus of our economic analysis. Thank you very much.

Zhongxiang Zhang

First of all I would like to thank President Ernesto Zedillo for your invitation. It is really a great honor for me to join other distinguished colleagues here to speak at this event at Yale. I would also like to thank Haynie Wheeler for all of her kind arrangements to make things go smoothly.

I have spent half of my life in China and I never could imagine that any president would actually try to conquer this issue like Ernesto is trying to do here. It is a very complicated issue; Bill Nordhaus referred to it as a global public good earlier. It is an issue on which people like me have already spent 20 years. Many colleagues here have an even higher intellectual caliber and have worked on it even longer. The organizer asked me if a carbon price can make sense with regard to policy in China, and whether this harmonized carbon tax can be interesting for China.

If you ask whether this policy makes sense for China you have to first know why China turned to harness market forces. That is the first point in whether it makes sense for China as a public policy. Carbon pricing here may be narrowly defined. It may be called a harmonized carbon price, but actually it is a harmonized carbon tax.

Broadly speaking, when we talk about carbon price, it often refers to cap and trade and carbon taxation. From that point of view we will look at why we take this harmonized carbon tax, and then address the issue of whether China is interested in it. We'll look at some aspects that are appealing, and some aspects that are not appealing both from China and also from the climate mitigation and integration point of view. And because you are trying to push for a harmonized carbon tax, that means we have to compare what would be the alternative, like cap and trade, particularly looking at it from the case of China.

Why does China turn to market forces?

Let me start with why China turns to market forces. The biggest change that I can see is that by the end of 2010 the country reflected on what had been the accomplishments for achieving the energy efficiency targets for the eleventh five-year plan period that was from 2006 to 2010. Top officials realized that although the measures were effective they were not very efficient, because although they took administrative, some even irrational, measures like cutting electricity in hospitals and allowing manufacturers to only work three or four days per week, in the end they still missed the energy efficiency targets, and that China cannot continue to rely on costly administrative measures to honor its carbon intensity pledge in 2020 and to drive its future energy use and carbon emissions below the projected baseline levels to the extent possible. So they found they would have to look at more economic instruments, particularly given that the emission intensity and emission targets became more and more stringent over time.

The past three decades of economic reforms have witnessed a shift in control over resources and decision making to local governments. This devolution has placed environmental stewardship in the hands of local officials and polluting enterprises more concerned with economic growth and profits than the environment. The ability of and incentives for lower-level governments to effectively implement energy-saving and pollution-cutting policies are therefore critical. Learning from the lesson in the 11th five-year plan and confronted with increasing difficulty in further cutting energy and carbon intensities, going forward, you really had to find other means to deal with it in the context of government decentralization. So that is the reason they thought about these measures. In the meantime, the country also observed that environmental tax reforms and greenhouse gas emissions trading schemes in the OECD countries work.

Carbon pricing makes sense for China as a public policy

And so then if you turn to market forces, then the carbon pricing can be the one policy instrument, and there are a couple of arguments as to why it makes sense for China. One is you can complement existing energy-saving and pollution-cutting policies. Dale Jorgenson mentioned that because in China the energy mix is coal dominant, you want to cut carbon, and at the same time you also cut other pollutants like SO2. So altogether you can achieve an integrated collective benefit. Furthermore the government, particularly local governments, really do need the revenues, and for that reason it becomes more and more important to alleviate the financial burden to incentivize local governments not to keep their eye on economic growth alone.

When President Xi and Premier Li took office they held a very significant event that was called the Third Plenum of the 18th Central Committee of the Communist Party of China. At that Plenum in November 2013, one major decision that is particularly relevant to economics, and also relevant to the whole country, was to assign the market a decisive role in allocating resources. If you want the market to play a role, you have to get the energy price right from a whole value chain, from upstream, from resource allocation, to using energies and to disposition of the emissions, whether or not you go to a carbon tax or whether you go to emissions trading.

Another aspect of all this, which is well argued in Bill Nordhaus's paper, is that if you have this kind of harmonized carbon tax, the comparability of climate efforts (CCE) becomes more transparent and easier, and also reduces the legitimacy of the so-called carbon tariff.

And here I would like to note why it is important to define the comparability of climate efforts in China. China has repeatedly emphasized that it has taken many climate mitigation efforts. No country denies that, but at most China has received limited appreciation of its abatement efforts. Before China and the US agreed on emissions targets in November 2014, top officials from the US would come to China and say, "You're doing well, but it is easy to see that you still have to make even more efforts." So from that angle, I have always argued, since 2008, that defining the CCE is very important. If the comparability of climate efforts is defined, then the many abatement efforts that China has been making can be converted into the corresponding equivalent carbon allowance prices under the European Union and US proposed emissions trading schemes.

And there was some calculation to show that particularly in the years 2006–2008, when the economy was booming and China was trying to reduce exports of these energy-intensive products, China itself levied export tariffs of 10-15%. There was a calculation done by the Institute for Sustainable Development and International Relations (IDDRI) in Paris to show that these export tariffs which China levied on itself in 2006–2008 actually are equivalent to the quota price of 30–43 €/tCO2 for steel and 18–26 €/tCO2 for aluminium. So this is comparable to what was the European Union allowance price at that time. That means if the US wants to do a carbon tariff, forget about the WTO legitimatization for a while and just charge the difference. But if it is already higher than your allowance price then there is no reason for you to do that.

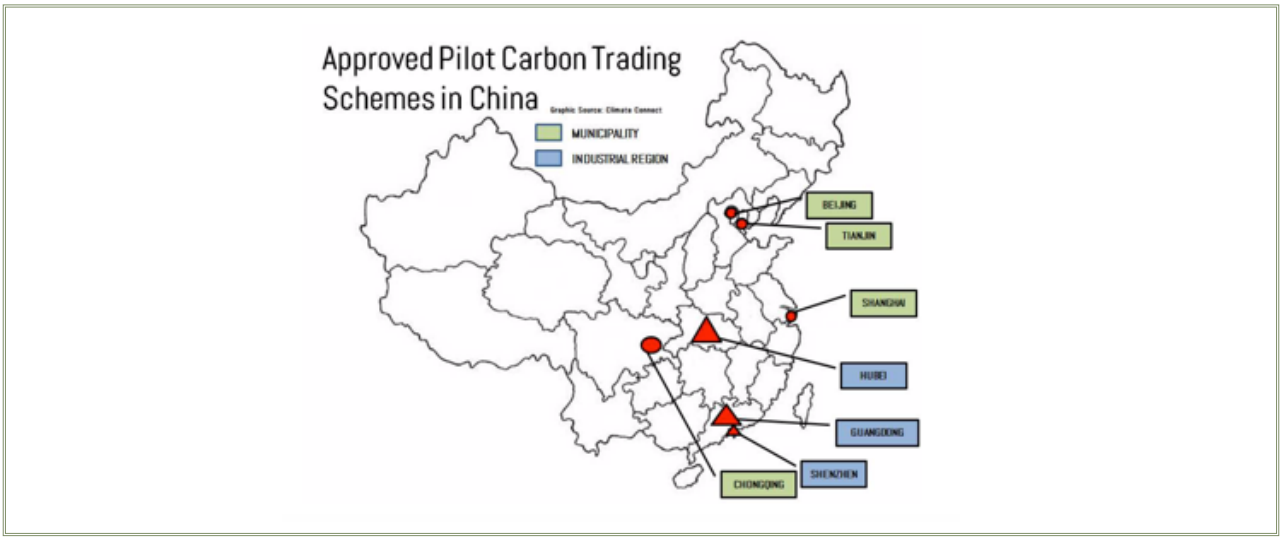
Carbon/environmental tax versus emissions trading

Now with regard to the domestic context, once China opts for a carbon price, the next question then is whether you go to environmental taxation or whether you go to carbon trading.

Of course, this is not only new for China – debates are happening in the US, and they happened in the EU and Australia, and in virtually all the countries. But China is a little bit unique in the sense that it had pilot carbon trading. You might not know why China chose carbon trading and not an environmental carbon tax. One major reason is that China has an environmental protection law that has been implemented since the middle of the 1980s. This law says that if a company's emissions are above certain levels, then this company is violating the laws unless it pays a penalty. And so certainly if you do that, you will be violating the current law unless you make a revision. Although many people still believe that the National People's Congress (Chinese legislature) acts as a rubber stamp, actually it has acted more and more like the US and other European parliaments and from a legislative point of view, it takes time to amend the existing environmental law and promulgate environmental tax law. And until it is completed, there is no legal basis to authorize the levy of these taxes. In the meantime, there is the pressing need to meet with the energy and emissions targets in a cost-effective way. I believe that a combination of these considerations motivates China to go for emissions trading. In late October 2011, the National Development and Reform Commission, China's top planning and economic policy agency, approved seven pilot carbon trading schemes first. But certainly environmental taxation and carbon trading are not substitutes. You need both to level the playing field.

Pilot carbon trading schemes

Here I will very briefly discuss seven pilot carbon trading programs that are taking place in China. The central government deliberately chose seven regions (Shenzhen, Shanghai, Beijing, Guangdong, Tianjin, Hubei, Chongqing) because they are very different in their level of economic development and also significantly different in terms of economic structures.



For example there are Beijing and Shanghai, where GDP is 70% extracted from services. There are some regions, like Hubei and Guangdong, which are still largely based on manufacturing. All the GDP levels of the seven are several times different. This is why the central government deliberately chose different regions at varying stages of development and allowed these regions considerable leeway to design their own schemes to find out how this kind of experiment could be carried out to enable implementation of a national carbon trading scheme quickly. These schemes have features in common, but vary considerably in their approach to issues such as the coverage of sectors, allocation of allowances, price uncertainty and market stabilization, potential market power of dominant players, use of offsets, and enforcement and compliance, just to mention few.

For the first compliance year, which started in 2013 and ended in June 2014, in five regions (Beijing, Guangdong, Shanghai, Shenzhen, Tianjin) you have high rates of compliance. All of us were surprised. The compliance rate was very, very high. Shanghai was 100% compliant; Beijing was 97% compliant in terms of the number of enterprises. The relatively low rate of compliance in Beijing is mainly because the Beijing pilot not only covers a large number of entities, but also these entities covered are very broad in scope. You know who are not compliant? Microsoft and Baidu, which are the multinational corporations; the ministries; universities like Peking and Tsinghua Universities; and the Chinese propaganda Xinhua news agency, all of which have non-compliance.

With regard to the kind of mechanism used in trying to stabilize the price, all seven carbon trading pilots have reserved a small portion of allowances for cost containment purposes. That means if the allowance price is too high, the government auctions these allowances and if it is too low, the government buys them. The difficult issue is how to set the triggering conditions; in other words, how to set aside an appropriate level of allowances for this cost containment purpose. So far only Beijing actually released the conditions under which to trigger the reserved allowances. Once it becomes a national regime, price uncertainty and market stabilization are expected to become even bigger issues. If the triggering price is set too low, it might be the case that the size of reserved allowances is not enough to meet the demand. This is because if one region gets into trouble when the triggering price is set too low, the reserved allowances might quickly be used up; and later on when other regions have problems, there might be no or insufficient reserved allowances anymore. If it is set too high, then it might not be able to achieve cost containment purposes. I strongly support a price corridor because it would be easy but effective against price uncertainty, introducing both a price ceiling and a price floor. Of course there are different ways to design what's a ceiling and what is a floor. But anyhow, if you set a price floor, then this harmonized carbon tax could be one alternative.

China needs a carbon/environmental tax

Even if China initially adopts the emissions trading system, it does still need a carbon/environmental tax for a number of reasons. Ernesto already mentioned that the emissions trading system does not cover all regions or all sectors and that you still need a tax to level the playing field. Also the auction is a very small percentage of the allocations. Among these pilot regions, Guangdong is the only region in which enterprises are required to buy 3% of the allocated allowances before they get the

remaining 97% for free. But for the rest of the regions, the allowances are free and I would argue that given the huge financial burden on the local governments, the environment tax would probably mitigate their concerns. Third, for those who follow China's financial and tax reforms, when Premier Zhu Rongji made significant reforms and had the so-called tax share reform that took place in 1993, revenue for the central government significantly increased from 22% in 1993 to 55% in 1994. But the central government's expenditures only increased 2%. The local government only accounted for about 25% of the total government revenue, but accounted for 75% of the total government expenditures. And that is the reason revenue became more important to the local governments; in particular, the easy option to sell the land became more and more exhausted.

Especially relevant to our discussion are a few points about incentivizing local governments in order to get their cooperation. Point one is about resource tax reforms. So far there are only seven resources taxed, so that means you need to broaden the coverage of resource taxation. It will also be necessary to change the way you tax, as it has been based on volume, not based on price. With regard to the environmental taxation, so far we don't have an environment tax, only an environmental charge/fees. The central government intends to replace this environmental fee and charge by an environmental tax. But 90% of the revenue for the environmental fee/charge goes to the local government. So that means that if you go to environmental taxation, at the beginning it might be charged at a level that could replace the current existing environmental charge, the majority of that revenue should be local in order to respect current distribution of the revenue between central and local governments.

Why a harmonized carbon tax approach?

So now let's move on to the wider harmonized carbon tax approach. Based on my observations, when it comes to international climate change negotiations, there are two approaches with which we are trying to break the Kyoto impasse. One is if negotiations continue along the Kyoto-style, quantity-based approach, the discussion should not be more or less focused on how everybody has a similar kind of commitment. Given the small number of major countries that contribute most of CO2 emissions, what matters most is the commitments of these key players. Therefore we should just focus on the big players because basically the top 20 countries generate 80% of emissions. So this is one approach. Another one is a harmonized carbon tax. Basically this approach considers the Kyoto-type approach that has failed to deliver, at least from a long-term point of view. Of course there are also some other discussions, such as that you can combine environmental with other international treaty issues and these become much more complex. But anyhow, these are the major two approaches that are very often discussed.

Now China and the US have already committed to emissions caps, and this raises the relevance issue of the harmonized carbon tax. Basically now you have larger parties that have already committed, so then the question is whether these commitments are acceptable/comparable by an international agreement. If a deal at COP21 in Paris, including the key players, could be reached, then the commitments could be interpreted as acceptable/comparable. So this is a tricky point challenging the

harmonized carbon tax approach. Of course even if the commitments are accepted by other parties, this does not necessarily mean that they will be socially optimal.

Is China interested in a harmonized carbon tax?

And let me say something about whether China is interested in a harmonized carbon tax. I like to look at this issue from three angles: appealing aspects, unappealing aspects, and compared with an alternative cap and trade. There are a number of appealing aspects. One appealing aspect is that it basically means you set a minimal charge that you allow individual countries to have. This kind of practice in China is already very common. China is actually using it as the approach in pollutant charges, differentiated power tariffs and also for ongoing nationwide ETS to be established. Basically the idea is to set the minimum and let other regions domestically do more if they feel the need.

The second point is that the revenues of a harmonized carbon tax will be domestically retained. This is a very appealing point. And another thing is the so-called pledge and review, which has also become very, very complex. A harmonized carbon tax (HCT) could simplify this, particularly if no international deal on emissions could be reached. HCT could be regarded as the comparable climate effort and removes or at least reduces the legitimacy of any proposed carbon tariffs. And another aspect is convergence of carbon pricing, at least in the short term. You do find that over time, at least from now on, the prices in key markets are getting closer than what they used to be. Of course, based on previous analysis, and for the longer term, it might be different.

We have been talking about the appealing aspects of a harmonized carbon tax, but there are also unappealing aspects. One is that if you want to achieve the climate goal, the harmonized carbon tax is not trivial in order to have mitigation effects. The question for China is, because the existing price is lower, that means the price in China will increase relatively faster. Combined with its coal- and carbon-intensive economy, that means the Chinese economy probably will be affected the most. Another argument is from differentiated responsibility: Why does China take on the same harmonized carbon tax given that major emitting developed countries have huge historical responsibilities.

The last angle is to compare with an alternative approach like cap and trade. In China, because now there are mounting public complaints against the present environmental pollutants, one way to get this under control is to cap the emission pollutants. This situation is very, very serious and from the short-term point of view, the cap approach is very appealing. Furthermore, if you look at the domestic institutions of some of the bigger players, tax levels are set by the national government; but firms, in particular large state-owned enterprises, have bargaining power in getting allowances under cap and trade. So they might prefer cap and trade because they have no say with regard to the national tax levels. But they have a lot to say under cap and trade on a regional basis and on a national basis. Firms also realize that if you have an emissions tax, environmental tax, or carbon tax, any unit of emissions is subject to those taxes, but only those units above the quotas are subject to taxes under cap and trade.

In theory, as long as China is a party to an international agreement, firms can engage in international carbon trading. So companies are very eager to do this and also financial institutions prefer to engage in international cap and trade, because they have more roles (for example, development of a variety of carbon derivatives) to play.

This is the general situation in China. It is a good thing that the country embraces these market instruments. Domestically speaking, carbon trading seemingly is doing well. On the other hand this system does not cover all regions and sectors. So an environmental tax certainly can play a role, particularly because the local government needs the revenue. Internationally, I would say it depends on whether the pledge and review process in international climate change negotiations can work. If that cannot work, a harmonized carbon tax and other options should be considered. Thank you.

Thomas Sterner

Thank you. Feeling somewhat like a mosquito coming in and speaking for Sweden after China. But I think we're all interested in principles, so even a small country can be interesting. I'll speak a little bit about the carbon tax in Sweden, then about whether or not I think the EU is likely to go the same way. And I'll speak about what I call sectorial carbon taxes. That is like gas taxes in the EU. And at the end, whether there could be any disadvantages in using taxes from the viewpoint of the national interest of some countries.

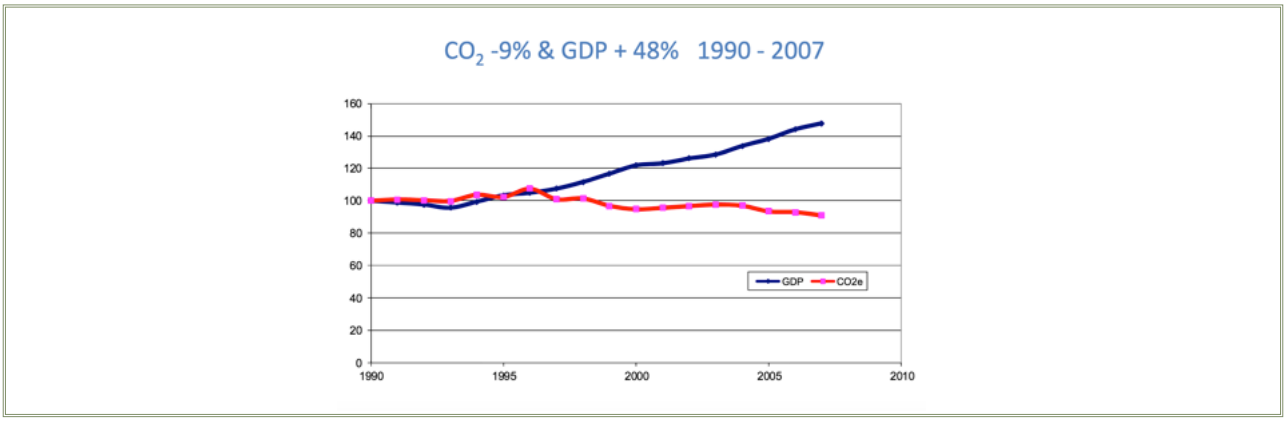
So it's kind of fun to represent Sweden here. The most important thing I'll tell you is that we have a carbon tax. I've been going around saying we have a carbon tax of $160. Now the US dollar has appreciated while the Swedish krona has fallen. So it's now more like $125. It's still important, and the most important message is that most Swedes are not so depressed that they can't get up in the morning. Most Swedes haven't noticed that there's a high carbon tax in Sweden. Life just goes on. Companies that produce cars or generators have not been very affected. The sectors that are affected are mainly transport, residential, commercial heating and some others. We hence don't use a lot of oil for heating houses anymore. We use wood, and we use other intelligent systems. I'll get to that in a moment.

There's an issue of context of course. We like taxes in Sweden; it's a strange place. But in the end of the 1980s we were getting uncomfortable. Marginal tax rates were getting, according to rumor, above 100%. And that got to be a little bit much, even for the Swedes. And there was a big tax reform to bring them down sizably. Wealth and inheritance taxes were abolished and property taxes were modified. The reform was broadened to include energy. A lot of changes happened. The carbon tax, even with the size of the Swedish carbon tax, was actually a relatively small detail in this whole shift. And there were some things inevitably that everybody liked and some things that a lot of people didn't like in this big tax reform. But it was a package. I think that's an important lesson.

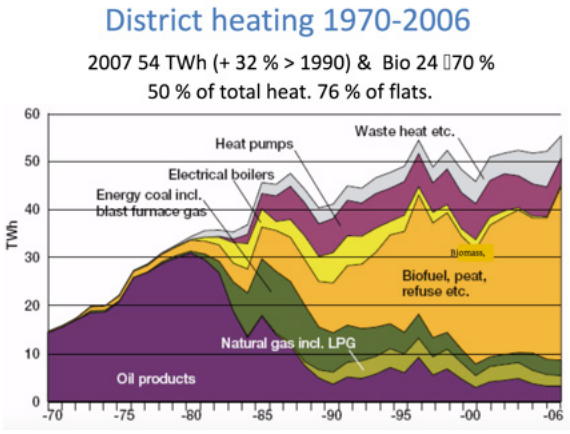
It is really a big tax. I just want to emphasize the number once more. I think, Bill [Nordhaus], you've calculated something like $17, or maybe you've got a bit above $20 as an optimum value. And [Nich-

olas] Stern was speaking of $20 to $50. And most permit prices are below that currently. When I was working at the Environmental Defense Fund (EDF), we built a tax model, and I had the privilege of going to Capitol Hill and talking to Senators and Congressmen. We had $5 or $10, and they thought that was high. France tried to pass $30, and then they tried to pass $17, and they failed both times. By now it seems that they sneaked the tax in as a temporary measure – but only by lowering other energy taxes that they had before.

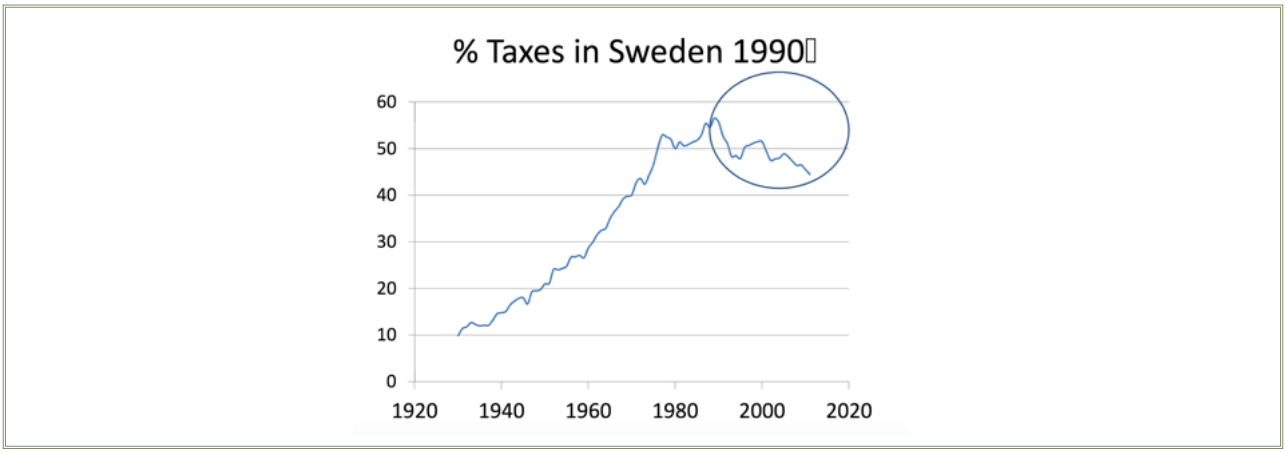
So in Sweden we have $125. So it's sort of interesting that this works. And of course it's had some effects. Swedish GDP goes up, and the carbon emissions don't go up very much. They go down slightly. Carbon emissions in other countries, the gray line there, go up. In Sweden, they've gone down.



One of the important parts of this is the heating system. It's a cold country. We do a lot of heating. And we do something called district heating, which is an inherently efficient way of heating things. We do this not only in cities, but in really small towns. You see the size of this system has gone from some 15 terawatt hours to 60–70. And it used to be fueled by oil. Today it's fueled mainly by wood and waste and heat pumps and a few other efficient things.



Now it's kind of obvious and a little embarrassing to say it, but the fact that one tax goes up doesn't mean the whole tax burden goes up. In fact, the total tax burden in Sweden has gone down over the last 20 years. Politically from the viewpoint of voters' opinions, that's important.



I think the general view is that the carbon tax has been necessary for the climate, efficient and easy to administer. It doesn't really damage the economy. Of course Sweden is tiny. It is the size of a village in China. And it's extremely open. We actually have some really big companies like Volvo, ABB, IKEA and a few others still. And trade is still more than 50% of GDP.

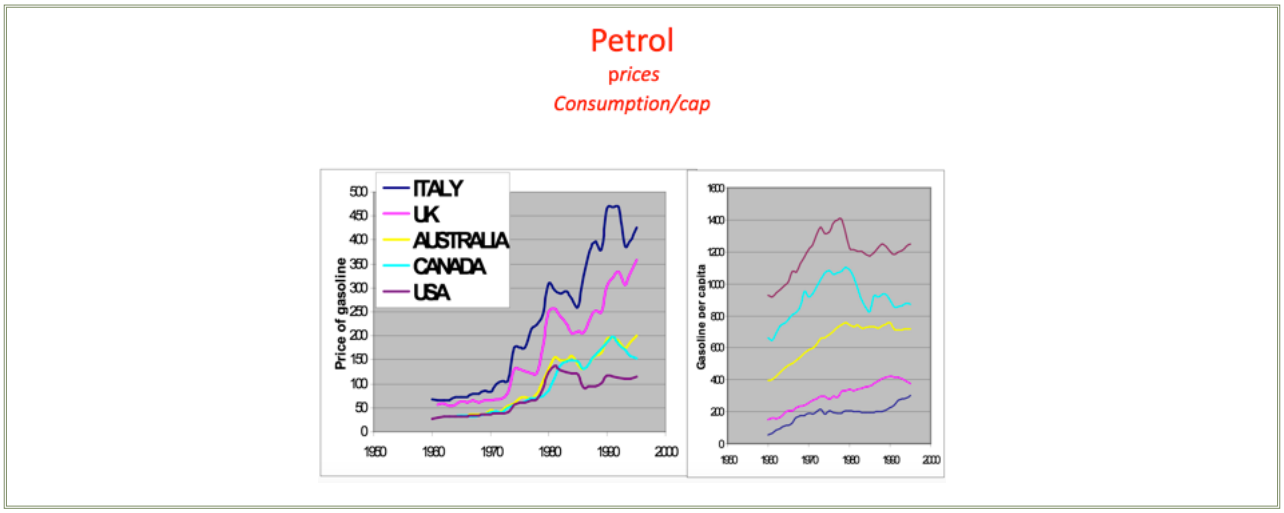
We don't have this carbon tax at the highest level on the trade-exposed sectors. So it's applied to transport and heating and all kinds of domestic use. There's a reduced level (of about 25% or just over 30 $/ton) that is applied to industry, and then there's complications with the ETS, the companies that pay. For a while they were paying both ETS and tax. And now they're just paying the ETS.

In conclusion the general feeling is that this doesn't necessarily hurt the poor, or if it does then the regressivity is very small and easily handled through the revenues collected (for instance lowering other regressive taxes or through spending with a progressive profile). And the policy context, that of a grand fiscal reform as I was mentioning, is really very important for the introduction of carbon taxes.

Does this all mean that the EU could enthusiastically do something similar? Well that's a lot less certain because it's been tried a couple of times, and of course it was tried in a different context. It was tried in the eighties and nineties. And the carbon issue, the climate issue, hadn't quite got the prominence that it has today. So if it were tried today, the situation would be different.

But there would be a huge issue around national sovereignty. Brussels is about as popular as Washington is in the US. So that's a problem. Still I think we should look at what I call sectorial carbon taxes, that is gas taxes and diesel taxes in Europe. They are gigantic. They are much higher than the Swedish carbon tax. They apply throughout the whole of Europe and Japan and quite a few other countries.

I have a very old diagram here because I've been talking about this subject for decades.



You can see here you have countries like Italy, which has always had a very high gas tax. And they use very little gasoline. And countries like the US, where it's nice to have a big car because gas is cheap, and consumption per capita is high.

This is not really surprising. There are thousands of published studies on this, and they generally show that the price elasticity is about -0.7. So I use that price elasticity to calculate what would've happened to fuel consumption with a gas tax. If the whole of the OECD included the US and Australia and so on, would've had the kind of prices we have in Britain or Italy or Europe in general for several decades (since adaptation takes quite a long time), fuel consumption in the whole OECD area would've been 0.7 gigatons of fuel. And if we all had had US prices, it would've been something like 1.5. With the current mix of prices OECD annual consumption is about 1.1 Gtons. We have thus saved something on the order of 400 million tons of fuel a year compared to current use (and we could have saved twice as much if the whole OECD would have had the same policy!).

This is the only policy that has had an effect on the parts per million (PPM) carbon content of the atmosphere. And it's several PPM, because this has been going on for decades. So it's a fairly big effect and one interesting conclusion is that there's been a significant harmonization within Europe in the last 30 years. Italy has always had high carbon taxes. But for instance, Britain used to have low, and they have harmonized upwards. So whether spontaneously or through the close integration within Europe, (and with the exception of Luxembourg, which still profiteers off everybody else having high carbon taxes, and they have low carbon taxes, and finance their whole budget that way) most European countries have harmonized upwards and have equivalently high carbon taxes, notably including the oil countries, Norway, which has the highest gasoline prices anywhere in the world, and the UK. That's sort of interesting. In other countries, you generally find that the more oil you have, the cheaper the gasoline.

So once introduced, the carbon tax, in this case the sectorial carbon tax, seems to be very popular with the finance ministries and tends to slip upwards over the years. The EU has put a lot of political clout into the ETS and Kyoto, and it's going to be hard for them to back track on these efforts but the fact is that their transport fuel taxes have achieved much more than the ETS.

So, carbon taxes have a number of advantages, many of which have been discussed in this conference. Are there no disadvantages? To answer this, I tried to think about what a harmonized carbon tax really implies from a distributional viewpoint, because the quantity negotiations have been mired by fairness concerns. Poor countries want per capita. Fast-growing countries are worried about having a cap altogether. Efficient countries want benchmarking. Gas-guzzling countries want grandfathering. There are a number of very different principles here.

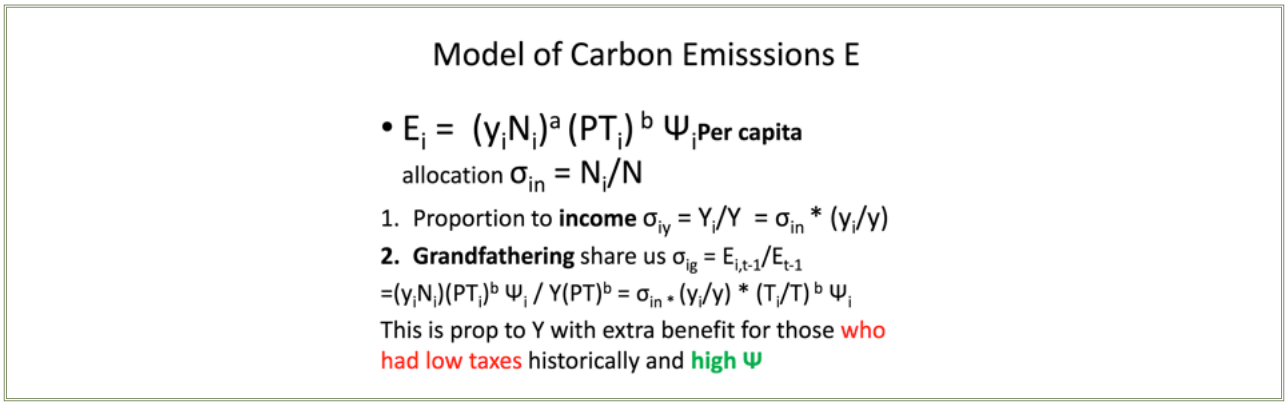
And so I built a very small model with pretty obvious symbols for population, income and carbon price. I assumed that the carbon use of a country and its emissions would depend on income and on the carbon price. And the price I was thinking would be the international price. I'm assuming there's one international price, which of course is not true. So the national price is just decided by the tax. The country has a tax variable it decides over. And the country also has some other characteristics (climate, population density, etc.) that determine how intense it will be in its carbon use.

- Population in country i N_i
- Income per cap y_i
- Income $Y_i = y_i N_i$
- Carbon price P
- Carbon use $E_i = Y_i^a (P T_i)^b \Psi_i = (y_i N_i)^a (P T_i)^b \Psi_i$
-

- Carbon use (a=1; Ti=T) $E_i = Y_i (P T)^b \Psi_i$
- Global Carbon Use $E = Y (P T)^b$

- **Country share E_i/E**

In terms of country shares, we can now define a couple of different principles here. One would be a per capita allocation. That's quite easy — share in proportion to your population. You could also have in proportion to income, or some kind of ability to pay, which is actually the same thing as per capita allocation, but multiplied by the relative income, so that if you're rich, the per capita weigh more.



You could also have grandfathering, which amounts to having the income share multiplied by two terms. The first term reflects what countries have done in the past. If you had a low tax compared to the world average, then you would get a more generous allocation. You would be compensated for that with grandfathering. The second term would ensure countries are compensated for having a climate that requires a lot of either heating or cooling. And this might be something that most people think spontaneously is good, but being compensated for just having had a policy in the past of subsidizing coal, for example, is not really a property we want.

So now the question is what principle do harmonized taxes correspond to? It turns out that a harmonized tax is roughly the same thing as having a per income allocation multiplied by just the factor Ψ. (Harmonised tax implies σip = Yi(PT) b Ψiγ /Y (PT)b σiy Ψiγ This is income share multiplied by Ψ So the question is whether this is reasonable and attractive. As far as I can see, this is attractive but not perfect. In the case of India, for example, a harmonized tax is better than grandfathering, but it's not as good as a per capita allocation.

So I fear that if we have a global negotiation on harmonized taxes, in fact the poor countries like India, those of Africa, will feel that they were going to get a lot of allowances because of per capita allocations but now they are not getting them. So they're going to ask for some compensation. And of course, we could give compensation. The feature about permits is that the allocation is built in. And that might be an attractive or an unattractive feature depending on which sort of politics you're thinking of. It's slightly attractive because they are not so overt. But on the other hand, they are a little bit automatic and unpredictable so that might be unattractive too.

To illustrate: India has 4% of emissions today. So if we use grandfathering, they would always have 4%. And they have 16% of world population, so if we had per capita, they would get 16%. It makes a big difference. And I think that one of the reasons why things are moving so slowly is, in fact, there's a lot of money at stake that normally takes decades to negotiate. And we haven't got that time. So of course trying to find some other allocation is a great idea. Emissions in proportion to income would be around 7% and would grow over time if the Indian economy has larger than average growth rates; so this would be better than grandfathering, but not as generous as per capita. Thank you all very much.

Gilbert Metcalf

Thank you very much. It's a real pleasure to be here. There have been great presentations so far this morning, so thank you very much, Ernesto [Zedillo] and Bill [Nordhaus] for this terrific conference. I'm sorry that I'm only here for the first day, so I'm going to miss a lot of the real fun tomorrow around clubs and protocols. But I'll be interested to hear what comes out of that. In my presentation I'm taking a much more parochial, domestic perspective looking at the U.S., thinking about what is the national interest for carbon pricing.

Of course we have a strong case on environmental grounds. But to me, the three most obvious and important non-carbon drivers of carbon pricing are the revenue and fiscal flexibility that that revenue provides, environmental co-benefits, and cost effectiveness. I just want to talk a little bit about those.

First, looking at the revenue from a carbon tax, there are lots of different estimates out there. Just taking the Congressional Budget Office's (CBO) estimate from its "Reducing the Deficit" publication, $25 per ton tax would net, after offsets and reductions of other taxes, about a trillion dollars over the decade, or about $100 billion annually. These kinds of revenue estimates are similar to what I've gotten with Sebastian Rausch and John Reilly, and what Sebastian and John have gotten in other research. So I'll use the $100 billion annually as kind of the benchmark of where to start, of what kind of revenue we could be getting.

Now this does not include the value of reducing, or removing subsidies of clean energy. Of course, if we did a carbon tax, or if we did cap and trade for that matter, then the argument for production and investment tax credits, or the 1603 cash grant program, those all go away, so that gets you some additional revenue, but not a whole lot. It's about 3% of the revenues from a carbon tax. It adds a little bit but not a huge amount.

So what can we do with this revenue? I think I perhaps have been accused of being somewhat schizophrenic because I've written lots of papers on what you could do. You could do all kinds of reductions, including reductions of capital taxes or labor taxes. You could make it a stand-alone tool or make it a component of fundamental tax reform: maybe the $100 billion a year is the grease that gets us over the finish line to a deal and helps close the gap between Republicans and Democrats.

I was quite interested in Dale's presentation, looking at the labor and the capital tax reductions. I'm not sure he would agree with this, but my takeaway is that if we look at the present discounted value, the NPV of GDP, and compare to the NPV of the welfare gains or losses from capital or labor tax reductions, I'm guessing these are pretty small numbers. So I would interpret Dale's results as costs are very low, maybe negative. But again, the key point is fiscal flexibility. We can address lots of different problems potentially with the carbon tax, which I think is quite valuable.

I'd like to suggest a carbon tax tripod that you need to think about. If we're actually going to do a carbon tax, I think you really need to be thinking about three things. You need to think about enhancing efficiency. Hopefully that'll get some Republicans on board. You have to maintain equity to keep Democrats on board. And you're going to have to address some demands for transitional assistance, some of which are merited, some of which are not. But they're going to be there. Whatever your ideal use of the revenue is, you're going to find that as we move towards a real reform, we're going to start taking some of that revenue and diverting it to other uses, which may not accord with what the models tell us we should be doing. But I think it's important to recognize that upfront.

Thinking about distributional considerations, I did a paper for the Hamilton Project a number of years ago that looked at what would happen if we used the carbon tax to reduce payroll taxes and increased benefits for non-working households (An Equitable Tax Reform to Address Global Climate Change). We found that if you did that, the tax burden would actually fall for the lowest 70% of the income distribution and go up modestly for the top 30%. The point here simply being that a carbon tax may be regressive, but a carbon tax reform is not regressive. A carbon tax reform can be designed to provide whatever distributional outcome you desire. It can be progressive, proportional, regressive, whatever.

But certainly there is focus and concern about income distribution, and that would need to be addressed. There's also the intergenerational impacts of a carbon tax. And this of course is one of the difficulties with any kind of carbon policy in the US. Work that [Jared] Carbone, [Richard] Morgenstern, [Roberton] Williams, and [Dallas] Burtraw have done, looking at the intergenerational impacts

of using the revenues for debt reduction, shows that you get a significant impact on the current voting age population, less of an impact on the young, of course, and on the not-yet-born, those who aren't voting yet. So that's a distributional consideration that creates political challenges.

You also have at least in the US, and you have this in the EU as well, differential impacts across regions. And that creates challenges. We saw this in the Waxman-Markey legislation with discussions about how we were going to address differential impacts on different regions.

And then you have sectorial considerations. You find that about 95% of manufacturers have very modest greenhouse gas intensity, and therefore would be not terribly impacted. But there is a tail, of 2 to 5%, that has a fairly high, greenhouse gas intensity, as high as 30 to 40%. So you have this small group of energy-intensive, some of whom are trade-exposed, sectors that are going to be clearly opposed to a policy, and that needs to be thought about as policy is being crafted.

Now that sort of sets up the challenges a carbon tax will face. And of course this immediately raises the question of what's reasonable and what's unreasonable tax relief for different groups. And reasonable, of course, is in the eyes of the beholder. In my eyes, older workers in coal mining have a legitimate claim to some sort of relief if we put a carbon tax in place. But energy-intensive trade-exposed sectors, it's less obvious to me.

The actual entire value added in the coal sector is on the order of about $15 billion a year. This includes profits and payments to all workers. You wouldn't need to compensate for the entire value added in the coal sector, but you don't need a whole lot of money. And of course, whatever you do, any of kind of transitional relief should be temporary.

So what are the co-benefits of a carbon tax? This is a chart from the clean power plan regulatory impact assessment.

Co-Benefits

- Power sector CO_2 emissions fall 25-30% below 2005 levels in 2025 – a reduction of 18-25% relative to business-as-usual baseline.

	Climate Change Impacts		Co-Benefits of Correlated Pollutants plus …	
	Domestic	Global	Domestic Climate Impacts	Global Climate Impacts
Benefits				
Climate Change	$ 3	$ 31	$3	$31
Health Co-Benefits			$45	$45
Total Benefits	$ 3	$ 31	$48	$76
Total Compliance Costs	$ 9	$ 9	$ 9	$ 9
Net Benefits	**- $ 6**	**$ 22**	**$ 39**	**$ 67**

EPA (2014)

If we look at the benefits of climate change from reducing emissions, we're looking (depending on whether we're valuing with a domestic or a global impact) between $3 and $31 billion. But the co-benefits from other criteria pollutants really are quite substantial. So this is clearly an additional benefit going forward. I think this is less relevant for the US, but clearly for China, India and other countries, this is a big deal.

We all know as economists that market mechanisms cut the costs of emissions dramatically. We've got evidence, for example, from the sulphur dioxide trading program. So is there a grand bargain to be had? Should we be trading the clean power plan for a carbon tax? And here I'm less sanguine. It's not clear to me what price you would need in a carbon tax to get the same reductions in emissions as we will get from the clean power plan. We actually had a discussion about this at breakfast. I was asking Adele Morris and Jim Stock what is the carbon price that's equivalent to the CPP, and I guess that's the million dollar question.

If you look at a recent paper by [Joseph] Cullen and [Erin] Mansur (Inferring Carbon Abatement Costs in Electricity Markets: A Revealed Preference Approach using the Shale Revolution), they look at fuel switching only, and it's in the short run, so I'd be clear about that. But they're finding a very high price is needed to get more than a modest reduction in emissions in the electricity sector. Now clearly that's going to be an issue, but I think this is going to be an important question. Whether we could get a high enough price, an explicit carbon price to get the same impacts as the obscured and hidden price in the clean power plan, forgetting reductions in emissions. So I think that in some sense what may be a challenge of harmonized carbon pricing is that the transparency is both a benefit and a challenge.

So summing up, I do think that the revenue considerations and efficiency, particularly revenue, is a particularly powerful driver, especially in the U.S., for carbon pricing. I think in fact if you talk in Washington, and we have people from Washington here who can confirm or reject this idea, you probably get more traction talking about the revenue potential than you do from the environmental benefits in some circles on the Hill. Cost effectiveness is certainly important to economists, maybe less so to politicians. But I do think that it will be a challenge, it will be a hard sell for environmental groups to think about trading off the clean power plan for a carbon price. I'll stop there. Thank you very much.

Adele Morris

Thank you very much for inviting me here. It's a pleasure to be here at Yale to talk about my very favorite topic, which is pricing carbon and how to do it, and how to actually do all the things that we've talked about so far today. Why would you do it? You're going to hear some themes that resonate with what Gilbert [Metcalf] just said. Obviously there is the potential to reduce emissions, do it cost effectively, replace less efficient policies, raise revenue, do stuff with it, and then have a transparent level of effort that we can bring to the international negotiations and leverage our action more easily. I pity the American delegation trying to explain Clean Air Act regulations to our interlocutors. I think it would be much easier to talk about carbon prices internationally.

I'm going to give you a flavor for some of the research that's been going on. I did a policy brief with Aparna Mathur last year (A Carbon Tax in Broader U.S. Fiscal Reform: Design and Distributional Issues), just going through how would you design a carbon tax in the US and what happens if you embed that in broader fiscal reform, tax reform, and so on, and all the issues that arise, a very practical reader-friendly version. We have a new book out, co-edited by Ian Parry, and Rob Williams, looking at exactly how you would do this. We have a terrific collection of authors for the different chapters. Pretty much every key design decision is represented in one of these chapters by this illustrious crew. It came out of an event that we had a few years ago at the American Enterprise Institute where Gilbert [Metcalf] spoke. And we got this book out the door just this spring, so we're happy to see that. It's available on Amazon.

And in addition, we're seeing more penetration of these ideas into the public finance literature. I organized a session two years ago, and they came out as a forum of five papers looking at various policy scenarios of a US carbon tax swap, and those came out in the *National Tax Journal* in March. And I'm going to speak to some of those results from a paper I did with Warwick McKibbin, Pete Wilcoxen and Yiyong Cai using the G-cubed model, and you'll see some of those results in a second. (The Potential Role of A Carbon Tax in U.S. Fiscal Reform).

Finally, we've got a very exciting project in the Stanford Energy Modeling Forum where we're doing some coordinated modeling scenarios. Dale is participating in that with his team, looking at various

US carbon tax swap approaches and comparing and contrasting with the EPA Clean Power Plan and trying to understand which of these results are robust across models, where the sensitivities are, and looking for where we can get that strong double dividend Dale talked about earlier. And there's a sense of our policy scenarios. We're looking at different tax trajectories, both starting rates and escalation rates. We're looking at different uses of the revenue, including lump sum rebates, capital income tax swaps, labor income tax swaps, and mixtures of the two. And we're solving to match, find the carbon tax that gives you the abatement in the Clean Power Plan. So we're going to try to answer Gilbert's question for him.

I'm going to talk about what has to go into a US carbon tax bill if we were going to do it. First, you have to figure out what to call it. It's amazing how much energy people spend on whether

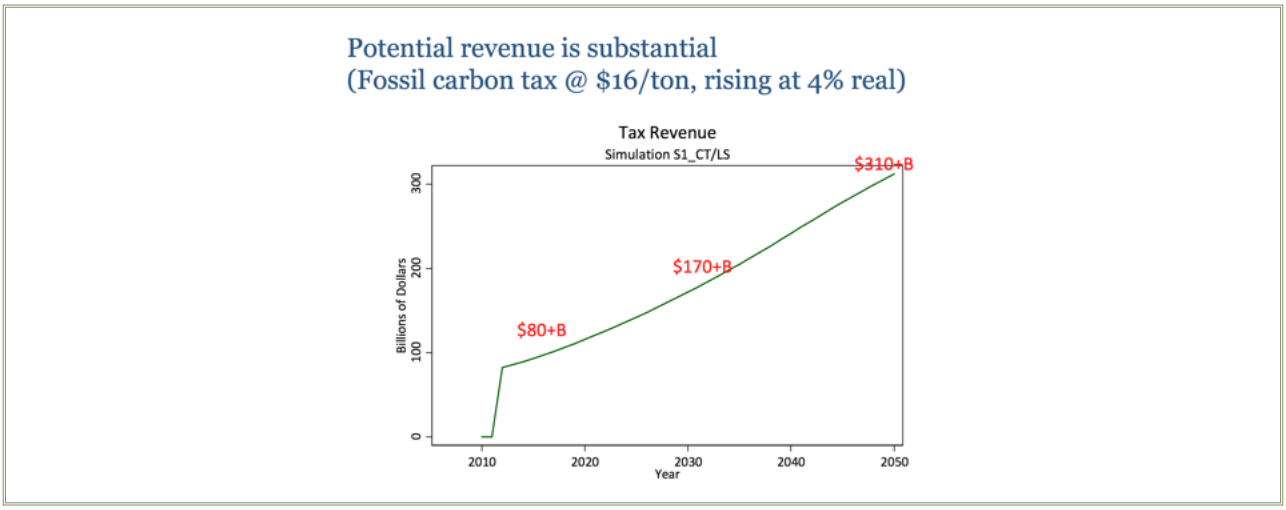
it's a tax or a fee or some other term of art. You have to decide what you're going to tax, who the taxable entities are going to be; we just talked about the upstream and downstream choice of tax incidence. You have to decide what your tax rate is going to be, and how it's going to evolve over time, and whether it's just a formulaic escalation or whether it's guided by some feedback, such as the environmental performance of the tax, or linkages to the international regime or what.

And then very importantly, what are you going to do about other federal environmental policies, not just the Clean Air Act, but subsidies and regulations of various other kinds. What do you do about state policies? Do you preempt them, or do you just let states do what they want to do? This came up in the Waxman-Markey discussions. Do you have credits of any kind such as for carbon sequestered underground, or embodied in long-life products? Do you allow any offsets? We had a big discussion about that under Waxman-Markey, and you could do something similar in a tax environment. The authority to collect it, is it an EPA or a Treasury program? And then what do you do about the competitiveness, leakage, and diplomatic dimensions?

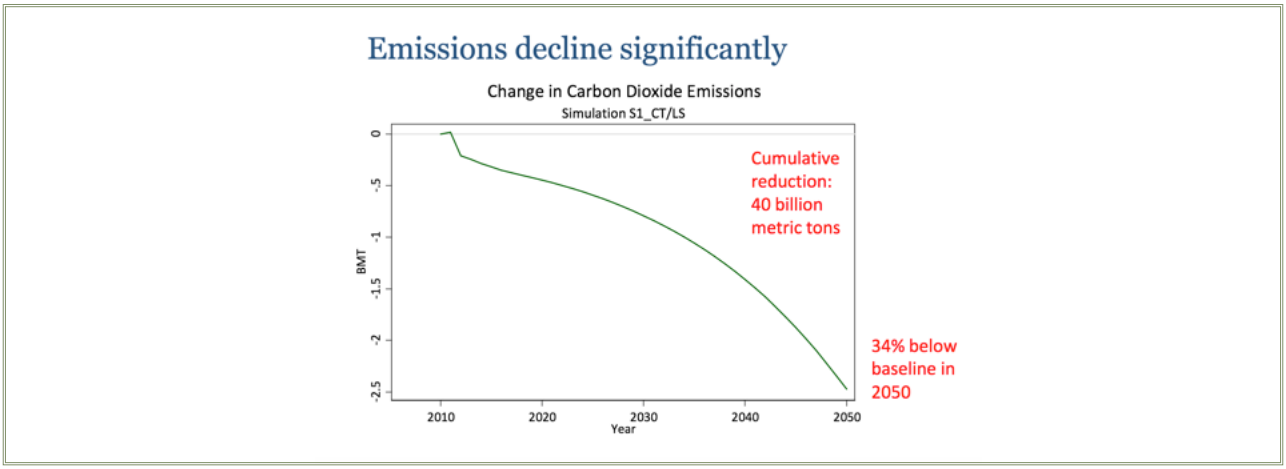
Michael Greenstone talked me into doing a proposal that I think could gather bipartisan support. It was for our Hamilton Project. So I just had to go into all these things and try to figure out what I think the Republicans and the Democrats might agree on. This was in a context of a bunch of proposals around deficit reduction, so that featured into my proposal. You're welcome to look at that on my website if you want to see how I thought it might work out (The Many Benefits of a Carbon Tax).

I'm going through some of those big design issues pretty quickly. There are a number of potential benchmarks of how you can set an initial tax rate. There is a new bill that bears some resemblance to my Hamilton Project proposal put out by John Delaney. It's called the Tax Pollution Not Profits bill, and that's in the House now. It starts at $30 a ton. And then there's of course the social cost of carbon estimates, and then there's the various other benchmarks, including the existing prices on carbon in California and the regional greenhouse gas initiative in the Mid-Atlantic in Northeastern states.

So as Gilbert said, the potential for revenue is very substantial. This is from the G-cubed modeling I described earlier that came out in the National Tax Journal. We only have fossil energy CO2, so our estimates are a little bit lower, and the carbon prices are a little bit lower. But at least $80 billion a year, not counting the 25% offset or haircut that CBO would use to score the tax.

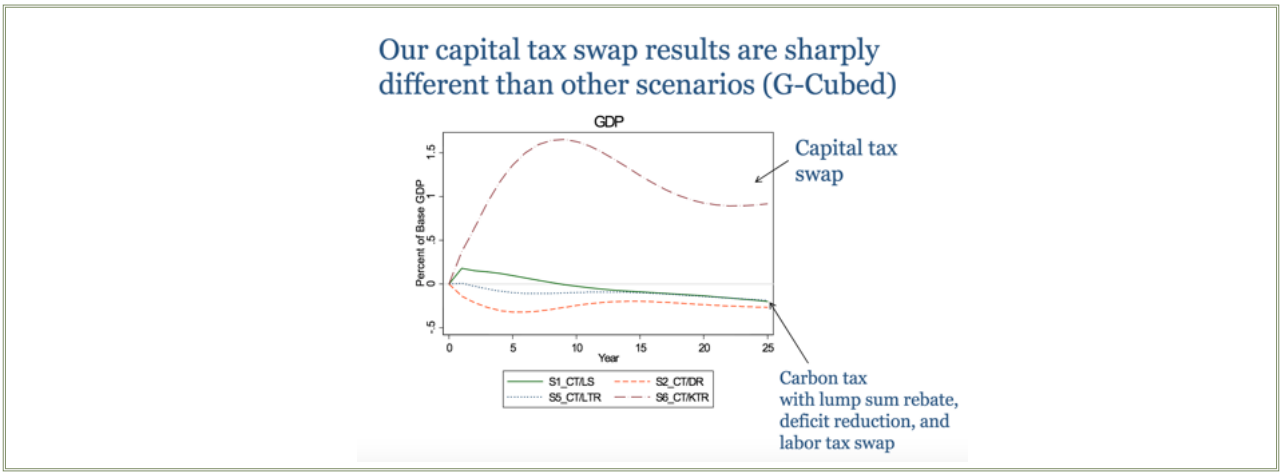


Emissions do decline significantly, and you see this pattern across the models when they do these kinds of scenarios.



As we've heard, the revenue does definitely affect the macroeconomic outcome. Now what is robust across the models is essentially the rank order of the different tax swaps. Many models get the best macro outcomes with a capital tax swap. Not everybody gets the strong double dividend. But most get that as the most positive outcome. And then ordering down from there, labor tax swap. Deficit reduction I think is a little sketchy because it's tough to model the costs of the high debt to GDP level, so I sort of want to abstract a little away from that. And then the lump sum rebates tend to come out the worst macro-economically in all of the models.

And so our model does get a double dividend in some tax scenarios. It depends on the price and the trajectory and over what timeframe you're looking. This again is the $16 tax starting now and evolving at 4% over inflation.

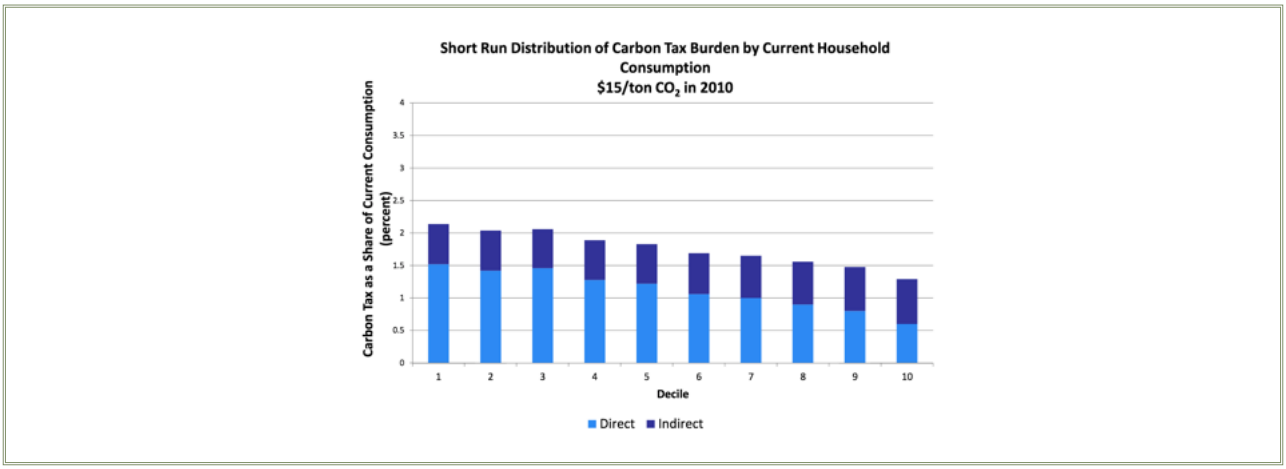


And you can see that the capital tax, represented by the dashed line, is substantially different in terms of GDP outcome than lump sum rebates, deficit reduction, and labor income tax swaps. Most of that GDP result is driven by increases in investment.

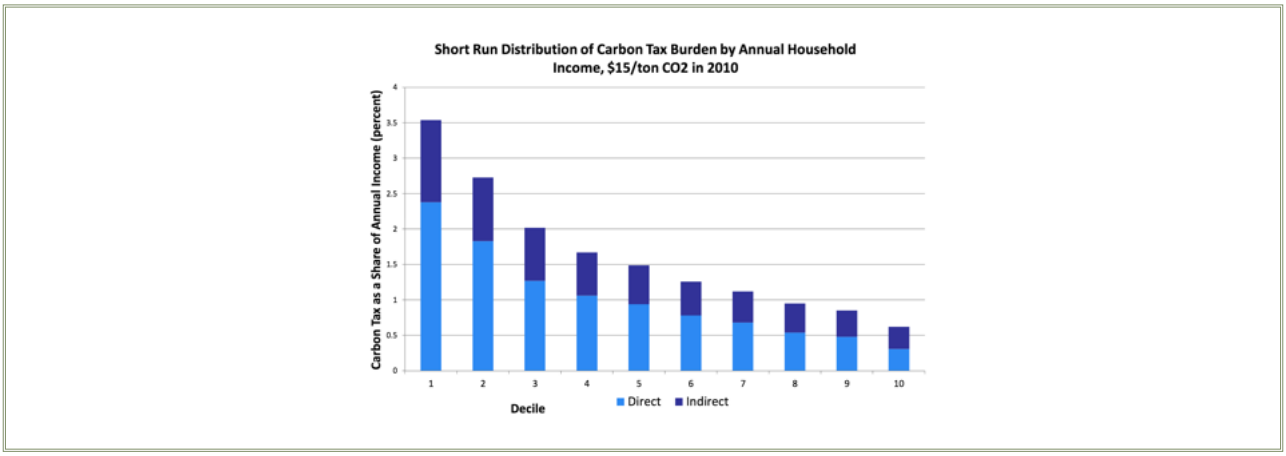
And we get similar results for wages and employment. So with these kinds of results, we can make a case to skeptics that it's not a job killing energy tax. One reason you get this result is on account of the US having relatively high statutory corporate tax rates compared to its trade partners. Now that's the statutory rate. Effective rates are arguably significantly less, but still in all I think there's some sense that this is a cause for less attractiveness for investment in the US.

Now the results change substantially if you're talking about regressivity. Lump sum rebates consistently across models are the most progressive and a capital tax swap the most regressive. One thing to note is that your use of the revenue can exacerbate regional impacts. A lot of capital income is concentrated in California and New York, which have relatively low burdens of a carbon tax. So when you do the capital income tax swap, you concentrate the benefits of those lower capital income taxes in the states with relatively low carbon tax burdens so it can amplify the results.

The below shows the work I did with Aparna, just looking at the direct and indirect incidence of a carbon tax, assuming 100% pass through, not accounting for the use of the revenue. You can see that mimics a lot of what Gilbert was saying about the regressivity. Those are income deciles on the horizontal axis.



Now if you measure it by consumption of course, you get a different outcome. So when you talk about progressive/regressive, it matters a lot how you're measuring that, whether it's income or consumption.



Here's an illustrative result from some modeling by the folks at RFF again showing the lump sum rebate being much more progressive than the capital tax recycling. And an illustration of the regional impacts, and you can see that they're concentrated in the high coal use, industrial Midwest. And burdens on the coast would be relatively low.

Gilbert talked about the different ways you can use the carbon tax revenue to achieve either revenue neutrality or to do something with spending that you might want to accomplish otherwise. It adds a new dimension to the fiscal policy negotiation.

Now I want to talk a little bit about what you would do with other federal energy and environment policies. Certainly there's a case to be made to unravel some other spending directed towards clean energy. I estimate we could get rid of about six billion a year, which is a little bit higher than what Gilbert said. But I think there's a lot of potential to get extra fiscal gains as a result of imposing the

excise tax. I'm a little more optimistic than Gilbert that we can find a middle ground to walk back from full EPA authority over greenhouse gases. If we impose a carbon tax, exactly how that would work I think is an important area of research. And certainly we have a lot of energy efficiency regulations that one would wonder whether the net benefits would still pertain in a carbon tax world.

Now on competitiveness. There are some things we can do unilaterally, and there're things we would have to do diplomatically. So unilaterally, illustratively, we could impose a modest carbon tax and raise it gradually. Give that time to reduce our tax base and adjust to new relative prices. Replace costly regulation; remember that costly regulation is the baseline now. So do the swap for a more cost-effective approach, and you have a pro-competitive benefit. Do some of that corporate income tax swap. Now the carbon tax incidence is not exactly distributionally the same as the capital income tax across industries. But still, if you're worried about the overall competitiveness of the US economy, lower corporate rates could be important. And then for those remaining firms at the very high end of energy intensity that Gilbert referenced, you can have a carefully designed border carbon adjustment.

Now we can do that unilaterally. What would we do diplomatically? One thing we could do, and when I say we, I mean the US government, we can bring to the international negotiations a call for using carbon pricing domestically, talking about carbon pricing in the monitoring, reporting, and verification agenda item, developing methodologies for reporting carbon pricing — the extent and the level. We could also call for trying to come up with carbon price equivalent of non-price measures just like we did tariff equivalent of non-tariff barriers, and try to talk about prices explicitly. The IMF has just come up with a really good way of accounting for energy subsidies, including foregone corrective tax revenues.

We could also offer an alternative measure of compliance through carbon pricing. We wouldn't necessarily try to unravel all the international discussions of quantities, targets, and timetables, but instead would allow countries to adopt an alternative compliance measure of an agreement among price and supplement the existing discussions with a price-based alternative. And we have a paper out on that. That's based on a working paper from 2009 (Achieving Comparable Efforts through Carbon Price Agreements).

And then in addition to that, the US could call for technical and administrative consultations around carbon pricing and get people talking about excise tax administration. We have this huge clean energy ministerial where people get together and talk about batteries and all sorts of stuff. If we can have bilateral agreements on batteries, then we can have bilaterals on excise tax administration. And that would actually probably in the long run be a lot more efficient and effective.

Now before I conclude, I want to just answer one question. I've been talking exclusively about federal carbon taxes. But I don't want to neglect the opportunity for states in the US to tax carbon. And the answer is they can do this, and for a lot of the same logical reasons that would apply at the federal

level, pro-growth fiscal reform, reducing emissions, replacing inefficient alternatives. A lot of states have renewable portfolio standards, and other sorts of regulations that could be cost-effectively replaced with a state-level carbon tax. And moreover, now we have the prospect of EPA regulation in the requirement to comply. And I have been encouraging EPA to craft its regulations in a way that would be consistent for states to adopt carbon taxes as a way to comply with their EPA regulations.

So to conclude, absolutely a US carbon tax could work. I mean obviously there are tremendous political headwinds. But I think if it's part of the broader tax reform package, there's very good potential there. And although there are distributional issues that we should be mindful of, they are not insurmountable. And I think there's a story for Republicans to declare victory when they've gotten EPA off your back, they've replaced regulation, and they've lowered your other tax burdens. And they don't even have to say that the climate is changing in order to take that position. Thanks very much.

Discussion

Ernesto Zedillo

Please will the other panelists come to the table? So who wants to start? Robert [Repetto]?

Robert Repetto

Just a question for Adele and Dale. When you model capital taxes, do you use the statutory marginal rates, or do you use the effective rates or some combination?

Dale Jorgenson

Marginal.

Adele Morris

Yes, marginal.

Robert Repetto

Does it make a difference given the big difference between effective and statutory rates?

Adele Morris

We haven't done it both ways.

Dale Jorgenson

Using marginal rates is the economically correct way to do it, so we didn't try non-economically correct alternatives.

Jason Bordoff

I just had a small technical question. Adele, you talked about calculating subsidies. The way the IMF did is not taxing carbon, so you obviously get much bigger numbers than just the fossil fuel subsidy reform as the G20 in Pittsburgh talked about it. Or earlier we were talking about border tax adjustments which you would apply if the country you were importing from does not have their own effective carbon price. And I'm just wondering in all those cases, and there are others, how do we account for the non-price regulations on carbon, like fuel economy standards or the clean power plant rule, which according to the thing EPA put out a few days ago, is going to do more to reduce emissions than Gilbert what you said, a $25-per-ton carbon tax would do. So how do we account for that?

Adele Morris

So to my mind, what we're going to have to do, if we're going to start imposing border carbon adjustments based on estimates of the level of effort of other countries, we're going to have to have something reasonable. One, the first cut would be to just look at any evidence of an actual pricing policy. But then you're exactly right that there are bunch of other non-price measures. I think it's feasible to come up with agreed methodologies for calculating the carbon price equivalent of non-price measures. And in that instance, you would have the option of using the measure, the carbon price equivalent of non-price measures in your determination of which countries were subject to the border carbon adjustment.

But honestly, I put myself in the chair of the poor guy at the Treasury or Commerce Department who has to figure out what these tariffs are going to be and for what products, from what firms, from what countries. And it sort of makes me ill. So I think that the more narrowly we can circumscribe this thing, and as simple as possible as we can keep it, the better, recognizing that there's lot of political energy around this topic. So for example, when I was talking to Congressional staff, how are they going to articulate the authority of the Secretary of the Treasury to impose these things? There's really not good work on what kind of statutory authority should the Treasury Secretary have. And what policy are they really trying to implement? So I would just say this is a big area for research on these innumerable practical details of how it could be done, and striking that balance.

Jason Bordoff

Sorry, when the IMF calculated their five trillion, did they account for non-price …

Adele Morris

No.

Kenneth Gillingham

My question is for Thomas Sterner. I was wondering. You mentioned this $125 carbon tax, which is a very high carbon tax. And you said the big companies don't mind at all. Is it really an economy-wide tax? Are there companies that are bothered by this tax? And moreover, are there any studies of effects of this tax that show where it has been making a behavioral change?

Richard Cooper

Concretely, just to add to that, does the steel industry pay the tax, and does Volvo pay the tax on the steel that it uses?

Thomas Sterner

Unfortunately, the answer is quite complicated. The tax rates have been changing year by year. There have been lots of exceptions. The main rule was that competitive industry would be paying 25% of the tax, which is still a lot, of course, until other countries had commensurate taxes. Then for a while they were paying both the tax and buying ETS, and then they complained in some court, and now

those who buy ETS rights don't get to pay the tax. There are still some smaller companies not in the ETS paying the lower tax rates, with the exception of some very small number, but high energy-intensive firms that have negotiated some kind of a ceiling on the percentage of tax paid of value added. And these things change with governments all the time. And so it's not easy to give an overview. But the sectors that are affected are commerce, heating, and transport. One of the big effects has been on the heating sector, for instance. And then obviously the transport sector, but that's the same as the rest of Europe.

Ernesto Zedillo

So what form does the tax take? Specifically, it is a tax on what?

Thomas Sterner

It's upstream, so it's on carbon content. There are also energy taxes, and the energy taxes are differentiated taking into account all kinds of other things. But the carbon tax is strictly on carbon, and it's upstream.

James Stock

I have two questions. First, briefly on other GHGs, I think this is something that Gilbert and Adele alluded to, one view, and this also relates to the Clean Air Act domestically in terms of its authority to regulate other GHGs, one view is that really it makes sense to carve out just the carbon part from the other GHGs, other GHGs being something that in many instances might be more amenable to old fashioned technology regulation, and that might be much more politically acceptable. I mean leaky valves and pumps, or offloading or whatever it is, is something where it might be easier just to do the technology rather than to try to measure how much of that is actually released, which has got to be a difficult problem. So that's a question. It didn't have a question mark, but it's a question.

The other issue is thinking about the broader level of these alternatives, mixing the carbon tax with an overall tax reform so that we could get at least part of the double dividend, it's hard for me to see a solution where we'd be able to go to something that's as clearly regressive as simply just a change in the capital gains tax rate. Maybe there's a world in which that would happen. But it would be a big shift from where we are right now. What's the best we could do? Have you done calculations that would say suppose we're going to be subject to some sort of distributional constraint, you can't get this exactly right, but some distribution constant — what's the best we can do in terms of getting some of that double dividend back, and what would that look like?

Adele Morris

I'll take that. I can comment on the first question. Absolutely you're right about the question. What is the appropriate tax base, and to what extent do you include non-CO2 gases or CO2 from process emissions and so on? Certainly land use and agriculture, there are a lot of source categories that may not be the best place to start with your excise tax. I totally agree it's not exactly clear where you draw the line of who's in and who's out. So there's work to be done.

Gilbert Metcalf

Let me comment on that while we're on that topic, because David Weisbach and I actually wrote a paper on designing a carbon tax where we looked at just that question, because you're talking 80% of emissions from carbon in energy, and another 20% from other gases. And we went through those other gases individually. And you're balancing off the desire for broad-based tax against increasing administrative complexity. And we did this rough calculation that you could get about half of the remaining 20%, so 10% is a rough rule. But that doesn't take into account the question of whether you're better off dealing with it through some other approach.

James Stock

The offloading is the easy one; the tough one is the cows. Measuring these things is hard.

Gilbert Metcalf

John O'Reilly and I have a paper on that where you can have a feed tax that addresses this to some extent.

Adele Morris

On your second question about where's the efficiency equity sweet spot, one of the columns in our energy modeling forum policy scenarios is half capital tax swap, half lump sum rebates. Now I can't remember exactly, but the idea is that for most of the models, you can kind of linearly interpolate between the categories of a full tax swap versus lump sum and kind of mix and match. And some of the models have distributional outcomes. So probably the answer will be in those models, interpolating and putting the portfolio of various tax usages together to get to your question. The answer right now is, I don't think we know exactly. And certainly if we do, we don't have any cross-model comparisons.

Ernesto Zedillo

Let me take a few more questions.

Eric Toder

I'll be very brief. First, these are great presentations, and I have to say this is a terrific session. And the second brief comment is, I'm extremely uncomfortable with the way all the models being used, these models, handled the treatment of taxation of capital income. I don't really have time to go through the reasons why, but I would be happy to have an offline conversation on that with anyone who's interested.

Carolyn Fischer

Mine maybe follows on Eric's, so I definitely want to talk to you. But just as a dabbler, I've been reading in this post-Piketty world that there are more and more people saying that large inequality is a big drag on economic growth. And so I'm wondering how, if there are newer insights on inequality from the macro literature, does that influence how we want to think about the capital income tax swap?

Adele Morris

Well first of all Eric, you're exactly right. To the extent that capital income is just rents, and it's not responsive to the marginal tax rate on capital, you're right. And so the models are going to overstate that elasticity and overstate the benefits of reducing the capital tax rate. I think the answer to Carolyn's question is going to be rightfully directed to the people who run the models that have the income deciles within them. I guess, partly back to the question that Jim raised though, what's going to matter is the distributional outcome of the whole package. So it's easy to fixate on the regressivity of the carbon excise tax.

But it matters not just what happens to the revenue from that tax, but what else is in that fiscal package. For example, perhaps what we're doing is forestalling the reduction of social safety net programs. So really what you want is to compare the fiscal package to the alternative scenario where you have exploding debt to GDP, and you have to reduce social safety net programs. And so the real question is how does the carbon tax compare to all the other ways of solving that problem? And I would also note that regulatory measures are probably regressive as well. So when you're doing that comparison, you want to look very holistically at the policy package. And arguably, a lot of the ancillary benefits in terms of human health outcomes are probably progressive as well. Certainly in a lot of other countries that would be true.

Dale Jorgenson

I think you've raised a very fundamental question, which is what is the impact of Piketty? After all, that's the bestselling book of recent times. And so it does trade off equity against economic growth, but a very narrow definition of equity, namely the top 1%. So how should you think about that? You should think of it in this way. Social welfare is the sum of two components, equity and efficiency. And social welfare combines equity effects with growth effects. It's precisely the combination you're looking for. Unfortunately, Piketty's book never mentioned that idea. So it isn't directly related. But for the purpose of this discussion, I think we can focus on the fact that equity plus efficiency is social welfare, and that takes into account both economic growth and distributional consideration. So that's the criterion that we ought be focusing on. And so the payoff from substituting a carbon tax for a capital tax is precisely the increase in social welfare. That's the key point.

Thomas Sterner

I had a couple of points. First, I got a question hon Sweden and the steel and manufacturing industries. The steel industry in Sweden would be paying the permit prices. And a lot of Swedish industry otherwise is manufacturing where the energy and carbon share is quite low. The paper industry is another story. There's a lot of conversion to using residue as fuel.

I also wanted to comment a bit on the Piketty and inequality thing. I've always found the argument that gasoline taxes are regressive as the best argument ever. It kind of stops the debate. But in most countries it's not true. In the US, it may be, but in all the low income countries in the world, gasoline

taxes are actually quite strongly progressive. In Europe, they're generally quite neutral. So that's important to remember.

It's also a little upsetting that the only time lots of people ever mention equity is when they're trying to stop a gasoline tax. I promised myself I wouldn't bring up the subject of meat tax when I came to the US, but I still thought I would. There's been some literature on this and some debate on this in Sweden recently, and it seems that you'd capture quite a sizable portion of other non-CO2 gases if you actually just tax red meat. So I'll just leave that thought with you.

Finally, I want to say one thing, and that is that a lot of the premise of our discussion is that climate policy is very costly. I really don't think so, and I think we've had a lot of presentations that show that here. The main cost is the cost to politicians fighting the lobbies. Now that's a very big cost, and it's for a very relevant group, the politicians. So it's real.

But we need to remember that lobbyism is the decisive, and the main barrier to climate policy, and I think understanding that perhaps has made me more enthusiastic about supporting renewables, because I think that's creating new lobbies, and it's weakening carbon lobbies. And it's one of the few things that actually is working currently in the world today. Subsidies to renewables, which we may be professionally doubtful about, are actually working quite nicely. Costs are coming down faster than people realize.

Ernesto Zedillo

Let me ask our friend from the World Bank, and I am getting even worse in my nearsightedness. So I cannot read your name, and it's difficult to pronounce also.

Grzegorz Peszko

Blame my parents. I have a question about the potential tradeoff between the fiscal dividends and the environmental effectiveness of a tax, in the context of recycling the revenues of the carbon tax. In your model it seems that the tradeoff does not exist. You continue to raise significant revenues that keep increasing over time while at the same time the emission reduction is delivered.

Many finance ministers that I've spoken with are quite skeptical about this idea. They are afraid that carbon taxes will over time erode their tax base. So what kind of price elasticities or demand have you seen? Have they been fixed over time, or have they been changing? We already know that longer elasticities are usually lower than the shorter elasticities. And some switch in the economic structure, in the consumer preferences, may actually destroy this tax base significantly, especially if we want to achieve significant emission reduction.

Adele Morris

I can answer for the US. Generally speaking, we're modeling scenarios where the carbon price goes up at 4% a year over inflation or something like that, so there's a real rate of increase. And yet the

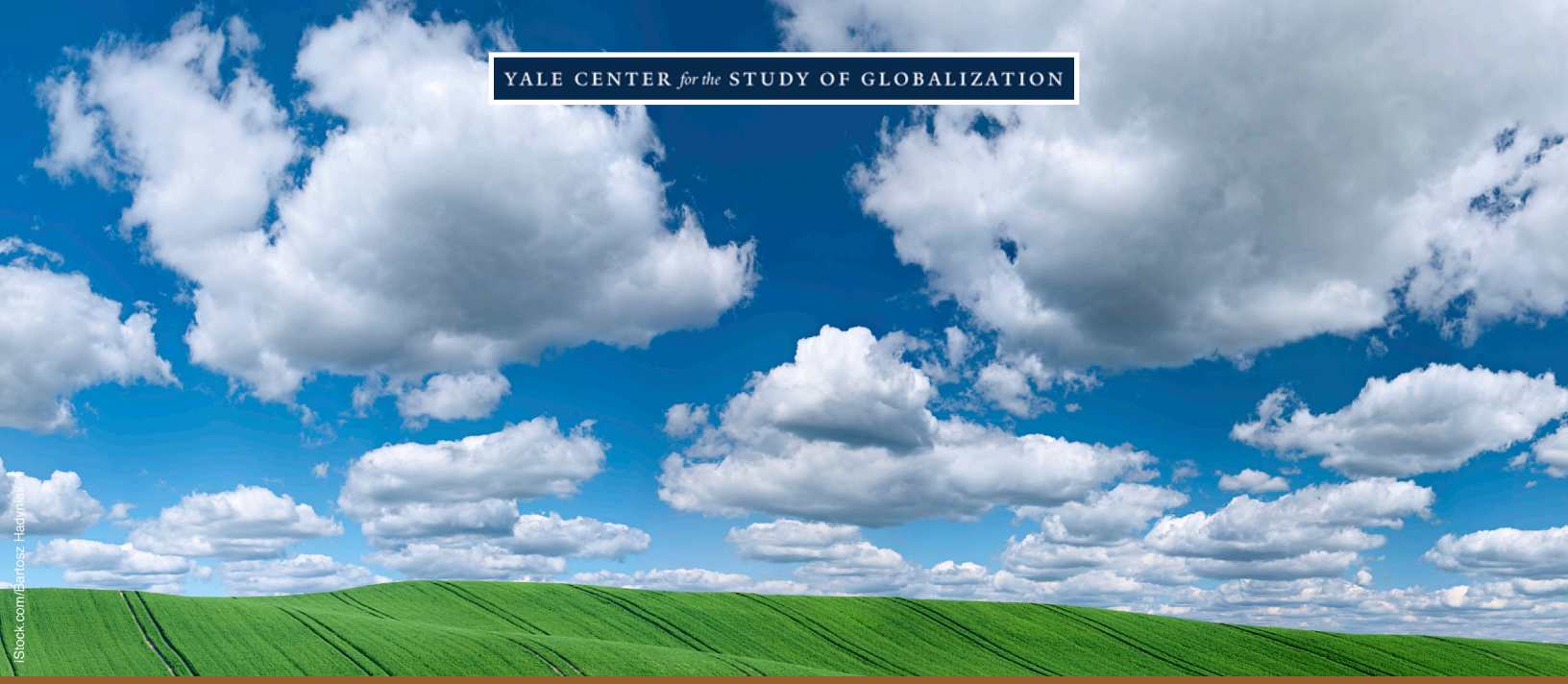
revenue goes up linearly. So in general, you don't get to the point where you're really eroding the tax revenue until much later. You're eroding the tax base. The increase in the tax rate dominates the shrinkage in the tax base for quite some time. And then eventually — out maybe three decades — you start really seeing the erosion of the revenue. And then you're going to have to replace that revenue with something else. But honestly, we should be so lucky we've so decarbonized that we're worried about our revenues.

Thomas Sterner

Bring it on. Tax base erosion in this case would be a good thing. We'll worry about that in the year 2060 or something.

Ernesto Zedillo

Okay. With that, let's go to lunch. Thank you so much.



iStock.com/Bartosz Hadyniak

Global Harmonized Carbon Pricing: Looking Beyond Paris

Yale Center for the Study of Globalization, International Conference, May 27 and 28, 2015

Session Three:

Dealing with the practicalities of international carbon pricing (other than participation and compliance)

Presentations and Discussion

PARTICIPANTS

Ian Parry, Richard Cooper, Kurt Van Dender, Grzegorz Peszko, Joshua Linn

MODERATOR

Ernesto Zedillo






Session Three — Dealing with the practicalities of international carbon pricing (other than participation and compliance).

This session will address a host of practical issues that must be thought about when designing an international agreement on climate change mitigation focused on carbon pricing. Some, but not all, of those issues are: analysis of whether a minimum price of carbon should be the target; formulas to deal with other energy taxes/subsidies on fuel, electricity, consumption, fuel supply, etc; accounting for other fiscal subsidies like favorable treatment of household energy products under the VAT; treatment of other taxes net of the domestic environmental benefits (e.g., should credit be given for air pollution and traffic congestion taxes?); coverage of emissions sources (just CO2 from energy — not forestry, non-CO2 greenhouse gases?); interpretation of the common but differentiated responsibility principle; formulas for converting national carbon prices into a common currency; international agency(s) to do the measuring and monitoring; acceptable modalities to meet the agreed carbon price (deciding about the coexistence of national tradable emissions permits with international carbon price); options for implementing carbon taxes (e.g., different points in the fossil fuel supply chain) and dealing with some other practical issues (e.g., are some sources too costly from an administrative perspective to include?); lessons learned from existing carbon pricing schemes to date; lessons from other international tax agreements.

Presentations

Ernesto Zedillo

I think we are approaching the moment of truth when we will be challenged by our lawyer friends to start addressing practical issues on how to go about defining and designing a regime based on carbon pricing. I know that some of you, as we said this morning, continue to have some reasonable degree of skepticism. But I will again beg you to contain your skepticism, and assume that the presenters this morning, those who advocated strongly for a carbon tax, are unquestionably right.

So let's now assume for the sake of the conference's objectives that we have bought into the general idea, and now we want to look at what kind of definitions would need to be included in an international agreement in a club. And we have a very distinguished panel to do that. Let me start by calling

on Ian Parry. And I take this opportunity to mention that the IMF's Fiscal Affairs department, and particularly our presenter now, have been enormously supportive of the undertaking of this conference. So I want to express publically my gratitude to you, Ian, and your bosses, to whom you were kind enough to introduce me. You also mentioned that Madame Lagarde actually is committed to explore these issues, so I think that's great news because if we can get Christine Lagarde at some point to become vocal on this, it will be very valuable. So the floor is yours, my friend.

Ian Parry

Thank you. I'm going to focus on a couple of issues. First, the case for agreeing over a minimum carbon price, a carbon price floor. And secondly, discuss various issues and how we might compare carbon prices across different countries.

First of all, in my view, in the ideal carbon pricing agreement, countries would agree over a minimum carbon price, a carbon price floor, preferably reflecting global climate change damages. But we would allow individual countries the freedom, the flexibility, to set higher prices than the floor level. They may want to do this for domestic fiscal reasons.

We know that carbon taxes are relatively straightforward to administer. They're a practical extension of existing road fuel excises, which are well established in most countries, and amongst the easiest of all taxes in the fiscal system to administer. And in addition, we heard this morning that the environmental tax literature more generally supports that up to a point. Raising revenue from carbon taxes may involve lower economic costs than raising revenue from broader fiscal instruments if the tax base for those broader fiscal instruments is relatively mobile, which it might be if those instruments are promoting a lot of black market activity, which is fairly pervasive in developing countries, or if it's promoting a lot of tax sheltering behavior, which is common in the United States, for example. The tax system causes a lot of distortion by shifting people into untaxed fringe benefits like employer healthcare, housing and so on.

In addition, countries may wish to set higher taxes than the floor price because of domestic environmental co-benefits. Again, we heard about that this morning, most obviously the reduction in air pollution deaths as carbon

pricing reduces the use of pollution-intensive fuels. But in addition, co-benefits include reductions in traffic congestion and traffic accidents as higher motor fuel taxes reduce the amount of vehicle use.

And actually our own estimates suggest that these co-benefits are quite substantial — on average, $57 per ton of CO2 across the top 20 CO2 emitters, but clearly with a lot of variation across countries. These co-benefits are obviously very high in China for example, where there's a high population density and a lot of population exposure to pollution, whereas they're relatively modest, for example, in Australia, where a lot of the coal plants are located on the coast, so emissions are dispersing over the oceans without harming people, and Australia is much less densely populated.

A third reason why it makes sense in my view to allow countries to charge different CO2 prices is just purely on pragmatic grounds. Clearly the political acceptability of stiff carbon pricing varies across countries. We've seen that Sweden was able to implement pretty stiff carbon pricing. But the opposite applies, for example, in Saudi Arabia. There's a lot of opposition to higher energy prices there. Previous experience with tax agreements also suggests that it's much easier for countries to reach an agreement over tax floors than over tax rates. We've seen this in the European Union experience with the value-added taxes and excise taxes on alcohol products, on tobacco products, on fuel products outside of the emissions trading system. In each case, the EU has reached agreement over a tax floor, not a tax rate.

So let's move on to some practical issues. How might we compare carbon prices across different countries? I think initially we want to limit any agreement to energy-related CO2 emissions, because those emissions are relatively easy to observe. Down the road perhaps the agreement could be extended to incorporate non-CO2 greenhouse gases and forest emissions.

Also I think it's important to start with a very small group of countries. Again, the EU experience suggests that it's much easier to get an agreement amongst a small group of countries, and that later countries that join the agreement are accepting of the initial provisions in that agreement. Whereas now that the EU has been enlarged to 28 member states, it's proving a lot more difficult to make progress on tax agreements. In particular, sensible reforms to the Energy Tax Directive in the European Union from an environmental perspective are basically going nowhere, because it's just difficult to get agreement amongst 28 countries.

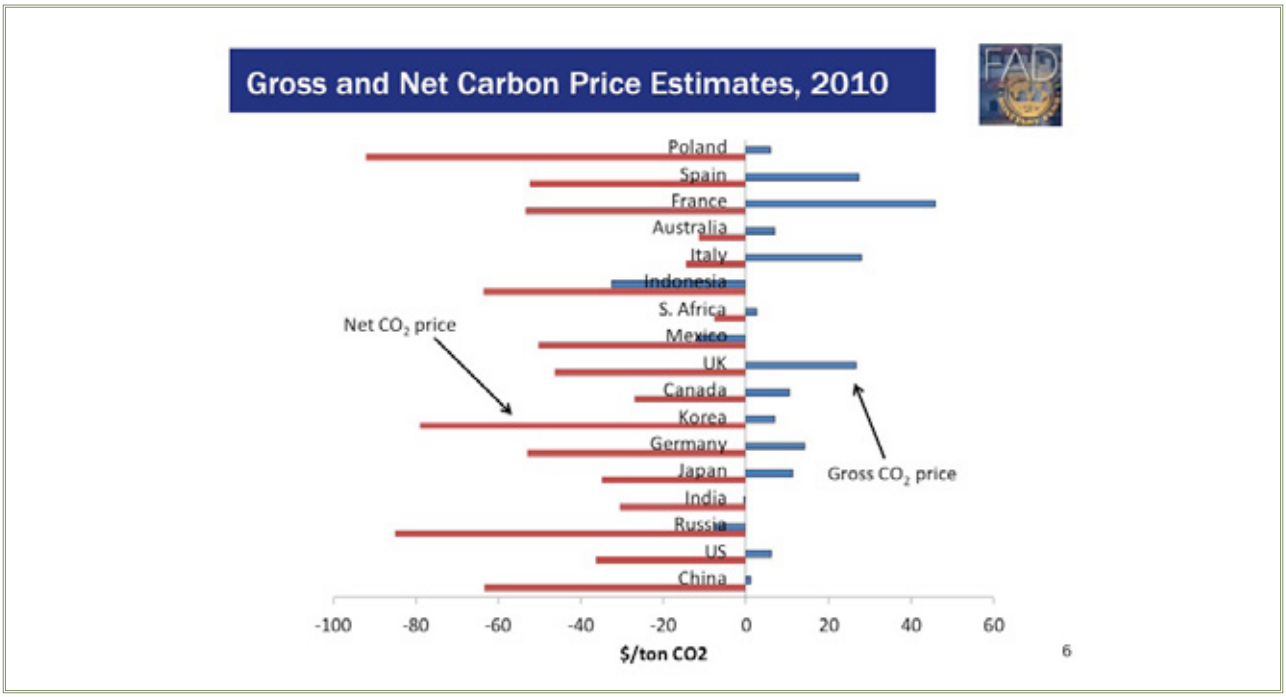
Maybe we differ a bit on this, but in my own view the agreement should just focus on fiscal or pricing instruments. I agree with Adele [Morris] that incorporating implicit CO2 prices from a regulatory instrument, such as standards for energy efficiency or renewables, would be practical and manageable if that's what countries wanted to do. We need to account for fiscal provisions downstream that are directly charging for CO2 emissions out of the smoke stack, so essentially we want to multiply the observed CO2 price by the fraction of energy-related emissions that are covered by the pricing program. But we also need to account for upstream fiscal provisions affecting fuel use, which are going to impact carbon emissions.

And in the latter regard, I think there are two initial steps you need to take to measure the effective carbon prices on fuel use. First, you need to divide the fuel tax or fuel subsidy by the fuel's CO2 emissions factor to express the tax or subsidy in currency units per ton of CO2. Second, you need to average across the different fuels by weighting fuel taxes or subsidies by the share of the fuel's emissions in energy-related emissions. With regard to doing this, we know what CO2 emissions factors are for different fuels. In addition, there's country level data on fuel use available on the web from the International Energy Agency (IEA), so we can easily infer the share of fuels and emissions for different countries.

But measuring the fuel taxes or subsidies is trickier. There's not an international database on excise taxes or fuel subsidies. So instead, at the IMF what we've been doing is using the 'price gap' approach to measure fuel taxes or subsidies. That's where you measure the fuel tax or subsidy by the difference between the observed retail fuel price and some reference international fuel price adjusted for transportation and distribution costs. One advantage of this approach is that it's picking up implicit taxes from monopoly pricing, or undercharging due to the failure to fully apply value-added taxes or general sales taxes to energy products consumed at the household level.

But there are a couple of tricky issues. First of all, ideally when we're aggregating over fuel taxes to come up with our measure of effective carbon pricing across different countries, we'd be weighting those fuel taxes by the relative responsiveness of those taxes at cutting emissions. So obviously, for example, if the demand for natural gas was perfectly inelastic, it doesn't matter how much we tax natural gas, it's not going to reduce emissions, and therefore its contribution to the effective CO2 price is zero. So we need to somehow incorporate fuel price elasticities for different countries when we're obtaining this aggregate measure of effective CO2 pricing.

A second issue is should we be measuring effective CO2 prices gross or net of the domestic external costs of fuel use? The air pollution damages or more generally the traffic congestion, traffic accidents and so on associated with use of fuels in automobiles. I don't think there's a clear conceptual answer to this. You can argue it both ways. You could argue that what should count is only what you are doing in excess of what's needed to cover your domestic externalities. Only that excess fuel tax should count towards what you're doing to reduce carbon emissions. Or alternatively, you could argue that the first priority is to price carbon emissions right. And then what you do beyond that to address your domestic external costs is the countries' issue. So it's not clear to me that one is conceptually preferable to the other. And which measure you are talking about makes a huge difference.



This figure here is showing crude estimates of effective carbon prices for selected countries in 2010. All we're doing here is aggregating over taxes or subsidies on coal use, natural gas, gasoline, and road diesel. The blue bars are the gross measure of carbon prices, ignoring domestic external costs. Notice that these vary quite dramatically across countries. The gross carbon price is negative in Indonesia in 2010, because at that point Indonesia was heavily subsidizing fuels. The gross price is highest in France, because France has relatively high road fuel excises. And in France, which is largely nuclear in the power sector, road fuels account for a relatively high share of economy-wide CO2 emissions.

But if we're to subtract off the domestic external costs of fuel use, the air pollution damages, the traffic congestion, accidents, road damage, and so on with motor fuels, then at least for these countries, the effective of carbon price becomes negative in all cases. Underscoring that our current fuel taxes on average are failing to correct for domestic external costs, let alone the global external costs. So this is just underscoring the point that was made this morning about the potential 'double dividend', for example, for China and India. There are actually negative costs to these countries from raising carbon prices because the domestic environmental benefits outweigh the domestic mitigation costs.

Nonetheless, In my view, for the purposes of an international agreement, we should just focus on the gross measure of effective CO2 prices, because that will leave aside all the contention about measuring domestic externalities and how we might value pollution deaths in different countries with different income levels. However, I think it's pretty hopeless to try and negotiate over harmonizing gross effective CO2 prices. First of all, given the very wide discrepancy in those prices across countries that we saw in the figure, and then secondly countries may want to tax domestic fuels at very different rates depending on domestic external costs, domestic fiscal considerations, and so on.

Instead, it seems to us that it makes sense for countries to agree on an increase in their gross effective CO2 prices in the future relative to their CO2 prices in some baseline year. So maybe all countries agree that gross effective CO2 prices will increase by, say, $20 per ton by 2020 — and I think one nice advantage of this approach is that it allows a lot of flexibility at the country level. Clearly there's going to be a lot of country-specific pressure for special provisions. Maybe some countries are landlocked, and they're worried if they raise taxes on diesel fuel too much, that'll create a lot of cross-border smuggling. Maybe some other countries like Sweden are worried about not raising energy prices too much for energy-intensive trade-exposed sectors. This approach says that's fine: we can accommodate that so long as you compensate by charging somewhat higher taxes on CO2 emissions elsewhere such that your overall effective CO2 tax still meets the obligations.

I'll just note that one complication we need to think through a bit more carefully is that national fuel taxes are expressed in national currencies, whereas to compare effective CO2 prices across countries, we need to convert them into common currencies. That's not a trivial issue. Should we use SDRs, or should we use purchasing power parity, market exchange rates, or what? I think we need to think through that a bit more carefully. And suppose there are sudden movements in exchange rates. Does that imply that national taxes should be adjusted in response? Thank you.

Richard Cooper

I do not have slides, but I'm going to follow the set of questions which management presented us for this session; so to follow my talk you can open your program to page two, and I will go through these questions. But I want to preface my remarks by two perspectives that strongly influence my thinking on climate change. The first is dealing with climate change is not the only public good in the international system. We have to be careful about side damage, externalities if you like, from whatever we do in this area for other parts of the system.

In particular, there is potentially large tension between the trading system, which has served us well for the last half century. It is itself evolving. But I don't think we want to damage it unduly. There is also a risk that concerns about the trading system inhibit sensible action on climate change. These two considerations lead me strongly, and in fact I would even argue decisively, in favor of a homogenous, uniform world carbon charge. I accept what Ian said, that it could be a minimum tax, but nonetheless, a uniform minimum tax.

Why? Because that would completely neutralize the arguments about competitiveness. A uniform carbon tax neutralizes that particular issue. Any other system that I can think of, including a free for all, is going to encounter the issue of competiveness. Business constituencies in the tradable sector of every country will claim that they have to pay whatever they have to pay under the heading of climate change. But country X's products don't pay the same, and therefore we should impose trade barriers.

So doing something serious about climate change could undermine the trading system. That leads me to a uniform minimum carbon tax globally. It's the only way I can think to reconcile smooth operation

of the trading system with effective action on climate change. And for me, that argument is decisive. We could spend a lot of time discussing cap and trade. I believe a cap and trade at a global level is simply not on for a variety of reasons, especially its invitation to favoritism in allocating emission permits. But that's not the topic of this session.

The other perspective that influences me is an analogy. I'm going to choose copper as my example, but you can substitute many other commodities for copper. How does the world market for copper work? There's a price for copper, set in the London Metal Exchange. It's for electrolytic copper, I believe the most homogeneous product we have in the world, because you have to reach a certain threshold of purity before copper will conduct electricity efficiently. Its London price of course is adjusted for transport and other costs to different parts of the world market.

Everyone who uses copper pays the price of copper. History is irrelevant. A century ago we had extremely rich copper ores, with 5% copper. We are now mining copper that is three-tenths of 1% copper. So the quality of the ores has deteriorated over the last century. We have not seen a strong Ricardian price effect because technical change has kept up with the deterioration in the quality of ores. Europe and then the United States used up the good copper ores. Under special and differential treatment, does India pay a lower price for copper today than Europeans or Americans do, because the Europeans and the Americans used up the rich copper ores? No, no one thinks about it at all. The marginal cost of copper today is what all people pay if they want to use copper.

I make the analogy to climate change. We discovered two to three decades ago that we are using up our atmosphere as a disposal medium for carbon dioxide and other greenhouse gases. That has future consequences that we don't like. So I think of the atmosphere as a disposal medium, as a resource like copper. History is irrelevant. Equity is irrelevant. If you put carbon dioxide into the atmosphere, you should pay its global social cost. Everyone should pay for it, just like anyone who wants to use copper pays the going price of copper. So this is the perspective that I bring to greenhouse gas emissions. It does not appeal to Indian diplomats, who in effect argue that India should be able to buy copper, or oil, more cheaply than other people because India is poor (although not all Indians are poor, especially those who consume oil and copper). I think it's an appropriate analogy.

So now let me go down the list that you all have on page two. I think we should have a minimum price of greenhouse gas emissions as a target. The price is going to be negotiated. Marty [Weitzman] did a good job this morning of explaining why negotiating one objective is a lot easier than negotiating N objectives, particularly when the N objectives are distributional. The price has some distributional implications. But if you're negotiating N targets, you're actually negotiating distributional issues directly, and that's the most difficult kind of negotiation to succeed.

I clustered the next set of questions. What should we do with the *status quo ante*? My view, with one qualification, and I think I come out at the same place Ian did, is that you pay no attention to the *status quo ante*. Whatever congestion charges or pollution charges or subsidies that countries have on

the use of fossil fuels, they have for whatever past reasons they have them. Unless those reasons go away, in which case they will presumably change their policies, this is a new reason — that we're crowding the atmosphere — and we should all pay for it at the margin. Take all of the rest of the stuff as given national policy and not make any adjustments for existing policies, including subsidies. Countries will have to decide themselves when they want to get rid of their subsidies.

I do make one exception for that, which is that some countries have moved more quickly than others in adopting climate change policies. So I would give credit to climate change policies that have already been undertaken. British Columbia has a carbon tax specifically to address climate change. There's no reason to put another world carbon tax on top of it. I would have an adjudicatory procedure, a discussion procedure whereby countries make the claim that they introduced their policy because of climate change, post-Kyoto, and therefore they should get credit. So that's the only credit I would give for existing policies, nothing else. I would basically leave the status quo out of it.

Should coverage of emission sources be just CO2 from energy? My view is that in principle we ought to cover all of the greenhouse gases. But of course one would have to pay attention to the practical questions of implementation. The problems are mainly in agriculture and forestry. You don't want to go through all kinds of hoops, which some countries are incapable of going through, to impose taxes that in fact can't be imposed as a practical matter.

But I would say the stated objective should be that all greenhouse gases should be covered, and we now have the carbon dioxide equivalents for most of those gases at least as a rough approximation. It probably makes sense to start with fossil fuels, as Ian [Parry] suggested, and CO2. But I would not frame the issue as ending there. I would frame the issue as comprehensive. At the end of the day we probably will not be able to tax wet rice production, and some other agricultural activities. But at least in principle, we should cover all important greenhouse gases and work out how it might be done as a practical matter.

Interpretation of common but differentiated responsibility, forget it. That goes back to my copper analogy. This is just a mistake. It was a mistake to put into the trading regime back in the late 1960s. India has been the main free rider since that time, and India needs to be told it can't free ride any-

more. It is too big, too important. It's true that India is still poor, but that has nothing to do with its consumption of copper or oil. And it shouldn't have anything to do with its restrictions on greenhouse gas emissions. That's going to be a hard sell, I know. But I think it is the correct position. Incidentally, India badly needs the revenues that would flow from an emissions tax, and could devote some of the revenue to development.

Formula for converting national carbon prices into a common currency: I may not understand that issue. Ian [Parry] said this was an important issue. The way I think of it, again with the trading system in mind, this is a straightforward issue. You do it at the same price that trade takes place, which is the market exchange rate for most countries. Again, it's the link to trade that's important. There are a few countries, North Korea being probably the most outstanding, where the official exchange rate bears no relationship whatsoever to anything. There may be a few other countries in that category. But they're not quantitatively important. India has current account convertibility; China has current account convertibility. Indonesia and Brazil have full convertibility. Just use market exchange rates for converting the common agreed price into national currencies.

Who should do the measuring and monitoring? We've had tremendous improvement in satellite observation, both in the number of satellites and in the sensors that we put on them. Among things that satellites can pick up is infrared intensity. So one part of the surveillance should be explicitly charging countries that have these satellites with collecting data on heat generating and other relevant activities.

We will have each country's declaration of its own greenhouse gases, and there can be a lot of technical assistance in collecting that information — and by the way, observation while the technical assistance is being given. So we have a baseline, we have the satellite observations, and we have the IMF monitoring the fiscal situation in each country. It will be easy enough to determine whether countries have passed the required tax into law, but very hard in many countries to find out whether they're actually collecting the tax. I would charge the IMF with that responsibility. Then one can imagine a series of consultations that get harder and harder if a country is charged with, or suspected of, not being in compliance.

Again, we have analogous provision in other treaties, such as the non-proliferation treaty. We have some experience with that now. It's not a perfect process, but it probably will work well enough.

I think I've covered the sources of emissions. If they're too costly, they're too costly. We shouldn't try to do things that we can't do.

Europe in particular seems to be committed to a cap and trade regime for at least 40% to 50% of its emissions, and China may be moving in that direction. I think it's possible to combine a uniform minimum world carbon tax with a cap and trade system, subject to some side rules. It requires a little imagination, but not a tremendous amount. Moving to an international regime on carbon taxes

would not require Europe and other countries that have embraced cap and trade to abandon their systems. It would have something to say about the minimum prices which clear those markets; if for some stipulated period of time, let's say six months, the market clearing price in the ETS were below the internationally agreed price, then Europe would be required to adjust the permit levels to raise the price. It's a little complicated, but I think it's entirely manageable. It's not a deep conflict.

I have nothing to say about existing international tax agreements. At least in my limited knowledge of them, they're not relevant to this problem. That concludes my remarks.

Kurt Van Dender

These notes are an edited and slightly updated version of the presentation given at the Workshop on Global Harmonized Carbon Pricing: Looking Beyond Paris, Yale Center for the Study of Globalization, May 27 and 28, 2015.

1. Introduction

This presentation offers thoughts on practical aspects of international carbon pricing. No attempt is made to develop a comprehensive and fully coherent framework. Instead, it draws from recent OECD work to provide some quantitative anchor-points for the discussion, and it offers some reflections. All interpretations reflect a personal point of view and should not be attributed to the OECD.

The presentation touches upon the following points: carbon pricing is the cornerstone of climate policy, but transitioning to a low-carbon economy will require alignment of a broad range of policies; current taxes on energy use are often low and incoherent from an environmental point of view, resulting in weak carbon price signals; agreement on minimum carbon prices is easier than on a specific price level; evidence on the distributional and competitiveness impacts of carbon prices suggests that adverse effects are more limited than is often assumed, and can be overcome by accompanying policies.

Before discussing these points in some detail, I would like to thank the organizers for extending an invitation to the OECD, and for the generous financial and logistical support that made my attendance possible.

2. Carbon prices are not used to their full potential

The view that putting a price on carbon is an indispensable component of climate policy is widely shared. For example, in his opening remarks to the 2015 Conference of the International Tax Dialogue, which was devoted to "Tax and the Environment", OECD Secretary General Angel Gurría said that "The partners of the International Tax Dialogue [Inter-American Center of Tax Administrations – CIAT, European Commission, Inter-American Development Bank, IMF, OECD, and World Bank] share the conviction that putting a price on carbon alone is not sufficient to address the environmental

challenges we face, but it is an essential part of the solution."[1] The partner organizations concluded after the conference that, "Taxes are potentially among the most effective ways of cutting pollution and greenhouse gas emissions, but they are currently — with very few exceptions — underused; and even where used, they are frequently designed in a sub-optimal way".[2]

Taxes and auctioned tradable permits can be used to price carbon, and they raise public revenue. This adds to their appeal, at least as long as the revenue is used productively. The case for putting a price on carbon is weaker if there is no revenue or if it risks to be put to unproductive use. Tax and cap-and-trade can be roughly equivalent in revenue terms if permits are auctioned, although taxes are often thought to be simpler to administer and the conditions for smoothly functioning markets are not met everywhere. However, irrespective of its relative merits in principle, cap-and-trade is likely to remain part of the policy mix in several regions, e.g. the European Union and China, so that pragmatic approaches to fixing observed drawbacks can be highly productive.

3. The need for broad policy alignment

Other climate policies are needed in addition to carbon pricing, and non-climate policies need to accommodate climate policies or at least not hinder them. The OECD, in co-operation with the International Energy Agency, the International Transport Forum, and the Nuclear Energy Agency, released in July 2015 a report entitled 'Aligning policies for a low carbon economy'.[3] The key insight from the report is that policy practice in many domains (taxation, investment, transport, electricity, land use, etc.) was developed in a context where climate change was not a concern, and that this frequently results in policy misalignments: even if core climate policies, including carbon prices, were in place, they would not live up to their potential unless the broad policy context is better aligned with transitioning to a low carbon economy. Some examples of misalignments include government support for R&D for fossil fuels, government support for the production or consumption of fossil fuels, and favorable tax treatment of company cars. These forms of support are used to varying degrees in different countries, but in total are worth considerably more than government support for renewable energy (in years between 2010–2013, an estimated USD 660 billion per year was spent for fossil fuel support against ca. USD 100 billion per year for renewable energy support).[4]

1. http://www.oecd.org/about/secretary-general/6th-international-tax-dialogue-global-conference-opening-remarks.htm; bracketed expression added.

2. http://www.oecd.org/tax/much-better-use-can-and-must-be-made-of-taxes-to-help-reduce-pollution-and-greenhouse-gas-emissions.htm

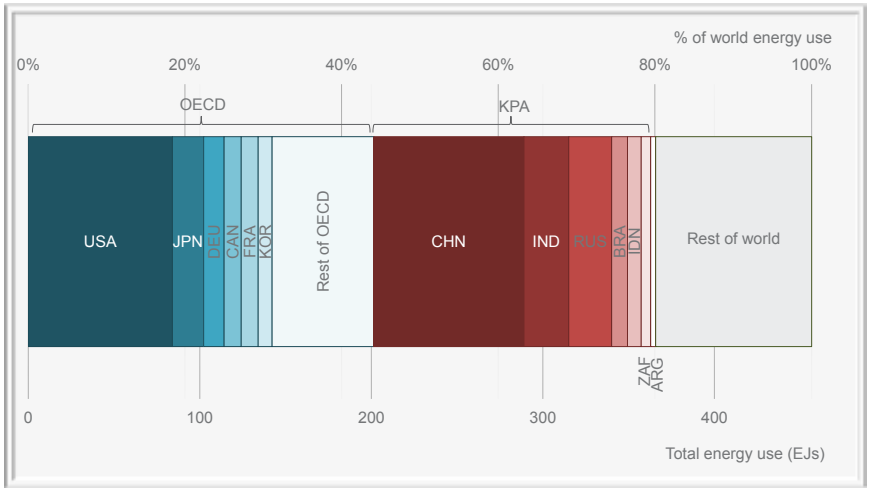
3. OECD, 2015, *Aligning Policies for a Low-carbon Economy*, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/9789264233294-en

4. These estimates combine evidence from OECD, 2013, Inventory of Estimated Budgetary Support and Tax Expenditures for Fossil Fuels. DOI:10.1787/9789264187610-en; IEA, 2013, World Energy Outlook – http://www.worldenergyoutlook.org/publications/weo-2013/; IEA, 2013, Tracking Clean Energy Progress Report – http://www.iea.org/etp/tracking2013/; and OECD, 2013, Effective Carbon Prices. DOI : 10.1787/9789264196964-en. The subsidies discussed here are, in IMF terminology, "pre-tax subsidies". So-called "post-tax subsidies" are not included. "Post-tax subsidies" are non-internalized external costs, which here are labelled and discussed as such.

4. How is energy use presently taxed?

Energy use is an important contributor to greenhouse gas emissions; taxes on energy use could play a prominent role in containing greenhouse gas emissions. Two OECD reports provide a detailed description of the specific taxes levied on energy use in 41 countries, the 34 OECD member economies (ca. 45% of world energy use in 2012) and seven selected partner economies (ca. 35% of world energy use in 2012; ca. 80% of energy use in total, see Figure 1).[5] The reports clarify to what extent taxes currently act as effective carbon prices, and how carbon pricing might be added to or replace existing taxes.

Figure 1. Coverage of world energy use in the OECD Taxing Energy Use publications

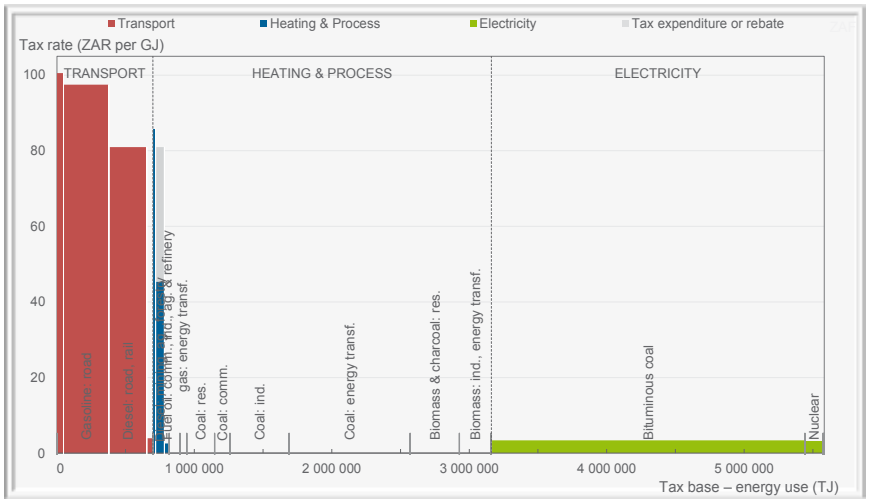


Source: OECD, 2015, Taxing Energy Use 2015 – OECD and Selected Partner Economies, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/9789264232334-en

For each of the 41 countries, a graphical profile summarizes energy use and specific taxes on energy use. Figure 2 shows the profile for South Africa, by way of example. The horizontal axis shows energy use in terajoules; alternatively, the profile can be shown with CO2-emissions on the horizontal axis. Tax rates per Gigajoule are on the vertical axis; alternatively, they can be shown per ton of CO2. Energy use is divided in three sectors (transport, heating and process use, and electricity) and subcategories thereof (by fuel and usage type).

5. OECD, 2013, *Taxing Energy Use – A Graphical Analysis*, OECD Publishing, Paris. DOI: 10.1787/9789264183933-en and OECD, 2015, *Taxing Energy Use 2015: OECD and Selected Partner Economies*, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/9789264232334-en

Figure 2. Graphical profile of energy use and taxation in South Africa



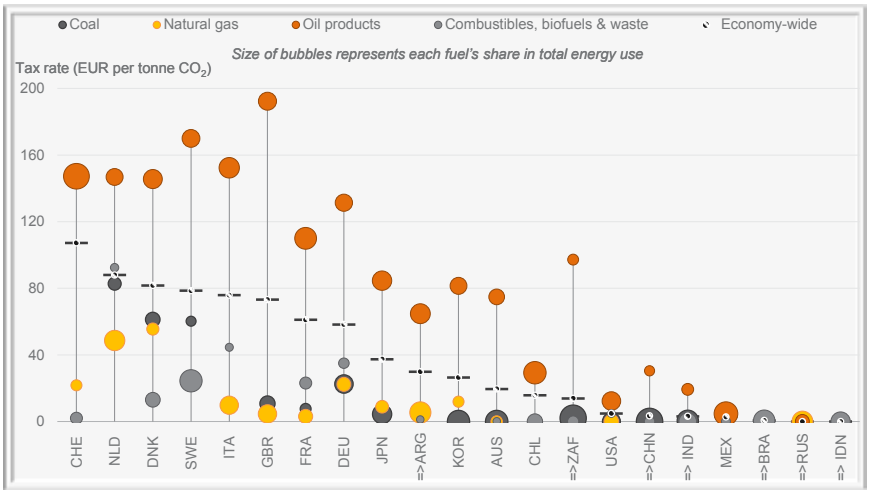
Source: OECD, 2015, Taxing Energy Use 2015 – OECD and Selected Partner Economies, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/9789264232334-en

The tax rates in the transport sector are higher than in the other sectors — not only in South Africa but in all of the 41 countries included in the database except for Brazil. Typically gasoline is taxed more highly per liter than diesel which, from a climate point of view, does not make sense because the carbon content of diesel is higher than that of gasoline. Other externality-related rationales for fuel taxes also point in the direction of higher taxes per liter of diesel than per liter of petrol.[6]

In heating and process use in South Africa, as — to varying degrees — in other countries, much lower taxes are observed than in transport. Also as in many countries, taxes on oil products used for heating and process use are higher than taxes on other fuels used for these purposes. Heating and process energy is dominated by coal, and coal use in this sector is untaxed in South Africa in 2012. This too is a common pattern: taxes on coal often are low or zero, despite its relatively high environmental costs. South Africa taxes coal used to generate electricity, and it taxes nuclear power. The tax on coal for electricity generation amounts to EUR 3.45 per ton of CO2.

6. Harding, Michelle, 2014, The Diesel Differential : Differences in the Tax Treatment of Gasoline and Diesel for Road Use, OECD Taxation Working Papers, 21. DOI:10.1787/22235558

Figure 3. Economy-wide effective tax rates on carbon by fuel and on average



Source: OECD, 2015, Taxing Energy Use 2015 – OECD and Selected Partner Economies, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/9789264232334-en

The detailed energy tax information allows calculating various aggregated effective tax rates on carbon, in EUR per ton of CO2. For example, it is instructive to consider these effective tax rates separately by fuel type. Among the 41 countries, the median effective tax rate per ton of CO2-emissions from all coal use is EUR 2.2 per ton. At the first quartile, the effective tax rate is zero; at the third quartile it equals EUR 10.2 per ton. For combustibles, biofuels and waste, the effective tax rates per ton of CO2 at the median, first and third quartile, are EUR 0.6, zero and EUR 11, respectively. For natural gas, the analogous rates are EUR 4, 0.05 and 19.4. For oil products, they are EUR 112.4, 65.4 and 132.5. Differences between countries are large and for some fuels, e.g. coal, taxes are zero or very low in many countries.

Figure 3 shows the effective tax rates by fuel type for a subset of the 41 countries. In Switzerland (CHE, leftmost on the figure), for example, the effective tax rate on oil products — which are mostly used in transport — is around EUR 150 per ton of CO2. The effective tax rate on natural gas is much lower, about EUR 20 per ton of CO2. Effective tax rates on combustible biofuels and waste are close to zero. The average effective tax rate for Switzerland is approximately EUR 110 per ton of CO2. This country-wide average is clearly strongly dependent on the effective tax rate in the transport sector. The country-wide effective tax rates are lower in other countries.

Using an estimate of the social cost of carbon of EUR 30 per ton of CO2,[7] country-wide averages are below the social cost of carbon in many cases. If abstraction is made of taxes on fuel for road transport, effective tax rates are most often well below EUR 30 per ton of CO2. This means that, even if energy taxes were used to price for carbon alone, then current taxes should be increased for most types of use in most countries. Table 1 makes this point at the level of sector aggregates, with rates averaged over the 41 countries included in the database. Transport has quite high rates in terms of CO2 (EUR 70 per ton) but rates are quite low in the other sectors.

Table 1. Effective tax rates on energy and on carbon: country average for the OECD and Selected Partner economies by Sector

Weighted average effective tax rates	Transport	Heating & process	Electricity	All fuels
Energy *EUR/GJ*	5.0	0.3	0.3	1.1
Carbon emissions *EUR/tonne CO_2*	70.1	3.1	3.4	14.8

Source: OECD, 2015, Taxing Energy Use 2015 – OECD and Selected Partner Economies, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/9789264232334-en

To summarize, what is observed at present is a patchwork, with incoherent and often very low taxes on energy use. The pattern of low specific taxes on energy use is strengthened by concessional VAT rates for some types of energy use, in about half of the countries included in the Taxing Energy Use database. Taxes are clearly influenced by a range of policy objectives, including revenue raising concerns (for example, in transport), equity concerns (sometimes leading, for example, to low heating fuel taxes, even if this is not a very well targeted distributional policy), and competitiveness concerns. Environment and climate concerns affect energy taxes as well, but perhaps mostly in the sense that taxes on average are higher in countries where such concerns are higher on the agenda. Within countries, consistency in tax signals from a climate or broader environmental point of view is rare.

It is clear from the calculation of the effective tax rates that explicit carbon prices alone do not capture the full extent of carbon pricing. Taxes on energy use exist for several reasons, but the tax burden can be reduced by reducing energy use or switching to less carbon-intensive fuels, so reducing carbon emissions. Taxes on energy use hence can be thought of as effective carbon prices. Fuel taxes

7. The social cost of carbon reflects the damage from an additional ton of CO2 emissions. Measuring this damage is very complex because of major uncertainties on the underlying climate and economic processes and the long time horizon over which impacts need to be measured. The EUR 30 per ton of CO2 used here refers to current emissions; the damage is very likely to be higher for future emissions. The value reflects global damage, not the damage at the level of a particular country. EUR 30 is at the lower end of central tendency estimates (see for example the discussion in Marron, Donald, Eric Toder and Lydia Austin, 2015, Taxing Carbon: What, Why, and How, Tax Policy Center, Urban Institute and Brookings Institution, June 2015).

differ from explicit carbon taxes only to the extent that they do not reflect the relative carbon context of different fuels. Considering effective carbon prices also produces measures that are less vulnerable to fiscal cushioning, as might occur when explicit carbon prices are compensated by reductions of fuel taxes.

5. Taxes on energy use and international carbon pricing

In debates on international coordination of carbon pricing, should carbon taxes be additional to existing effective carbon taxes, or should there be some form of recognition of efforts already made, even if these take the form of effective carbon prices as calculated above, but not necessarily in the form of explicit carbon prices?

One approach is to assume that prevailing taxes on energy use include an implicit carbon component, as well as components to address other policy goals (e.g. raise revenue, combat pollution, reduce congestion, etc.). Taxes could be reformed to ensure that the carbon component is made equal across fuels and user types, as would be the case with an explicit carbon tax. This would require (1) deciding why taxes are set the way they are, and (2) putting values on these components. The uncertainties implied in both steps are large. While considerations related to Pigouvian taxation are helpful to gauge the environmental effectiveness of countries' pricing systems and can indicate strategic directions for domestic tax reform, they may be less directly relevant to the international carbon pricing debate. The complexity of the analysis and the interactions between different policy spheres risk paralyzing an already very complex international coordination process.

The relation between taxes and external costs is particularly complex in the transport sector. Fuel tax rates for road transport are relatively high in many countries, and fuel taxes can be used to internalize a range of external costs. However, some external costs are closely related to driving (notably congestion, but also air pollution) and only indirectly to fuel use. If a country would introduce distance-based charges or congestion charges to internalize these costs, the second best case for a high fuel tax (to reflect driving-related external costs) disappears and in principle fuel taxes should decline (as "co-benefits" from fuel taxes have disappeared). Reducing fuel taxes may not be a very practicable recommendation, although fuel taxes could decline gradually over time by not increasing their nominal level, if they are gradually replaced by driving-related charges. Such a change would imply a reduction of the effective tax rate on carbon from transport fuels, but it would also constitute an improvement in the efficiency of the transport tax system. More generally, the Pigouvian case for adding explicit carbon taxes to existing transport fuel taxes is weak in some countries (not all countries – higher fuel taxes are justified in a number of countries, including very large ones) because current tax levels arguably contain sufficiently high effective carbon tax components already. If these high taxes do not lead to strong 'decarbonization' of the sector, this indicates that further abatement in the sector under current conditions is expensive, and that non-tax policies may need to change for strong carbon cuts to be possible.

A second and more pragmatic approach is to require that the tax on all sources and uses of energy is at least equal to the aspired level of carbon prices. Alternatively, a uniform carbon price could be added to existing specific taxes on energy use except where there are explicit carbon taxes or cap-and-trade schemes. The difference between these two alternatives reflects a view on whether current taxes contain some degree of implicit carbon taxation or not, and the choice between both may mainly be a matter of political expedience. The importance of the reform in both cases is that all forms of energy use would be subject to at least the intended carbon price. Other policy objectives, e.g. co-benefits, could lead countries to set higher taxes. Given the currently low carbon prices for large portions of energy use, including but not limited to carbon-rich coal, large gains are to be had from such reforms. Decisions on how to deploy revenues can vary depending on local circumstances.

Current practice in different countries or subnational governments reflects both forms of the pragmatic approach. The Canadian province of British Columbia introduced a carbon tax in 2008. It applies to all combustion of fossil fuels and it was additional to existing taxes. The tax is revenue neutral. Tax cuts initially mainly favored individuals or households, but over time more of the revenue was used to cut taxes on business, with some concern over the introduction of "seemingly unrelated tax credits"[8]. The tax rate is CAD 30 per ton of CO2 (approximately EUR 22) since 2012.

Ireland introduced a carbon tax in 2010, at a rate of EUR 15 per ton of CO2 (later increased to EUR 20), covering most CO2-emissions from sectors not covered in the EU Emission Trading Scheme. The tax was additional but not revenue neutral, as it was part of a broader reform designed to raise more revenue in the wake of the fiscal crisis that started in late 2008. The revenue from the carbon tax contributed more than 20% of the tax revenue increases that were required by the Troika in the November 2010 agreement with the government.[9]

In France, after two failed attempts to introduce a carbon tax, a tax of EUR 7 per ton of CO2 was introduced in 2014 (*la contribution climat-énergie*), in the sense that if a source of energy was already taxed at least EUR 7 per ton, the rate would not increase, whereas for types of energy that were taxed at less than EUR 7 per ton, the rate would increase to EUR 7 per ton. In practice, the tax rate on transport fuels did not change, while the tax rate on natural gas and on coal did increase to EUR 7 per ton. France will raise the carbon tax to EUR 20 per ton for all types of fuels in 2016; a proposal is under consideration to increase the tax to EUR 56 per ton of CO2 by 2020.[10] This is an example of a gradual introduction of a carbon tax within the existing excise tax system, recognizing that existing excises are effective carbon prices and that they can already contain an implicit carbon pricing component.

8. Harrison, Kathryn, 2013, The Political Economy of British Columbia's Carbon Tax, OECD Environment Working Papers, 63. DOI: 10.1787/19970900

9. Convery, Frank, Louise Dunne and Deirdre Joyce, 2013, Ireland's Carbon Tax and the Fiscal Crisis – Issues in Fiscal Adjustment, Environmental Effectiveness, Competitiveness, Leakage and Equity Implications, OECD Environment Working Papers, 59. DOI: 10.1787/19970900

10. http://www.lesechos.fr/journal20150806/lec1_france/021246807763-prix-des-carburants-ce-que-va-couter-la-taxe-carbone-1142588.php

These three examples illustrate that there are different approaches to introducing carbon taxes, and such diversity can be expected to continue as policy development reflects specific local circumstances. International coordination of carbon prices could accommodate such diversity.

6. Concerns about regressivity and reduced competitiveness

Two commonly cited hurdles to increasing effective carbon prices are adverse equity impacts (e.g. regressivity or increased poverty risk) and reduced competitiveness of energy-intensive industries (as long as there is no full international coordination). Recent OECD working papers indicate that such concerns should not be overstated for current policies: careful econometric analysis finds no adverse impacts of prevailing carbon prices on common indicators of competitiveness[11], and systematic evidence from household budget surveys for more than 20 (mostly European) OECD countries[12] shows that taxes on transport fuels are on average not regressive, and slightly regressive for heating fuels and for electricity. The point here is not that equity and competitiveness impacts can safely be disregarded in policy design, but rather that the evidence does show that gradual increases of carbon prices are possible and that with careful monitoring and accompanying policies, their environmental effectiveness can be retained while avoiding undesirable impacts on equity and on competitiveness.

7. Summing up

Carbon pricing is an essential part of climate policy. There is considerable scope for better harnessing the power of carbon pricing via taxes or auctioned tradable permits on condition that public revenues are put to productive use. At the country level, climate pricing policy can interact with other policies in complicated ways, so that international coordination is likely easier if it aims for a minimum price on carbon. Given that prevailing effective tax rates on carbon emission from many forms of energy use are very low — in particular for fuels other than oil products — in many countries, the potential environmental gains from such a minimum are very large, and with careful policy design they need not come at a cost in terms of equity, efficiency, or economic growth.

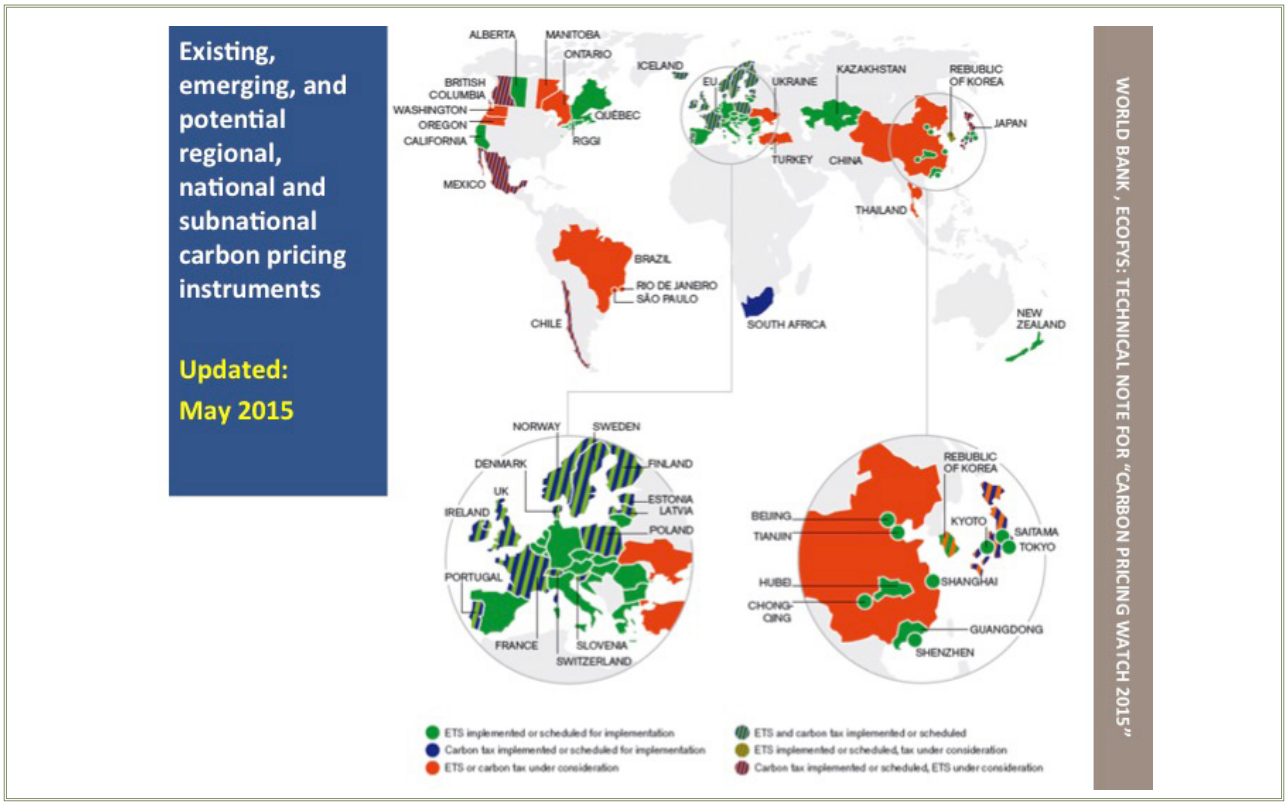
Grzegorz Peszko

Thank you very much, and thank you for having invited the World Bank to this meeting. I've learned a lot already. What I'm going to focus on is the practical aspects of implementing global carbon pricing.

This map is the first reality check. It's an extract from the annual publication, "Technical Note for Carbon Pricing Watch 2015" that we update every year on the state of and trends in carbon pricing. And it shows the distribution of the existing carbon pricing instruments around the world.

11. Arlinghaus, Johanna, 2015, Impacts of Carbon Prices on Indicators of Competitiveness, OECD Environment Working Papers, 87. DOI: 10.1787/19970900; Flues, Florens, 2015, Competitiveness Impacts of the German Electricity Tax, OECD Environment Working Papers, 88. DOI: 10.1787/19970900.

12. Flues, Florens and Alastair Thomas, 2015, The Distributional Effects of Energy Taxes, OECD Taxation Working Papers, 23. DOI: 10.1787/22235558.

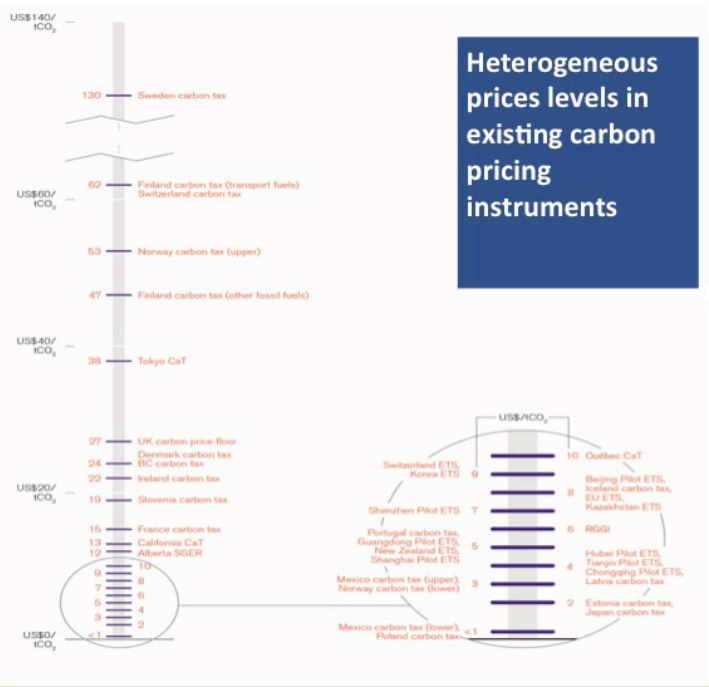


The countries in green are those that have implemented or are scheduled already for implementation: so, where there's a legal decision to implement cap and trade systems. The blue countries are those who either already have or are planning to have a carbon tax. And the red are those countries that are considering the implementation of either of these carbon pricing instruments.

If you haven't counted yet, I can tell you that at the moment, as of May of this year (2015), 40 national jurisdictions and 20 subnational jurisdictions have introduced some form of explicit carbon pricing. And this is on the explicit carbon pricing instruments that we monitor. All together they cover about 7 gigatons of CO2 emissions, which is about 12% of the global annual emissions.

If you add up all the coverage and the prices in the jurisdictions, the total volume of the carbon market at the moment — it includes both the tax revenues and the value of emission allowances — is around $50 billion globally.

The graph below shows the distribution of price levels, and as you can see, it varies a lot. The prices are very heterogeneous. The small circle on the bottom of the left bar is zoomed out so you can see that most of the carbon prices globally are in the very low ranges. Certainly Sweden is an outlier, but most of the countries have prices between zero and $10 a ton of CO2.



And interestingly, their heterogeneity, or the differences between the carbon tax rates is bigger than the differences between the prices in the cap and trade systems, but at least we have some very high carbon taxes and we don't have any high prices at the carbon markets.

Now I'm in trouble because in the rest of this presentation I'd like to focus on what we are working on at the World Bank in terms of supporting the effort to harmonize carbon pricing signals globally. And in that effort, we decided to follow the path of the cap and trade systems rather than taxes, although when we work with countries, we are basically oblivious as to whether it's a carbon tax or a cap and trade system.

However, what we found out is that for a variety of reasons, at the moment it looks like the path towards a global carbon price is more easily paved or more practically paved with linking or networking cap and trade systems rather than working on the efforts to harmonize carbon taxes between different jurisdictions.

It looks like harmonization of taxes and fiscal policy is strictly a matter of sovereign domain in many countries, and some countries have constitutional problems with harmonizing tax rates.

We have a lot of experience with linking different cap and trade systems. Eurovis is an example — the linking between the EU, ETS, and Norway's Iceland or Lichtenstein's cap and trade systems. California has a link with Quebec, and Ontario has just announced that it will join. There were a lot of linkages through it with a credit mechanism. We had an example of international trading with assigned amounts units under Article 17 of the Kyoto Protocol. We have the joint implementation mechanism, which was kind of a hybrid of the cap-based mechanism and the credit-based mechanism.

We have less experience with harmonizing energy and carbon taxes across different jurisdictions. Ian [Parry] mentioned that after a long and painful process, Europe has agreed on the minimum taxes on excise-duty on energy, but the Commission proposal for the revision of the energy tax directive that was supposed to introduce some differentiation of the energy tax rates, depending on the carbon content, basically got buried for the time being.

We have been thinking of how we, as the World Bank, can best support this international process of moving towards a globally coherent carbon price signal. We have also been considering what are the dynamics of the international process. As international negotiations have switched gears from the top-down, legally binding agreement, that we remember from Kyoto times, towards this INDC-driven, let a hundred flowers bloom and then see what happens, through the bottom-up processes of building negotiations and finding ways to create a critical mass of the different leaders, we thought that cap and trade feeds better into this soft and very pragmatic paradigm that has developed and allows for networking of cap and trade systems.

The approach is soft because we don't want to lose countries that have very different characteristics, so we have focused on linking efforts. We have some examples of linking, and it starts from the full, strict linking when the compliance uniting of one jurisdiction is fully accepted in the other jurisdiction; this is how the EU has linked their systems in the EU ETS with Norway or Lichtenstein and Iceland. There can be linking with some constraints, qualitative constraints or quantitative constraints, and there can be direct linking. We have seen how various mechanisms have been, or even still are, linked through the CDM mechanism, through a third carbon market.

What seems to be the prerequisite for full linking is at least ensuring that there is some fungibility, some comparability of the abatement efforts that can be quantified and turned into carbon assets across jurisdictions. This can be facilitated by some sort of assessment of risk to these assets. If there are qualitative differences between asset classes, we would need to accept some form of discounting.

So we started from the assumption that the world is as it is. There is no global carbon price, and we are very far from it. We are in a world of very fragmented, very heterogeneous efforts to introduce carbon price signals. In such a world, the comparability between the countries,

comparability of the abatement efforts, and the fungibility between the asset classes is increasingly relevant for bringing all these efforts together into something coherent.

Ensuring this comparability and fungibility involves determining some sort of value for the mitigation effort, and therefore determining exchange rates between the different carbon assets in different jurisdictions. These two elements, mitigation value and exchange rates, would determine the approach for facilitating the integration of the international carbon market.

Other principles that, for us, have to underlie these efforts to integrate carbon markets come from the realization of where we are now in the world. It has to be voluntary; it has to fully respect the sovereign rights of the countries; it has to be somehow compatible with the current shape of the UN process, and we don't see that the Paris Agreement will bring any meaningful top-down, strong, legally binding agreement on the process.

It should be incentive compatible by encouraging participation. It should facilitate self-enforcing international agreements, in the words of the early work of Scott Barrett. It has to facilitate participation of the private sector. And this is one of the values of the cap and trade system: by creating value associated with carbon assets it also creates some vested interest around maintaining this value. And it has to ensure environmental integrity.

The key components of these networked carbon markets consist of, first, an independent assessment framework to determine mitigation value and facilitate fungibility of different carbon assets across countries. Second, an international carbon asset reserve to facilitate price stability. Its main function would be to develop a mechanism that would create tax equivalents of the pricing signal in the cap and trade systems. Finally, it will have to consist of some sort of international settlement platform, which would be a new version of the registry. This would track trades and provide a clearing-house to control the risks that Martin Weitzman was talking about, the theft and abuse and corruption that could develop with a market.

There is still a lot of discussion going on about the independent assessment framework. We don't have answers yet, but the idea is that the relative value of any asset that represents certain abatement efforts and abatement outcomes should be a function of the risk at the program, project and jurisdiction level; the risk of the policy inconsistency and of sudden changes in the regulatory or institutional framework; as well as the risk of global environmental integrity, or whether any particular abatement effort really brings a country towards the pathway needed for a 2 degree target.

The fungibility through the carbon exchange rate is a very contentious issue. Everybody knows that it's inevitable, and there are and there will be different qualities of abatement efforts. But it's very difficult to design, in practical terms, the governance structure for it. It is difficult to assign the rates. You can have independent, private entities providing the rating, but translating the rating into exchange rates is a bit tricky.

There are all sorts of other issues: how stable should these exchange rates be; what should trigger their evolution; should they be fixed or indexed to some more observable variables.

And then there is the issue of an international carbon asset reserve. We have been working on a couple of concepts with some consultancy shops and some academic units. The basic idea is that any jurisdictions that would have cap and trade systems would set aside a portion of their allocations into a pooled reserve. This could be an extension of the system that exists now between California and Quebec, which already sets aside 4% of the allowances to a reserve. Or it could be the system that is now being designed by the European Union.

It could have many different functions, starting from very basic ones, like controlling price volatility. This could be done the way California and Quebec do it, where the intervention and the release of allowances from the reserve is triggered by the price of the allowances. Or it could be done in the way that the European Union is planning to do it, which is that the intervention release would be triggered by the threshold of the surplus rather than the threshold of the price.

The asset reserve could also help if there is no linking between the different jurisdictions, by providing an indirect link through the reserve mechanism. If suddenly there was a surplus of allowances in one jurisdiction and a shortage of allowances in other jurisdictions, the reserve can facilitate an allowance swap between the jurisdictions through the mechanism of reserves. It can also provide all sorts of functions related to market making, to liquidity, to risk hedging, but this all depends on the level of authority that the participating jurisdictions would be willing to transfer to that central mechanism.

These are some thoughts about how, from a very pragmatic perspective, we can think of moving towards a world where heterogeneous carbon prices in different jurisdictions can be slowly, step-by-step, brought together to increase the coherency of the carbon price signals across the world. Thank you.

Joshua Linn

I'm going to speak informally from some notes I prepared. Thanks for inviting me and asking me to speak here on practical issues.

There are two topics that I want to discuss. First of all, the question is "What should the international price be?" If we're going to take a minimum price as our objective, what should that price be? For example, if somebody from the U.S. State Department calls you up and asks what price should he or she be negotiating for in these international discussions, what should they be pushing for?

The second question is conditional on having chosen that price: what rule should we apply to countries to assess whether they're actually meeting that price? We've touched on some of these issues in the discussion already, but there are a number of points that I wanted to make that are based on 1) contributions of many people in this room to the academic literature; 2) some recent experiences the

U.S. government has had in trying to develop the social cost of carbon as well as the Clean Power Plan (which is regulating electricity sector emissions); as well as 3) California's experience with AB 32.

I should mention, of course, before I go any further, even though my badge says I'm from the Council of Economic Advisers, I, of course, don't speak for them, and I certainly don't speak for the administration.

I'll turn to the first question, which is: What should the carbon price be? Since 2010 the U.S. government has been using the social cost of carbon for evaluating the benefits of reducing emissions. And one could take a similar approach to figuring out what should the international carbon price be. One would need to make some modifications, but in general, it would amount to taking an integrated assessment model or models and estimating the price that maximizes social welfare.

I think that one could do that, and certainly there are some estimates out there in the literature. However, there are a number of areas where I'd say there's still quite a bit of disagreement and uncertainty over how that analysis should be done. Therefore, answering that first question would require some serious work in that direction. I think that that research would bolster this effort around an international carbon price.

To dig a little deeper, let me highlight two of the major issues of uncertainty and disagreement about the carbon price. The first is: what is the damage function? The damage function links changes in climate, say temperature, to the economic harm. There are fundamental questions about the damage function, including its functional form. For example, do temperature changes reduce GDP growth rates or do they affect the level of GDP? These questions are unresolved, with a lack of empirical evidence one way or the other.

The second question concerns the discount rate. The U.S. government uses a constant 3% discount rate to discount future economic damages. There's an argument in the literature that suggests using a declining discount rate schedule, but I think that the literature has not presented a clear indication of how you actually implement that. What should that discount rate schedule look like?

I should mention, just before going on, that one might be tempted to consider the effect of the carbon price on an individual country's decision about whether or not to join. Should we take that into consideration when we are determining the international carbon price?

My inclination is that that's getting a little bit too cute. Of course one could account for those sorts of issues, but the analysis you'd have to build into that gets very complex very quickly. It may just be much more transparent to ask, "What is the carbon price that maximizes social welfare," not accounting for the effects on participation. That is, we could determine the price assuming that all countries participate and use other policy tools to try to encourage participation or discourage free-riding. And I would say that regarding these participation issues, there may be other and better ways to deal with them anyway, some of which I'll get into in the next few minutes.

The main thing that I want to spend my time discussing is once we've actually picked the international carbon price, how do we set the rules? How do we determine whether countries are actually meeting that carbon price? In this discussion I'll draw from some examples from the U.S. Clean Power Plan, California, and the EU.

In a sense, I think the simplest approach would be to say: "Any country that adopts a carbon tax, that's great. You're in as long as your tax exceeds the minimum. Anyone else, you're out." That would be simple and transparent. It would probably make some of the speakers in the previous session very happy, and maybe that's a valid long-term approach.

In the short term, however, many countries will not be excited about adopting a carbon tax. Given that hesitancy, let's consider other rules besides just requiring that everybody has to have a carbon tax.

As I'm going to indicate, I think there are some serious considerations, yet at least some extensions beyond a basic carbon tax should be workable.

First of all let's think about subsidies. Should we allow subsidies to clean generation? Picking up on Ian's discussion about how you might treat fuel taxes, with a subsidy to wind power, you could do a similar sort of calculation, right?

So let's take the U.S. Wind Protection Tax Credit. Qualifying generators receive a credit of $23 per megawatt hour of generation. If we make an assumption about what generation that wind power is displacing, we can convert that subsidy to an implicit carbon price. For example, if we assume that wind is displacing primarily natural gas-fired generation, you'd get a carbon price of around $40 per ton. So we could go ahead and make that calculation for renewable output subsidies.

We could do a similar sort of exercise with just one additional step for investment tax credits. Specifically, we would need to make an assumption about how much output each facility produces—say a new solar plant. With that assumption we could convert the investment subsidy into an implicit carbon price.

However, if we're going to count subsidies towards a country's carbon price obligation, we need to think about the perverse incentives that these subsidies create. For example, let's imagine that the U.S. just has a wind production tax credit and no other climate policy. This production tax credit is financed generally out of the government budget as opposed to being financed out of a charge to rate payers. This form of financing the subsidy causes lower electricity prices than would occur otherwise. And so lower electricity prices in the long run will induce consumption of electricity and a bit more fossil fuel generation. Therefore, the subsidy has an offsetting effect on emissions.

So, if we're going to allow these subsidies to be included, do we account for these sorts of perverse incentives created by the subsidy? In principle, one could do this with appropriate assumptions on supply and demand elasticities, but it is a consideration to think about.

Next, I want to take this discussion of subsidy one step further, and think about another type of policy that is very popular, but creates some of the same perverse incentives.

We've talked a fair bit about cap and trade and of using the carbon price as a policy that is equivalent to a carbon tax. What about an emissions rate standard, in which you require that the average emissions rate has to be at some level. Suppose you implement this as a tradable credit system so that producers that have emissions rates below that standard generate credits, and they can sell those credits to producers that have emissions rates above the standard.

You're going to end up with an equilibrium credit price that could be denominated in units of dollars per ton of CO2. So at least you're going to have that credit price that looks a lot like the credit price under a cap and trade program. So you might be tempted to allow these types of emissions rate policies to be included towards the country's carbon price. This could become very common, for example, under the U.S. Clean Power Plan. It could be that many states end up using an emissions rate standard with tradable credits. And so the question is: do we take those credit prices from an emissions rate standard and count them towards the carbon price?"

The issue that comes up, and which has received some attention in the literature already, is that you get a similar flavor of output subsidies as you do with those generation and investment subsidies I was talking about earlier. Any generator with an emissions rate below that emissions rate standard receives a production subsidy implicitly, and so they're going to want to produce more electricity. That incentive undermines some of the emissions gains we thought we were getting.

So, again, if we're going to allow these policies, the recent literature suggests that these issues could be quite big. Then, should we account for these implicit output subsidies when evaluating whether a country meets its carbon price obligation?

Given these considerations, what should we do? I'm going to use a tool that I've seen used frequently in my year or so working in government, which is, when you have a complicated issue, try to propose a few options to solve the problem. Usually that tool is used when presenting a problem to higher-ups who don't have a lot of time. That's not the case here. Obviously we have time for conversation, but I think it's still a useful tool in this context for focusing the discussion.

So the first option, as I mentioned, will be just to include carbon taxes and nothing else. The second option would be to allow a cap and trade, and then convert that to a carbon price. And probably the easiest way to do that would be simply to observe the equilibrium carbon price in that system and count that towards the country's compliance.

One thing to note, and here's where I want to bring in California's experience, is that when you do that, you're implicitly giving zero credit to other policies that may be complementing that cap and trade program. California not only has a cap and trade program that covers most of its economy, but California also has a low carbon fuel standard, energy efficiency programs, a renewable portfolio

standard, and a variety of other policies. All of these policies, on balance, end up reducing the equilibrium credit price in the cap and trade program relative to what you would have if there were just the cap and trade program alone.

So if you're just going to be using those equilibrium credit prices, you're implicitly giving zero value to the RPS and to the energy efficiency and to all those other policies.

In other words, if using the equilibrium credit prices points us to a third option, which is, more or less, anything goes. We do our best to assess what is the implicit carbon price from all the different policies together, and try to account for the complicated interactions among policies. And particularly, as the literate suggests, when we have price and quantity mechanisms working together — for example, if we have a cap, investment subsidies, and production subsidies — things can get really complex.

Given that complexity, I want to propose developing rules of thumb that, on average, account for the interactions and these perverse effects. Effectively, a country would be penalized for adopting policies that choose policies that create perverse incentives to increase emissions. We would use a uniform set of rules that apply to all countries, and avoid trying to develop country-specific rules.

I agree with the previous speakers very much that that would just get way too complicated. And even with a uniform set of rules you're going to create some disincentive for countries to use policies that create these perverse effects. Furthermore, if we're comfortable with a rough correction for all these complicated issues, it's going to be moving us the right direction.

I want to wrap up with a few closing thoughts. First of all, there are some important questions about what should that international carbon price be. This disagreement would probably not prevent international discussions from going forward, but I think there are some real areas where there could be improvement, and it could help give a clearer message about what that carbon price ought to be.

Second, there are some real practical issues to including policies other than a carbon tax when assessing a country's compliance towards that upon tax. We need to recognize that whatever rules we set up for evaluating a country's participation, those rules affect the country's decision about what policies to adopt. Because this is a dynamic and very complex game, setting simple rules could at least reduce, if not eliminate, some of these perverse outcomes that we might get if we simply credit everything and ignore the perverse effects that some policies create.

That's all and thank you for your attention. I'm looking forward to the discussion later. Thank you.

Discussion

Ernesto Zedillo

Lets start with Massimo.

Massimo Tavoni

Going going back to Ian for a little bit and the issue about land CO2 and whether we should include land CO2 or not. It seems to me that forestry is certainly an example where there's a lot of carbon and a lot of co-benefits. There's potential and things are also moving forward. So I think we need to answer questions like whether we want to do this separately or whether we want to bring it in to the agreement. We want to make sure that we don't lose the opportunity of stopping deforestation.

And maybe to Greg and Kurt, what about using the revenues to promote innovations? And to what extent should we think about technology for progress? What is our current price that would ensure that we get technology going?

And this connects also to another point; also maybe connected to Joshua's presentation (I'm trying to cover all the speakers more or less at the same time), which corresponds to the question of price schedules. We talked about current prices with 20, 30, 15, whatever it is, but how should it rise over time? I mean are we talking about 5%, 4%, plus inflation? These are very high growth rates. That might be important to give a signal for investors also thinking about the innovation. At some point this price would be very, very high and relatively soon at 5% a year. And I think it is really key, especially given the investment cycles, to think about a price schedule, not just one price. So maybe there'll be consideration about how the price should change and can increase over time.

Ian Parry

On principle I agree on the forestry emissions so long as the reliable monitoring capabilities have been developed, which for some countries they are in the process of developing reliable measures of stored carbon through a combination of satellite aerial photography, ground-level sampling and so on. So fine, if countries have established reliable estimates of carbon inventories and then they're going to re-measure those inventories on a periodic basic once every few years so we can look at changes in stored carbon over time, then fine. Once that administrative monitoring capability is in place, then it's fine that those emissions can be included in the agreement.

Kurt Van Dender

On the question on using tax revenues to promote innovation, I guess I would give the standard answer that this is a possibility. I mean it's possibly one type of productive revenue that could be used but there are others. We've heard about very many other types of revenue used for reducing pre-existing distortionary taxes and the like which do seem to come out quite high in comparing the different policy options.

This does not mean there is never a case for supporting innovation. We all know the [Daron] Acemoglu kinds of reasoning which say that, in general, there is a case for supporting innovation on the basis of some external costs, and there's also a case possibly for giving that some direction in a green direction, but nevertheless, I mean, my basic answer would be that it is just one of the competing forms of revenue use, and in the current economic situation it's not entirely obvious to me that it would be the one that comes first.

The other question is "What price do you need to trigger technological innovation?" This is a very different question. Where do you want to end up? If you look at the figures that many people show, including myself, we have very high, at least implicit, carbon prices in transport, yet do we see decarbonization in transport? No, not at all. So if you think that decarbonization is where you need to end up, then either you need a much higher price on the use of carbon in transport or you need different policies. It might be expecting too much from a tax policy to help you get onto a much lower carbon path for the transport sector, and I think I would end up in that second option. I don't think if you really want to decarbonize deep cuts in carbon in that sector that you should mainly think about tax instruments to get there.

Grzegorz Peszko

Maybe just to add to that a little bit, two comments. One is that innovation in countries is not really constrained by the absence of funding for R&D; it's rather in the quality of institutions, in the market structures, in the market designs. Russia is a classic example. We looked at why Russia is not innovating, notwithstanding very high potential. There's a lot of know-how in the country, but there's a lack of incentives in the market institutions to innovate, to compete both domestically and difficulties with accessing international markets that really hinders innovation.

Another comment is that the opportunity cost of innovation and using tax revenues for innovation; there are also the risks of targeting industrial policies and picking the losers. But I think what is important is that if you look around the world most of the developing and middle-income countries are not the countries that are the innovators of this world.

So if you think of earmarking for innovation, I think it's important to recognize that some countries would be better off by providing funding for this very upstream resurgent development of new breakthrough technologies. Others would be better off by focusing on bringing some of these new technologies into the market diffusion distribution, bringing them through the value of that sometimes, and really imitating rather than innovating.

Joshua Linn

I'll dispense with the price question. Yes, you caught me when I was talking about a carbon price earlier — I meant carbon price at one point in time in the schedule over time. And I agree that that's important.

I wanted to come back to the R&D question. I think there's no doubt that there need to be dramatic improvements in many of these technologies — carbon capture and storage — storage more generally — solar even — and there likely needs to be a lot of funding of basic research, small-scale demonstration and the like. And if a country wants to use its tax revenue to promote those activities, that's great. I don't see, in general, how to work R&D programs and demonstration programs into this sort of carbon-pricing framework. By their nature, these activities are very hard to quantify the benefits. That's why the private investors don't do it the first place, so how do you incorporate that into this kind of structure? It just seems too difficult to pull off.

Kate Brown de Vejar

I wanted to come back to a point that was raised by Ian Parry, and I wanted to take the temperature of the room to see if it's a concept that is shared, and perhaps also to understand the factors that go into it.

You mentioned that rather than agreeing on a gross effective carbon price, we should be looking at something that is more along the lines of an increase in CO2 price relative to a baseline year. I wanted to understand whether that's something that everyone thinks is probably a better option, whether it is equally effective and whether it will simply be easier to get agreement on that. But also, when we look at then compensating at the border, perhaps, vis-à-vis those countries that are not a part of our club, does that then raise additional issues of making sure that we have parity of treatment?

Ernesto Zedillo

Who wants to take that one?

Ian Parry

The idea was that it's impractical to try to equate the gross carbon prices across countries given that there's so much difference between them at present and given that there are other objectives for energy taxes, domestic objectives, which influence how much you want to tax domestic fiscal considerations, and other fiscal externalities.

So if we can't move towards harmonized gross carbon prices, it seems like the next best thing is to have targets for everybody increasing those gross carbon prices by the same amount over time — $20 per ton or something.

And in addition, the advantage of that is that it recognizes the practicalities. Some countries can't raise taxes on road fuels because they're worried about smuggling issues. Some countries are worried

about protecting their trade-sensitive sectors and so on. So it allows them the flexibility to charge lower amounts on a CO2 for certain sectors or certain fuels if it's very important for them to do so for domestic political reasons, but they can compensate for that through charging higher CO2 taxes on other fuel. So it just accommodates flexibility in country-specific circumstances.

Ernesto Zedillo

Are you thinking about convergence or is convergence out of the question?

Ian Parry

No, just that countries would say you'd have an outside assessment of where you are now in terms of your effective carbon price adding up over fiscal provisions affecting energy or in direct pricing of CO2. So you'd have an independent assessment of the average effective CO2 price now, and then countries would agree to increase that average effective CO2 price by, say, $20 a ton over the next five years, and they could do that basically through increasing CO2 taxes on fuels, and then you'd have independent assessments to make sure that the average effective CO2 prices are meeting the increase that countries have committed to.

Ernesto Zedillo

Doesn't it need to get you back to the free-rider problem?

Ian Parry

That's a tangential issue that we'll deal with more tomorrow. This is on the practicalities of "Okay, countries want to agree on moving forward with carbon pricing, but how do we actually measure the carbon pricing when you take into account that you have all sorts of fiscal provisions affecting energy that might be adjusted over time, and you have instruments for directly taxing the emissions downstream?" It's taking account of all those to make sure there's not fiscal cushioning.

If you just agreed on a carbon price, then some countries might undermine that through cutting fuel taxes upstream, and undermining the effects of a downstream CO2 tax. So this is just a check to make sure that there's no fiscal cushioning undermining the agreed carbon pricing.

Richard Cooper

I agree with the outcome, but I would actually phrase the whole issue differently. I would not get into these calculations at all, certainly not in the negotiations. It's a huge digression and you'd have fighting over every issue. I would simply say, with the exception that I'll come back to, I would say whatever tax system you have now, you have for your own reasons. We're starting with that and we're going to add a carbon tax now as an international endeavor on top of that. And I think getting into gross and net is not necessary, confusing, and so forth. I'd just add it on top of that.

The exception I would make is that some countries have already anticipated that. British Columbia is my favorite example. They anticipated this non-agreement by some years, and so I would have an

adjudicatory process whereby a country could come forward and say, "Look, after Kyoto we did the following in the name of climate change," and then they could get credit.

And then in terms of undermining the agreement, I would charge his organization with making sure that doesn't happen. This is a repository of fiscal actions in all member countries, which is now 193 countries, and it would be part of the agreement that here's the purpose of the agreement, and our undertaking is to impose this new charge, on the one hand, and not to take other steps which undermine its objective.

And then I would ask the IMF fiscal department if, for example, in principle they would be free to change any taxes that they wanted except subject to the agreement. But part of the agreement was no changes that undermine the purpose of the agreement. And then we would ask the fiscal department to signal cases where that might be taking place, and that would trigger a consultation process and so forth. As I said, we have that in other treaties.

Ian Parry

I was trying to say that essentially.

Richard Cooper

Yes, we're actually at the same place I think.

Carolyn Fischer

I want to thank everyone for some very thoughtful discussion of the devil is in the details of the practicalities of this. It got me thinking though. If part of the beauty of negotiating a harmonized carbon price is really ensuring equal competitiveness impacts and a level playing field, how much of that do we start losing when we are accounting for policies that aren't really pricing carbon, that offer subsidies instead so that rebate revenues are allocated based on outputs or subsidizing output performance standards that aren't then subsequently continuing to price the carbon that's embodied in products to send the right price signals to consumers. I'm trying to wrap my head around the tradeoffs there because then we're giving credit for policies that aren't fulfilling the noble goal of sending the right price signals.

Richard Cooper

I don't think we should give countries any credit for those kinds of policies. And if a country wants to retain them, it's up to the country. If a country wants, as Adele suggested in her remarks, to substitute the carbon charge for past policies that are not of a price nature, I'd let a thousand flowers blossom as we keep the objective in mind.

Ernesto Zedillo

Any other responses?

Kurt Van Dender

I guess my only question is this would mean that all countries immediately will re-label fuel taxes and transports to pay carbon tax.

Richard Cooper

No, they couldn't. Not under my regime.

Kurt Van Dender

So history is frozen, boom, and then we add a tax?

Richard Cooper

History is frozen as far as the objective is concerned. History is not frozen in general. But if a country is reducing taxes that clearly lead to more emissions, that's against the commitment it's made in the agreement.

Ernesto Zedillo

So Sweden will be one example of a country going to this special body to get credit?

Richard Cooper

Well, Sweden, we haven't talked much about numbers, but if we take the face value seriously, Sweden's way above the international numbers, so it meets the minimum. I actually would want to know more about what actually happens in Sweden because we got a sense this morning that there are a number of important exemptions to the Swedish charges, and those would be a target in the international agreement.

Robert Repetto

Back to the discussion of innovation, which everybody agrees is important in the long run. I have a prices versus quantities question. What gives the stronger incentive for innovation all along the chain, a price advantage as in a carbon tax, or a policy like emissions limit that creates a definite market space for alternatives as well as providing a price differential? I would have thought that if you have both defined market space as well as a price advantage, that would be a strong, strong incentive to do something.

Grzegorz Peszko

My sense is that, and if you look at the kind of history of innovation, there were always a lot of innovations in abatement measures when you introduce cap and trade systems, and it gives a lot of flexibility especially if it covers different sectors, and it includes both the technology innovation as well as behavioral or management innovations.

And in principle, if the pricing, now that the margin is similar and if it's similarly stable and predictable, then both instruments should encourage innovation. There are ways to increase price stability in

the market systems, and many jurisdictions are working on it. And there are ways to destroy price stability in the tax systems. We work in many countries that are notorious for their inconsistent policies.

You have a timeframe of four years usually where the tax system is more or less predictable and then a lot of question marks. And if you think of the kind of long-term destructive innovations especially, I think this long-term price stability is an important issue.

Adele Morris

My comment is to the World Bank, and I guess I just want to express some concern.

I think that it's important for the Bank to be more neutral about the policy mechanism for pricing carbon, and maybe it has been. I think there is a downside risk of cap and trade in promoting the idea of the emissions trading, particularly in countries where there's poor governance and what I would characterize as wishful thinking about potential gains from trade from offset markets.

I think there's been a misunderstanding about the potential for the U.S. to be a strong source of demand for offsets. Certainly we saw that in the process leading up to the Waxman-Markey legislation in the House of Representatives. If you looked at EPA's analysis, the U.S. would be spending six times more on imported offsets than on domestic abatement in the early years of that program. That's preposterous. And I can't imagine the U.S. ever going into a serious policy discussion where there would be that level of international transfers.

My sense, though, is not everybody has really woken up to that; that the U.S., at least, is not going to be providing much of a demand schedule for these things. And if we're in the world of a carbon tax discussion domestically, then the chances that we're going to expose ourselves to large tax expenditures through an offset market are extremely small, especially an international asset market.

I worry a little that countries think that someone else is going to pay for their abatement, and that they don't need to do all the things that the Fiscal Affairs Department of the IMF is discussing. Someone else is going to pay for their local external costs. Someone else is going to pay for their CO2 abatement. And I would just encourage the Bank to be more forthcoming about the realities of what countries are going to need to do in terms of their own emissions mitigation.

Richard Cooper

A system in which governments produce pieces of paper that have economic value in the international market is an invitation for favoritism, the polite word, but corruption is the correct word. I'm not talking about Finland now, but run through your mind Brazil, Philippines, Putin's Russia, and so forth — this is an absolute setup for corruption. I will therefore make the political prediction that no knowledgeable U.S. senator would vote to ratify a treaty in which the average American, through electricity prices, would be paying the market price for emissions to oligarchs or political favorites in other countries.

I was distressed by what you said about the line that the World Bank is taking. I think global cap and trade is simply not on. You can manage it between California and Quebec — I didn't know that arrangement existed — but not between the United States and the Philippines, which is seen as a friendly country, not to mention unfriendly countries. It's just not on. Therefore the notion of an integrated world cap and trade system is not feasible unless it excludes the United States, and my guess is that it will exclude other countries as well.

Grzegorz Peszko
Well, first of all a caveat. I'm not the World Bank. It's a big organization. We do a lot of things. And what I presented here is just one stream of the carbon pricing-related activities that we carry on.

Actually the stream that feeds off this session, which is practicalities of the global carbon pricing, is because this is the only process that we see globally to harmonize global carbon pricing. We don't see any efforts of any jurisdictions trying to discuss bilateral-trilateral deals on carbon taxes. What we see is a lot of efforts discussing some sort of linkages of carbon pricing. Having said that, we do support a lot of countries in developing their carbon taxes. I mean I'm working on one of the gulf countries that recently asked us to support that.

We have a Partnership of Market Readiness that supports the development of carbon taxes in a number of developing countries. Historically we have been biased towards cap and trade systems because this has been a dominant instrument in the climate policy, but it's true that our bias has been increased a little bit by the fact that a lot of countries have given us all these hefty trust funds to purchase, on their behalf, emission reduction units from both credit and allowance-based systems.

I think that this historical bias is disappearing now. We are very neutral, but we are practical, and it was the title of the session. We are not ideological so we do recognize that introducing well-functioning carbon markets in many countries is a huge challenge, not only because of the corruption, which we cannot assume by default, I mean we take for granted that countries will try to introduce policies not in order to syphon money somewhere to strange places and destinations.

Yes, the countries that don't have competitive markets in the first place, the countries that have weak institutions, we will probably advise them to go for the tax route. But there are other countries that are working on the quality of their institutions, so working on more competitive market structures. And there, if they think of introducing more flexibility, more opportunities to contain different risks to their markets, and by talking to other markets about connecting, we're also supportive.

And, you know, talking about the U.S. and its position, I'm old enough to remember — and actually I was quite heavily involved in — the discussion around the Kyoto Protocol about the design of the flexible mechanisms. At that time the T word was forbidden in this country, especially in the context of the Kyoto Protocol. Tax and United States? I heard singularly passionate statements that the United States should never be in any agreement that mentions the word *tax*.

Now we have a flip side of it, and equally passionate. I appreciate it, you know?

Ernesto Zedillo

But now the statement is the United States will not be a part of any agreement period.

Grzegorz Peszko

I think it's a learning-by-doing process. This is mega experimentation. It's safer for us to put our eggs into many different baskets which are emerging here and there, and follow all the different experimentations at the level of different jurisdictions rather than have ideological preference, you know, we will only support tax and never a cap and trade system, or the way around.

I think we had historical bias because we had all these carbon funds. I think we are now free from it, but what I presented may have looked like a biased presentation because yes, I focused on one stream of work that we follow that's probably, at the moment, the most promising way of harmonizing carbon price signals across different jurisdictions because it is happening.

Ian Parry

Just a quick comment. I think the fiscal rationale for carbon taxes is stronger in developing countries where the broader revenue bases are often hindered by a loss of mobility of the tax base due to large informal sectors.

Ernesto Zedillo

I would like to extend a little bit on that in order to provoke Dale because he, on his analysis of the U.S. case, is very strong on this capital dividend. But when I think about developing countries and the duality of the labor market, which has become huge and a serious problem, and let me give you the example of my own country.

Workers employed in the modern sector and productivity in the modern sector can grow 6%, sometimes 7% total fact [phonetic] of productivity. And when you measure productivity in the traditional or informal sectors, the rate of growth is negative. So that means that what you do in the modern sectors, you undo in the informal sector, and even more now because we have more than 55% of our labor force employed in the formal sector.

Now these could have been, at the beginning, let's say a default outcome, but I think now we have evidence that is policy-designed. Why? Because we over tax the use of labor in the formal sector with all kinds of taxes. And actually nowadays, we subsidize the use of labor in the informal sector because now we have developed these social security programs for people employed in the informal sector, people who don't make any contribution towards their social security.

So all the incentives are there to continue this process of increasing labor force participation in the informal sector, and therefore the bias of the Mexican economy to grow at very small rates is getting worse and worse. Some people have suggested that the only way to correct this is to go towards a

universal social security system, which means whether you are an informal or a formal worker, it doesn't matter. You have access to medical services. You have access to a minimum pension, and you may even have access to unemployment insurance.

But, of course, the question is how do you pay for that? And one of the ways you can pay for that is through carbon taxation, and probably increasing, and that's regressive, but you have other instruments to compensate, like increasing the value-added tax. But I would not discard carbon taxes as one source of revenue that could undermine the very strong incentive that we now have for duality in the labor market. This has become, along with the question of rule of law, the two biggest problems in my country.

Dale, I think if you were going to help your friends in Mexico — and you have a lot of friends in Mexico -- to look at the Mexican case, my suspicion is that your conclusion will be very different and your result more into labor taxes. But I don't know if you agree that my priors are right or wrong.

Dale Jorgenson

I think that's an interesting experiment to perform, but I think that you have to remember that even in the informal sector, people are using a lot of capital, and they don't have very much labor. They don't have very much capital. So it's really the relationship between the two that's critical. I think that remains to be looked into, but it's certainly worth a try.

If you look at China, China has a very large informal sector too. It's called agriculture. And it's something that figures into the calculations that I described, and you come up with a double dividend. So Mexico is a much richer country than China, and the informal sector is probably relatively less important in Mexico than it is in China.

Ernesto Zedillo

No, unfortunately not. As a percentage of the labor force, this is becoming a huge problem. China doesn't have almost 60% of its labor force employed in the informal sector. Mexico compares poorly with Brazil and, in fact, with African countries.

Dale Jorgenson

The point that Ian made in his presentation is worth emphasizing here, which is that the co-benefits that are associated with conventional pollutants in countries like Mexico, China, and India really dominate the picture. It's not so much the tax tradeoff. I don't know if you agree with that, Ian. Maybe you can comment.

Ian Parry

It's both, and it varies from country to country. The co-benefits are huge in countries that use a lot of coal, which are densely populated, and there's a lot of population exposure to the pollution. And countries which have relatively mobile tax bases for broader fiscal instruments, there is a bigger potential for a double-dividend result through tax shifting. But it's going to vary with country-specific circumstances.

James Stock

A question came up about decarbonization in the transportation sector, and I think it's useful, and maybe I'll say this just a little more starkly than it's been said so far. It's important to keep in mind that, especially for the transportation sector, but of course that will apply more generally, that a carbon tax by itself isn't going to solve the problem.

If we think about a carbon tax that's $0.50 a gallon, instead of it being $2.75 nationally right now, it would be $3.25. That's a step in the right direction, but that higher gasoline tax has resulted in much more fuel economy, much more fuel efficiency in Europe, but they haven't really been transformative because there are the additional externalities. There's the additional externality of what technology innovation needs to see in terms of, say, electric vehicles; but there's also importantly the network externality. And in the electric vehicles you've got to have the charging stations and you've got to have the vehicles to building the charging stations, you've got to have the vehicles, that sort of thing. And that says that there might be a couple of rankable equilibria. We're not at the right one, but this is in nobody's interest to move individually to the other one. So that's another role. The transportation sector raises additional complex problems that a carbon tax is not going to solve, which is not to say a carbon tax isn't a great idea. It's not the complete solution.

How does it become the complete solution in the models; somehow that all just gets swept under the rug in a log of the models. But that actually gets to the question I was going to ask which has to do with going back to the comments on land-use change. Since we're supposed to be talking about technicalities, I'd like to push back a little bit on that. Ian's response on land-use changes, well if you could quantify it, then you'd be able to somehow bring that in to the international agreement. And that's correct in a cap and trade system. I'm not exactly sure how that works in a carbon tax arrangement.

What are we going to be doing? Let's take the easiest case of all. There's a farmer in Vermont who wants to cut down some trees because he wants to do something about it. Are you going to tax the farmer per tree that he cuts down? Maybe, but then again you're going to have to subsidize somebody else in terms of the planting of it and how you actually implement that. And that's the easy case of doing it in Vermont. And, of course, doing it in other countries is exceptionally complicated. It's not a trivial point both because the amount of land-use change is substantial, but also because it relates directly to the indirect land-use-change calculations that go into calculations about biofuels. And biomass and biofuels are a big part of the issue, even a little bit in the United States, but certainly in other countries. There are countries that are making positive movements in terms of, say, sugar cane ethanol in Brazil, which actually does really have a reduced GHG emissions footprint. How are you going to do those calculations?

I think what we've seen with the low carbon fuel standard (LCFS) in California that those calculations are really difficult ones. The science is okay for conferences, but boy, when you're talking about billions of dollars on that sort of science, I don't know; that seems to be a challenge.

Then if you really look ahead, the models that are the ones that say "There's maybe a solution in sight if we have a big enough carbon tax," is because they get to add in bio mass combustion with carbon capture and storage (Bio-CCS) so that we actually have net emissions. And those net emissions are going to be super cost effective at a high carbon tax, but that requires counting the bio part of the Bio-CCS. All of this seems to be, when we're talking about technicalities, really complicated. So I'm pushing back a little bit on this and trying to get into the weeds, so to speak.

Ian Parry

I agree that's why I think we should just start out by focusing on energy-related CO2 emissions, and then as reliable administrative monitoring capability for broader emission sources is developed, and it's credible, then those can be incorporated into the agreement.

With regards to forestry, perhaps the best approach is that the tax is more like a fee bait or a tax subsidy scheme where you would develop a measure of carbon storage in a particular baseline year, and then you'd either charge or subsidize land owners according to whether they increase or reduce carbon storage in future years relative to the baseline levels. I think that's a better way of incorporating forestry than just taxing all stored carbon in forestry.

Grzegorz Peszko

A comment on transportation. This is the sector where the need for complementary policies is probably the most apparent. The pricing signal does the job only if it is backed up by a number of policies that address non-carbon externalities. But as you said, the policies that address the natural network externalities, which is mainly investment in infrastructure.

Both the fuel shifts as well as behavioral changes, the motor shifts in the transport sector, it really dramatically depends, and we have seen in many countries, and there is huge literature on this. The responsiveness to the price signal by both fuel and motor shifts dramatically increases if you have the right infrastructure in place.

Now this brings me back to Adele's previous comments, to which I haven't responded, on the issue that Americans will never agree if some of the resources from the tax revenues or cap and trade systems are transferred abroad. I think, for us in the World Bank, we look at it from the global perspective. Infrastructure costs a lot of money, and it's sometimes unaffordable for the developing countries. I think any meaningful international agreement, whether it's global or whether it's driven by coalitions, that is going to engage developing countries, it must be associated with serious resource transfers from the rich countries that have more of a vested interest in introducing aggressive carbon policies to the developing countries, to bring them in.

Whether you share your domestic tax revenues or whether you allow resources to be transferred through the linked cap and trade systems, I don't care. But it is essential and it has to be built into not only the letter of the agreement, but also one day it has to be built into the mindset of the people

around the world. But we individuals must share and we must agree to give up some of our resources and transfer them to developing countries. And we cannot insulate these carbon gains from the equity issues, and we cannot just say to the Indian negotiators, "Forget about the past and let's move on and have the same kind of marginal price going forward" partly because we have this kind of infrastructure backlog in many countries that prevents them from moving towards harnessing the low carbon opportunities.

Ernesto Zedillo

I don't think anybody is against international solidarity. The question is whether you link that international solidarity to a global cap and trade or to a carbon price. That's the big question, but I think everybody is in agreement to some degree of solidarity. But we have to see the downsides of linking the mechanism with that solidarity.

Joshua Linn

I wanted to pick up on this transition to transportation, and maybe just start by making the obvious point that the reason why a carbon price would not have much effect on transportation sector emissions is that it's relatively expensive to reduce emissions from that sector given current technology.

And so just to pick up and echo a point that was made this morning that if we're in a world with an international carbon price, that ought to generate a sort of comprehensive rethinking of what the other policies are trying to do. Policies that are much more directly targeted at fundamentally reducing costs as opposed to getting a little bit more biodiesel into the system, a little bit more corn ethanol, and so on. And so we want different types of policies, more generally.

Richard Cooper

I wanted to comment on something that Mr. Peszko said in his opening remarks about our not having any experience in negotiating taxes, and that raises issues of national sovereignty and so forth.

That's actually not quite right. We have lots of experience in negotiating taxes. They happen to be called tariffs. And we've had seven rounds, not counting Doha, through the Uruguay round of negotiating tariffs. The same issues arose originally. This is parliamentary prerogative and sovereignty, blah, blah, blah. But the restrictiveness of the trading system was so overwhelming in the late 1940s that governments decided — and governments were not likely to act unilaterally — there was the same free rider problem, so governments decided that a cooperative endeavor in reducing this particular kind of tax was desirable.

And we've had both kinds. We've had harmonization mostly in the zero-on-zero negotiations; but we've also had the tariff equivalent of minimum charges, except they're maximum in the case of tariffs, and they're called tariff bindings. And we have lots of experience both in binding tariffs and less experience, but some, in tariff harmonizing usually around zero, not always literally zero.

So my own view is that this issue is going to have to become sufficiently salient in the political domain of particularly the United States and China, which are the two elephants in this particular room; but I think salient questions of sovereignty actually can be overcome through a mutual international agreement. I'm not pessimistic, but maybe you have to be patient.

Massimo Tavoni

One thing that we didn't discuss so much so far is adaptation. History might not matter so much for pricing carbon, but then it might matter for damages. It certainly does matter for damages of climate change. And there's discussion about the funds to be used for compensating countries from damages for the past emissions and, of course, the future emissions.

If we have an international carbon price, one more complete competing claim in addition to infrastructure or to the national interest about recycling or innovation would certainly be in light of using some of those funds, at least part of those funds, to compensate countries which would be affected more by climate change, meaning mostly countries in the developing world because they happen to be also the countries which would suffer most from climate change, being already hotter places to begin with. So how do you go about that?

Grzegorz Peszko

I think the funding for the patient is much more distant from the choice of carbon pricing instruments than the funding for mitigation. When you think of the cross-boundary transfer for mitigation purposes, then I think you see stronger links between what kind of instruments you choose that may facilitate or hinder it.

In the case of climate finance for adaptation, it's just a pure political/ethical decision irrespective of the source of funding and instruments of funding. In a way, also, adaptation is more of a private good from the point of view of the country that adapts. In India the only barriers are information access to finance. And that can be addressed through climate finance instruments. I don't think that there is any discussion in the context of carbon finance to address mitigation adaptation issues. It's a kind of pure fiscal transfer issue.

Ian Parry

Well, I guess I'd just be a little bit wary about saying that a certain portion of the revenues have to go to adaptation because we're trying to make this participation in this agreement as desirable as possible to potential entrants. And obviously a big attraction of carbon pricing is the potential revenues, which you can use for domestic purposes, cutting other taxes or whatever.

So I'm a little bit worried that if we start saying, "If you come into this agreement, we're going to take 10% of your revenues and send them to other countries." I'm a bit worried that might put countries off joining the agreement. Maybe adaptation needs a better address through other mechanisms funding through the Green Climate Fund or whatever.

Silke Goldberg

Thank you very much for all these very interesting presentations. Each highlighted different challenges in relation to the practicalities of implementing a global carbon price. I'm deliberately choosing the neutral price because a lot of the debate has shown that there are numerous difficulties associated with one scheme over the other.

I started to think about how this would translate into a term sheet. I'm interested to see where the panel would see the institutional anchorage of some of these practicalities. It has already been mentioned, for example, that the Fiscal Affairs Department of the IMF could be in charge of the monitoring and verification, perhaps, of the tax collection or tax enforcement. The Green Climate Fund has been bantered around in a couple of presentations earlier this morning, and now as well has come up in the discussion. And I was wondering how the panel would see institutional anchorage overall over any international mechanism.

Ian Parry

I guess it would be nice to have a pilot group of countries that are willing to submit themselves to evaluating their fiscal provisions — how much they're taxing energy at the moment — and developing procedures that are applied specifically in those countries for measuring effective carbon prices and how they might change over time.

I don't see why this is necessarily confined to us. Clearly the OECD's done some very valuable work on measuring energy taxes and effective CO2 taxes, so I don't see why we can't all work on this together.

Ernesto Zedillo

Well, China and India are not part of the OECD to begin with. Dick?

Richard Cooper

Well, I would be guided by the problems that actually arise. If you think about other areas, we formally institutionalized dealing with contagious diseases in the World Health Organization. We had a nonproliferation treaty, and we decided we needed a new organization to do monitoring and inspections, so we created the IAEA. We had a trade agreement that existed for decades with no institutional framework. There was a small secretariat in Geneva that was a convening place and collected information, but they were not a formal organization. The WTO was not created until 1994, as the need for it became evident.

So I would start out and see what path we're on. Use existing institutions where you can. And if we run into problems where a new institution would help, then create it. I would not anticipate it long in advance. There are several groups that would like to step into the potential breach. The United Nations Environmental Fund I'm sure would like to have a role. Whether that would be a good thing or a bad thing depends on the practical problems that would arise under the agreement, and UNEF's capacity to deal with them.

Anonymous Participant

I was not going to make this comment, but then Mr. Cooper sort of triggered it. The difference, I think, between harmonizing and finding a harmonized price or tax and tariff is that in the tariff negotiation each government decides which product they will protect and what tariff level they will want on that product except for the zero negotiation.

And in fact, some governments have started to say that the reason why the negotiation in Doha doesn't work it's because now we have this fixed formula. Everybody has to reduce all governments 10% on everything. Argentina and others have said, "Why don't we go back to the old GATT where we each decide where we go up and down?"

That's why when Ian Parry suggested this sort of middle term, I thought it's close to what is happening also in what I know. Setting aside harmonizing regulations, although I fully agree with you that licenses is a net for corruption, and we saw it in the banana disputes for years — full of corruption; but I thought that harmonization could be difficult. And rather in services the focus is on mutual recognition. And I thought that in middle term where everybody says "I'll do X in that sector if you do this," could be easier than a harmonized tax. I don't know. I'm not an expert, but I was surprised by your comment and your reference to tariff.

Richard Cooper

My interpretation of the trade negotiations is evidently different from yours. It's true that a large part of the tariff negotiations resulted in bindings rather than harmonization, and the bindings were different from country to country because different countries had different constraints. But it is not true that all of the negotiators were free to do whatever they wanted to do.

Their negotiating partners said, "In order to reach a deal, I insist that you reduce your tariffs on automobiles from wherever it is to no more than 15%" as an example. That was the bargaining that went on. So there was extensive bargaining about other countries' tariffs, not just what I'm willing to offer, but what I want you to offer. That's basically what the negotiations were all about.

As to why the Doha Round failed, that would involve another conference.

Ernesto Zedillo

Kate has the last question before I ask the panel to provide some final thoughts. Kate?

Kate Brown de Vejar

Another question. This one, I think, for Josh. You mentioned that since 2010 the U.S. government has been using the social cost of carbon to arrive at what we think might represent the international carbon price. But my question was: is that a model that is transplantable to other countries and perhaps globally?

Joshua Linn

Yes, I was trying to suggest that a similar approach could be translated to the global context because I mean the estimate is derived from running models that do have global coverage to try to estimate the effect to global economic harm of one ton of additional emissions. We're no longer thinking about the changing of one ton of emissions. Now we're thinking about everybody putting in a carbon price and reducing their emissions by a lot. And so in that sense it's a different exercise, but in principle, at least, the same models could be used and the same sort of approach could be used.

Kate Brown de Vejar

Would that model give rise to very different results in different jurisdictions? I mean even if we could agree on the model, would it give rise to very disparate prices?

Joshua Linn

If you consider the benefits to people in the U.S. of one ton of emissions reduction, that's much different from benefits elsewhere in the world. And so in that sense, yes, the domestic portion of those overall global benefits varies a lot from country to country.

In general, what I was trying to convey is that even though we have this approach that we say is based on the best available science, this is a science that's evolving. What goes into these models and the components and the underlying assumptions are developing, and so I think there's quite a bit of work that needs to be done to improve and enhance this approach.

Jason Bordoff

Can I just ask a follow-up question?

Ernesto Zedillo

Yes, please.

Jason Bordoff

That makes sense that you'd figure out what those social damages are and figure out your social cost of carbon, but then I heard Ian, I think, in your presentation, talk about how you might need to adjust because the elasticity of demand is different in different places. Kurt talked about how the kind of price signals we're seeing in the transportation sector aren't big enough to get the kind of demand reductions we want. This made me wonder if we're actually trying to figure out what the social damages are and price it, and whatever the demand response is, if that's the optimal level of consumption or whether we, in fact, want a quantity outcome which leads you to a different place when you think about what the price should be.

Ian Parry

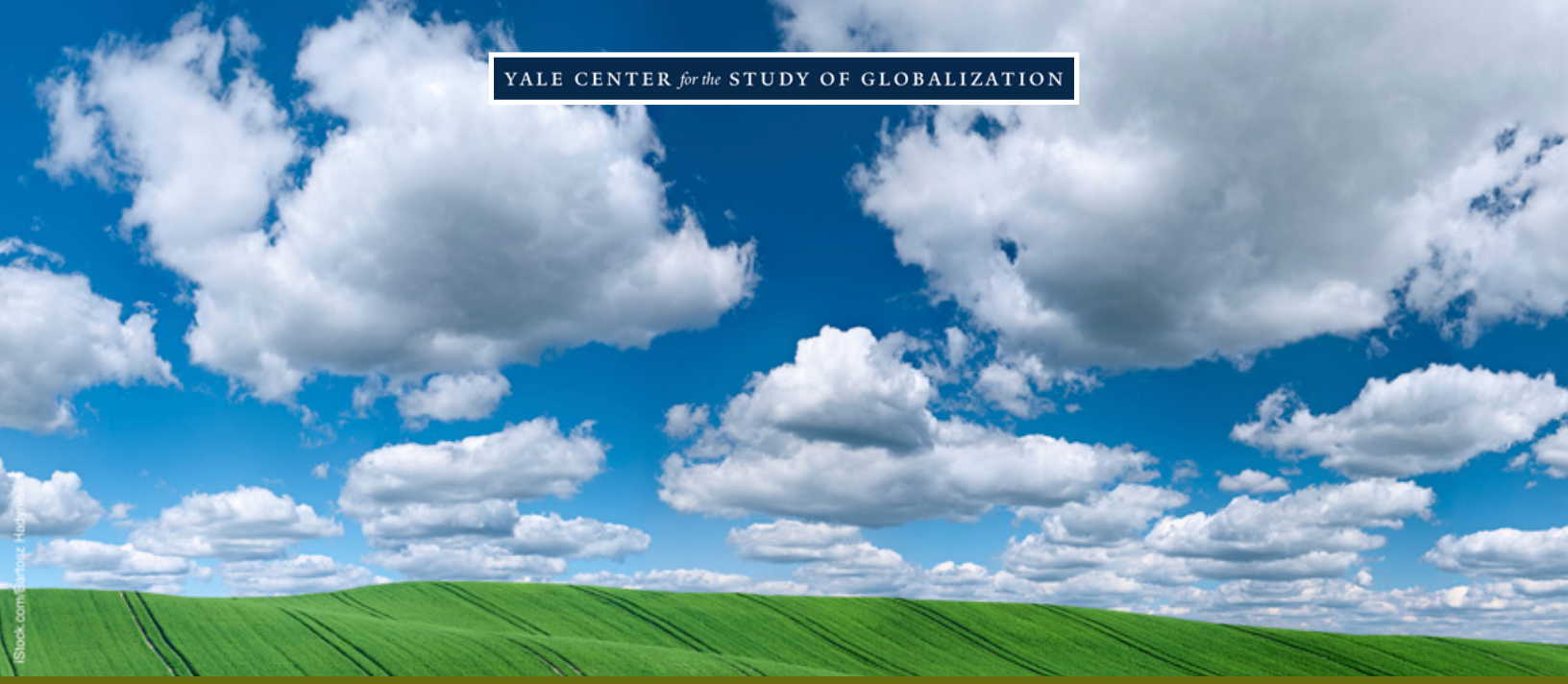
Maybe I was a little bit unclear. Ideally, countries would be imposing a minimum price in line with our estimates would be a social cost of carbon in my view. But I was dealing with a broader notion of

trying to accommodate flexibility in the agreement; countries that maybe want to adjust some of their fuel taxes as part of the contribution towards their effective carbon pricing. Maybe some countries want to move ahead with heavily taxing coal, but for political or other reasons they can't tax natural gas. I was thinking, how can you add up these provisions in a flexible way that accommodates these special needs of countries? Maybe one country can't touch the diesel fuel because they're worried about cross-border smuggling or whatever.

And so this broader notion of tracking your effective carbon tax over time and how that changes over time, that's when these elasticities come in to weight the different taxes on fuels according to their relative effectiveness at reducing CO2.

Ernesto Zedillo

Any final thoughts from the panelists? Thank you very much. It's been an excellent day. Thanks a lot.



Global Harmonized Carbon Pricing: Looking Beyond Paris

Yale Center for the Study of Globalization, International Conference, May 27 and 28, 2015

Session Four:

The challenge of achieving participation and compliance

Presentations and Discussion

PARTICIPANTS

Carolyn Fischer, William Nordhaus, Santiago Rubio, Scott Shelton

MODERATOR

Samuel Kortum




Session Four — The challenge of achieving participation and compliance

This session will discuss the alternative instruments for promoting participation (including the modality of a "club"), procedures for monitoring, mechanisms for enforcement, and in particular address the question of whether trade policy should be entertained at all, or under which circumstances, as the instrument for achieving participation and enforcement of such international agreement. Some of the thorny issues that need to be addressed are inconsistencies with existing international trade law, potential damage to the multilateral trading system, and the role of the dispute settlement understanding of the WTO.

Presentations

Samuel Kortum

Okay, let's begin. It's great to be here. I'm a trade economist and not an expert in these issues. But it's a very exciting set of issues for a trade economist and I dabbled a little bit in them when I was at Chicago. One of the things that sort or jumped out at me is the importance of the free rider problem, even aside from the issue of carbon leakage. And I think that this panel coming at things from very different angles is going to emphasize that issue. We have economists, lawyers, all sorts of people contributing here. Our first speaker will be Bill Nordhaus.

William Nordhaus

I would begin by saying how grateful I am personally, but also institutionally, at having someone like Ernesto Zedillo here. Conferences such as this have enriched our university, not just

areas like this, but on nuclear non-proliferation, meetings on trade, drug policy, and many other areas. So, we are very grateful to him more generally, but also for this meeting.

My talk is about Climate Clubs. Here is the background: Much progress has been made by scientists and economists in understanding the science, technologies, and policies involved in climate change and reducing emissions. Notwithstanding this progress, it has up to now proven difficult to induce countries to join in an international agreement with significant reductions in emissions.

The Kyoto Protocol was an ambitious attempt to construct an international climate-change agreement to harmonize the policies of different countries. Analyses showed that, even if indefinitely extended, the Kyoto reductions would have a limited impact on future climate change. It died a quiet death, largely unnoticed and mourned by few, on December 31, 2012.

Nations have struggled through a series of summits and conferences to find a replacement, with the Paris meeting in late 2015 being the latest attempt to reach an agreement that would replace Kyoto with an effective international agreement.

My suggestion is that the Kyoto Protocol ran aground, and current approaches are unlikely to do better, because of the tendency of countries to free-ride on the efforts of others for global public goods.

So, in talking about free riding in climate agreements, I want to emphasize that it is a positive theory, not a normative theory. It is a theory about how countries will behave assuming countries behave in their self-interest. Without international agreements, countries will end up in a non-cooperative equilibrium with very low abatement.

With international cooperation, it's actually a little more complicated, but the result differs very little. Without sanctions on non-participants, you end up with what I call the small coalition paradox. You may end up with a few small, bottom-up treaties, such as China and the U.S. joining together. But under the small treaty paradox, the only stable treaties are ones with a very small number of countries. Because of the free riding, as you get larger and larger coalitions, they're unstable.

So the bottom line is that the current approach will lead (as it has led) to minimal abatement.

One approach that I would like to consider is to have a Climate Club. So what is a club? While most of us belong to clubs, we seldom consider their structure. A club is a voluntary group deriving mutual benefits from sharing the costs of producing a shared good or service. The gains from a successful club are sufficiently large that members will pay dues and adhere to club rules in order to gain the benefits of membership.

The theory of clubs is a little-known but important corner of the social sciences. The major conditions for a successful club include the following: (1) that there is a public-good-type resource that can be shared (whether the benefits from a military alliance or the enjoyment of a golf course); (2) that the cooperative arrangement, including the dues, is beneficial for each of the members; (3) that non-members can be excluded or penalized at relatively low cost to members; and (4) that the membership is stable in the sense that no one wants to leave.

Here is a brief description of the proposed Climate Club: 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 CO2. Countries could meet the international target price requirement using whatever mechanism they choose — carbon tax, cap-and-trade, or a hybrid. But the harmonizing mechanism is a carbon price.

A key part of the club mechanism (and the major difference from all current proposals) is that non-participants are penalized. The penalty analyzed here is uniform percentage tariffs on the imports of non-participants into the club region. Calculations suggest that a relatively low penalty tariff rate will induce widespread participation among countries as long as the target carbon price is in the range up to $50 per ton.

In order to understand how a Climate Club would operate, it is necessary to move beyond description to analytical and numerical modeling of the incentives and behavior of regions with realistic economic and geophysical structures. The challenge of analyzing and modeling the science and policy associated with global warming is particularly difficult because it spans many disciplines and parts of society. An important approach to bringing the different fields together has been the development of integrated assessment models (IAMs). These pull together in a single model a wide variety of geophysical, economic, and political relationships so that projections, analyses, and decisions can consider simultaneously all important endogenous variables at work. IAMs generally do not aspire to have the most detailed and complex representation of each of its components. Rather, they aspire to have at a first level of approximation the most important relationships and ones that can operate simultaneously and with reasonable accuracy.

In the major study on which this presentation is based, I describe an integrated-assessment model (the Coalition-DICE or C-DICE model) of economics, tariffs, and climate change that examines the

effects of different potential Climate Clubs. I will not give a detailed report on the results of those simulations but refer you to the original source for an extended discussion.

The C-DICE model is designed to find whether or not countries join a Climate Club, a coalition of high-abatement countries, and to find stable coalitions. It examines 44 different "regimes," where a regime is defined as an international target carbon price and a penalty tariff rate. The assumed target prices are $12.5, $25, $50, and $100 per ton CO2, and uniform penalty tariffs range from 0% to 10%. For reference purposes, the US government estimates the global social cost of carbon (or the damage imposed by an additional ton of CO2 emissions) to be around $35 per ton of CO2.

In most models, a carbon tax of this magnitude would lead to emissions reduced 15–20% relative to a business-as-usual path in the near term. Most economic studies would recommend that the carbon price rise over time to reduce more sharply and even eliminate greenhouse gas emissions over this century.

I close by highlighting some of the conclusions of the modeling studies of a Climate Club. The first major result is to confirm that a regime without trade sanctions (the Kyoto model) will dissipate to the low-abatement, non-cooperative equilibrium. A second surprising result is that, when trade sanctions are imposed, the Climate Club structure generates stable coalitions for virtually all sets of parameters.

A next set of results concerns the impact of different Climate Club parameters on the participation structure. For the lowest target carbon prices ($12.5 and $25 per ton of CO2), full participation and efficient abatement are achieved with relatively low penalty tariffs (2% or more). However, as the target carbon price rises, it becomes increasingly difficult to achieve full participation. For a $50 per ton target carbon price, the Club can attain 90 plus percent efficiency with a tariff rate of 5% or more. However, for a target carbon price of $100 per ton, it is difficult to induce more than the non-cooperative level of abatement.

What is the pattern of gains and losses? The benefits of a Climate Club are widely distributed among countries. A few regions have losses in some regimes. However, the losses are small relative to gains for other regions. There are no regimes with aggregate losses.

A paradoxical result is that all regions would prefer a climate-club regime with penalties and modest carbon prices to an ineffective regime with no penalties. This is the case even for countries that do not participate. The reason is that the gains from strong mitigation measures of participants outweigh the losses from the tariffs for non-participants — as long as the tariff rate is not too high. This powerful result indicates that a regime with sanctions should be attractive to most regions.

To summarize: The analysis shows how an 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 forging agreements that can effectively slow climate change.

I will wrap up here. Let me emphasize there are many issues raised by the idea of a Climate Club. How do we get started? How does it fit in with international law? How can we get people to move from the Kyoto model to the club model? What is the right price?

But before we talk about those, I just want to plant this seed and see if it grows.

Samuel Kortum

Thank you. Now we have Carolyn Fischer.

Carolyn Fischer

This is a session on participation and compliance. I'm going to talk about border carbon adjustments and why they're not just for participation and compliance.

I think fundamentally, the big reason we're here is the problem of carbon leakage. When countries take actions unilaterally or sell globally it's like squeezing on a balloon. If you price carbon when not everyone else is, you may be sending emissions elsewhere.

There are several channels for carbon leakage. I think the one that pops up in most people's minds, especially politicians' minds, is the competitiveness angle: the concerns that economic activity manufacturing in energy intensive industries is going to shift abroad where it's cheaper because they don't have to pay the carbon penalty. But actually, modeling shows the bigger effect is through global energy markets. If some countries, the U.S., Europe, would draw our demand for fossil fuels and we run down that supply curve, the prices fall, and that just makes it cheaper for India to pay for oil and consume more, even without moving any manufacturing plants.

There are a couple of other channels. People have looked at income effects — they're pretty second order. And some folks have also looked at technology spillover. Theoretically you could get some negative leakage if the carbon policy produces a lot of innovation and clean technologies, brings down their cost and they spill over to other countries. So, theoretically there's a possibility for negative leakage. But the fossil energy and competitiveness issues are important.

What are the main options for coping with carbon leakage? Well, the first one is the best one:

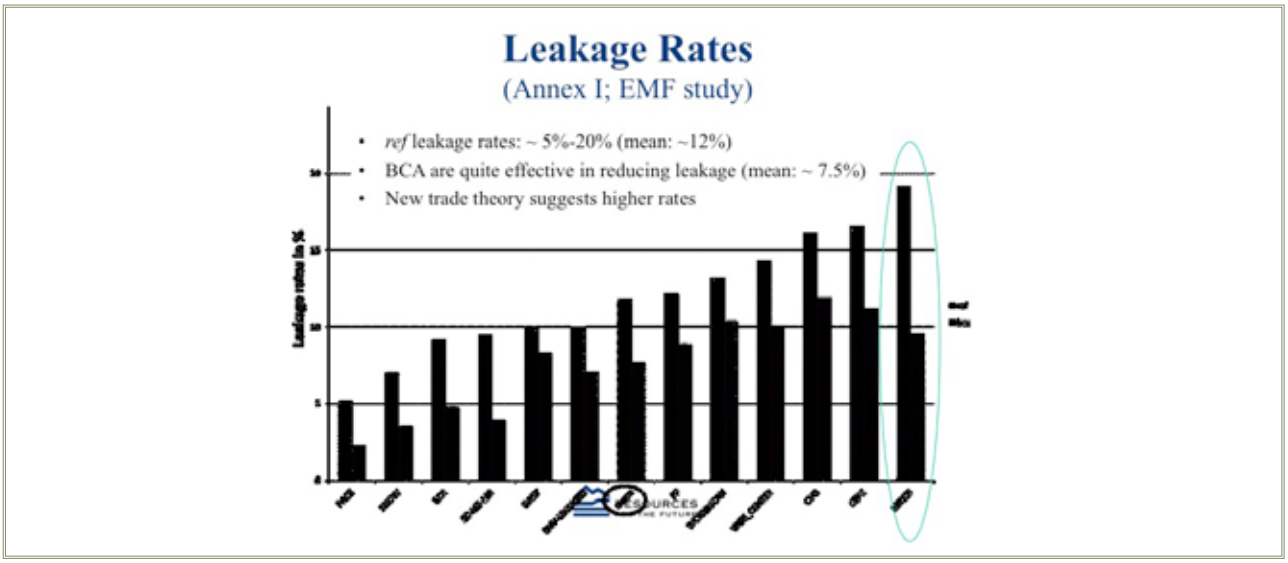
it's a global price on carbon. I think that's what we're all here trying to get. That would be the ideal because that's the only mechanism that really addresses all of the channels of carbon leakage.

Barring that, what are you left with? Not such great options. You can weaken your policies, then you get less leakage. That doesn't really get us to where we need to go in terms of emissions reductions. There's kind of a neat idea: instead of withdrawing demand for fossil fuels, withdraw supply. So, if we could convince Canada and Venezuela to stop drilling for oil and Australia to stop extracting coal, that would be great. But that's highly unlikely. We could give away our clean technologies and deal with the spillover channel, but that still doesn't get at competitiveness and that's what we're left with in terms of dealing with carbon leakage.

This does set up some of the tensions with the trade regime because competitiveness is not a reason — there is no Article XX exception for competitiveness. It's the same reason as protectionism. Reducing carbon leakage and obtaining your environmental goal is, so it's a little hairy because in this case they're linked because this is the one channel we can get at.

There are some different options for dealing with competitiveness. The popular one is exempting the trade exposed sectors. This is done a lot with energy taxes in Europe. There are a lot of energy exceptions. This isn't great because you lose a lot of cost effective opportunities in these sectors to get them to reduce their emissions. There is output based rebating, which I'm happy to expand upon later. Benchmarking, maybe using emissions allocations preferentially to trade exposed industries, is not bad. It can improve the efficiency overall taking into account for leakage, but it's not great because then you're not really sending the right signals to consumers that these energy intensive products have carbon embodied in them that we should be thinking about and trying to find alternatives to them.

There are sectoral agreements Scott has worked on, some of these issues. At least you can target the competitiveness sensitive sectors and get all the big players regulating carbon in them so you're a little more comfortable trading. And then there's border carbon adjustment. This is the idea that you would place a charge on imports, on products from energy intensive sectors based on some measure of their carbon content, and that way try to have more of a destination based carbon tax where consumers are facing consistent prices regardless of the origin of the product.



This is from a, this was from an EMF study, so a cross model study we did on border carbon adjustments with a bunch of different models. This is looking at leakage rates. So, the bar on the left, this is by model, leakage rates without border carbon estimates, so just with a carbon price. We see that border carbon adjustments do reduce leakage, but they don't totally get rid of it and that's because they can't get out of that energy market channel. You still have it. But they reduce it by maybe about a third on average.

And I'll just point out that the range is from 10 to 20% for most of them. But this model here (circled in green), this is the Colorado School of Mines Model that's based on new trade theory. This is the only model that does that, places it in a world with heterogeneous firms and monopolistic competition. Modeling this new trade theory, you get much bigger leakage rates and much more effectiveness of border carbon adjustments, just to throw out some of the things that are driving this range. Leakage rates, if you're looking at them in terms of particular sectors, can also go much higher.

A couple of years ago I was involved with a group of mostly NGO people, economists, trade lawyers, development specialists, to think through the following: seeing that border carbon adjustment proposals are coming down the pike, what do we think might be a reasonable elaboration of this policy that would be somewhat disciplined? It would be prone to abuse and more likely to achieve the environmental outcomes and thus conform to a variety of international agreements — kind of a golden rule. How do we think we might do this? It forced us to go through a lot of the details.

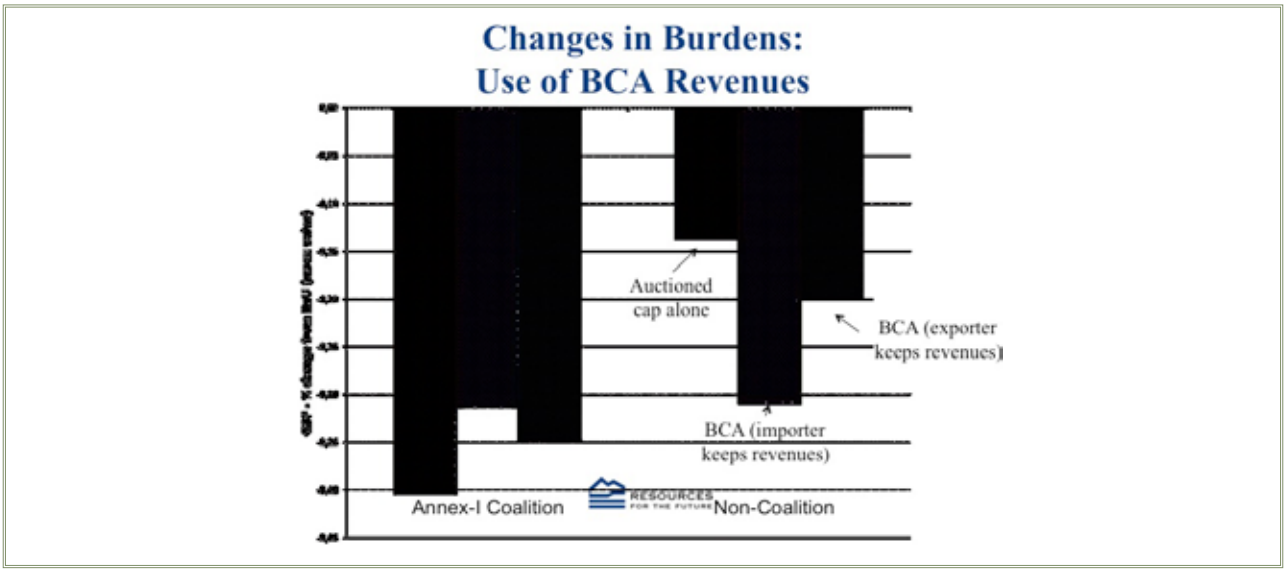
The main international obligations you have to worry about a previous speaker already told us about the WTO non-discrimination principles, but there is this Article XX exception in that. Of course, it doesn't apply to subsidies. But in addition to that, we have the principle of common but differentiated responsibilities that Richard [Cooper] wants to throw out but has been agreed to formally in several international agreements. So, we needed to be sensitive to that.

We thought through what are the potential motivations for using border carbon adjustments? First and foremost, we identified preventing carbon leakage. This is the one that conforms with the GATT Article XX goal. If you think that you're going to need to rely on the Article XX exception to make this policy WTO compatible, then you're going to have to show this is primarily for preventing carbon leakage.

Politically, competitiveness concerns are very popular, but this isn't a legitimate motivation. Although, if you don't address the competitive concerns, you're not going to get a significant carbon price. But I think that's a harder argument to make. In practice, it is important for facilitating agreements.

With regard to the potential for leverage, this is creating an incentive for your trade partners to take on more ambitious policies. This is viewed as potentially a serious violation of common but differentiated responsibilities. If we're not supposed to have the same expectations for developing countries in order to take on the same kinds of policies or carbon prices, having as your main motivation for border carbon adjustment, this kind of leverage may be an issue.

Then finally, enforcement for this session. My understanding is that if you're party to an agreement, you can agree to whatever you want. You can agree to border adjustments as an enforcement measure for not complying or for agreeing to a lower carbon price than the other guys in the club. That's fine. But the question is, can you use this as an enforcement measure for non-club members? This is one of the issues that Bill raised, because if you're outside the club, you're not agreeing to the rules.



What we have here is getting to this question, and Massimo brought it up yesterday about the distributional effects. This is a 20% emissions reduction for members of the Annex One Coalition. And this is the change in welfare as a consumption based metric of welfare. So, we see the cost of the coalition with just the carbon price. The next one is their cost with border adjustments. So, it lowers their cost. And then the third bar is border carbon adjustment where the exporting countries get to keep the revenues.

This is an idea and one way to increase your compatibility both with Article XX and with common but differentiated responsibilities is to show that you're not doing this for protection. Don't keep the revenues. We'll return it to the developing countries potentially in a mitigation adaptation fund or just directly to the exporters.

So you see here for the non-coalition parties, the first point is, they don't benefit from the coalition regulating carbon. They suffer welfare losses. So, it's not that they're running away to the bank while we take over the world economy. A lot of their trade partners now are reducing their demand.

Border adjustments really shift the burden further. There are big changes in terms of trade and they suffer much bigger welfare losses and these are developing countries. So, that may be a concern. If, however, they keep the revenues, this mitigates a lot of that additional burden shifting.

You can see the tension here that if you don't give them back the revenues, then their welfare in and out of the club is pretty much the same. So, it's a much bigger incentive to join the club. But if that's in conflict with common but differentiated responsibilities, you know, you don't want to punish them. But then the difference between being in and being out of the club is much bigger.

I just want to point out there are tensions between what we're trying to achieve with encouraging people to be more ambitious and take on carbon prices versus respecting some of our other international obligations. I'm happy to talk more about other details but I'll stop there.

Samuel Kortum

Okay, next we have Santiago Rubio.

Santiago Rubio

First of all I would like to thank Mr. Zedillo for the invitation to participate in this conference on carbon taxation and international environmental agreements. I would like also to thank the Center for the Study of Globalization for giving me the opportunity to visit Yale University.

The title of my presentation is: "What kind of climate club?" Recently, Professor Nordhaus has launched the idea of a Climate Club to face climate change. According to his proposal, the aim of the agreement would be to implement an "international target carbon price" with signatories using whatever mechanism they choose — carbon tax, cap-and-trade, or a hybrid — to meet the target instead of an agreement as the Kyoto Protocol on emissions. To stabilize such kind of agreement, non-signatories should be penalized. The penalty proposed is uniform percentage tariffs on the non-signatories' imports. Other scholars, among whom I am one, have moved in the last years in a different direction proposing a technology agreement leading to increased R&D in clean technologies to reduce abatement costs as an alternative to international cooperation on emissions reductions. In my presentation I would like to talk briefly about the proposal I'm working on: an international research joint venture to develop breakthrough technologies to control climate change, a different idea than that proposed by Professor Nordhaus; and to conclude, I would like to compare it with Professor Nordhaus' proposal.

I want to begin by mentioning a paper I published last year in *Resource and Energy Economics* entitled "Sharing R&D Investments in Cleaner Technologies to Mitigate Climate Change" where we examine the stability of an international cooperation on technological development. The focus of the paper is on mitigation and the result is pessimistic: the technology agreement does not lead to a substantial increase in participation. The focus of the present research is on "breakthrough" technologies that eliminate emissions, i.e. we focus on a zero-emissions technology treaty. A first analysis of climate treaties and "breakthrough" technologies was developed by Scott Barrett (2006) who also published in the *Journal of Economic Perspectives* in 2009 a survey of the possibilities of developing these technologies. The aim of our investigation is to analyze which could be the level of participation in a zero-emissions technology treaty.

So, let me present briefly what I have done up to now. The work done consists of the definition and solution of an R&D agreement formation game. It is a game that has a lot of features in common with the exercise that Professor Nordhaus has presented in this conference. Firstly, I'm going to present the payoffs of the players (countries), second, the timing of the game, and third, the main results.

The payoffs of the countries are given by the net benefits associated to the energy consumption. The national net benefits have three components. The benefits that depend of the country level of energy, the environmental damages that depend on global emissions — a global public bad — and finally the investment costs. National emissions are the product of the level of energy and the emission intensity of the energy system, which can be reduced by investing in cleaner technologies. In this way we take into account that there are two ways to reduce emissions. One is to reduce energy production and consumption. In this way, the country pays a cost in term of lesser benefits. The other is to invest more.

A key assumption of our model is that there exists a threshold for investment that, once reached, allows the economy to implement a "breakthrough" technology. Above that threshold, the emission intensity is zero and the country is free of GHG emissions.

So, what I have done is to solve this standard model but focusing on corner solutions. I have investigated which are the conditions that support a corner solution, and then I have analyzed the stability

of the technology agreement for these conditions. In order to derive explicit solutions for the different variables of the model, I have used a linear-quadratic specification of the net benefit function, assuming a linear-quadratic specification for benefits, a linear specification for damages and quadratic investment costs.

In the model it is assumed too that the effective investment in a country depends on the amount invested in that country in addition to the investments in R&D undertaken in all other countries. In other words, in the model are taken into account the effects of spillovers in R&D from one country to another. However, technological diffusion is not perfect; only part of the R&D investments undertaken in other countries is beneficial for a specific country. This beneficial effect is measured by the degree of spillovers that could take values between zero and one.

Moreover, countries can achieve larger technological spillovers by means of appropriate instruments such as technological cooperation. Cooperating countries can allow for patent agreements that provide the other countries in the coalition with a large share of their own innovative technology or they can sign agreements on technology transfers and/or joint R&D projects that increase the degree of innovation spillovers inside the coalition. Following the approach proposed by Kamien et al (1992), it is assumed that when countries cooperate they pool their R&D efforts so as to fully internalize spillover effects, which implies that in this case the degree of spillovers is the unity for signatories' investments and positive, but less than the unity for non-signatories' investments.

Thus, three cases can be distinguished depending of the value of the degree of spillovers for non-signatories. If the degree of spillovers is equal to one, then the effective investment is a (pure) public good. All countries benefit from the investment undertaken in all other countries. When the degree of spillovers is between zero and one, we have an *international research joint venture (IRJV)*; and finally, if the degree of spillovers for non-signatories is zero, then we have a *club good* because in this case the signatories can exclude the non-signatories from the benefit coming from their investment.

For the case of a public good, we are going to have problems to get a high level of participation. What would happen if a technology agreement comes to substitute for an emission agreement is that an agreement for cooperating in the provision of a public bad, the global emissions, is substituted by an agreement for cooperating in the provision of a public good, global effective capital; but for both types of agreements, the free-riding problem prevents the efficient provision of the global public good or bad. In the case of an IRJV an asymmetry appears between signatories and non-signatories. The effective investment of the signatories is equal to the total investment of signatories of the international research joint venture plus the spillover effects coming from the non-signatories' investment. However, the effective investment of the non-signatories is equal only to their national investment plus the spillover effects of the rest of the countries. So there is an asymmetry here. This asymmetry promotes participation in a technology agreement as El-Sayed and Rubio (2014) have shown, but not significantly if the focus is on mitigation. Finally, if it is possible to form a climate club, the signatories can exclude the non-signatories from the benefits of the club good and then participation is larger than in an IRJV but not very large.

Next, let me explain quickly the timing of the game. The R&D agreement formation game has three stages. The first stage is the membership game. In this stage, countries play a simultaneous open membership game with a single binding agreement that guarantees compliance with the agreed investment in the second stage. The level of participation is given by the internal and external stability conditions. The internal stability condition requires that any signatory country is at least as well-off staying in the agreement as withdrawing from it, assuming that all other countries do not change their membership status. The external stability condition similarly requires any non-signatory to be at least as well-off remaining a non-signatory as joining the agreement, assuming once again, that all other countries do not change their membership status.

At the second stage, the R&D investment game, signatory countries pool their R&D investments so as to fully internalize spillover effects between signatories and coordinate their R&D activities so as to maximize the aggregate net benefit of the agreement taking as given the R&D investments of non-signatories. On the other hand, non-signatories choose their investment in R&D acting non-cooperatively and taking the investment of all other countries as given in order to maximize their national benefits. Signatories and non-signatories choose their R&D investment simultaneously. Thus, R&D investments are provided by the *partial agreement Nash equilibrium* with respect to a coalition. Finally, given the level of participation and the investment in R&D of all countries, at the third stage, the emission

game, each country simultaneously selects its own emissions acting *non-cooperatively* and taking the emissions of all other countries as given. The game finishes when the emission sub-game is over.

The solution to the game shows that there exist two threshold values for marginal damages, such that if marginal damages are larger than the lowest threshold value, the grand coalition implements a "breakthrough" technology and emissions are eliminated, and if marginal damages are larger than the highest threshold value the fully non-cooperative equilibrium also implements a "breakthrough" technology, in other words, with large enough marginal damages cooperation is not necessary to eliminate emissions although they would be eliminated in an inefficient way. Moreover, we find that there exists another threshold value between those defined above such that if the marginal damages are larger than this third threshold value, the grand coalition is stable.

There is no time to explain these results in detail but it is clear that they solve what is known in the literature on international environmental agreements as the *small coalition paradox*. The small coalition paradox was establishes in the early nineties and although there are different versions, the most popular version says that the larger the gains from cooperation, the lower the level of participation. Our analysis show on one hand that the larger the marginal damages, the larger the gains coming from full cooperation and, on the other hand, that the larger the marginal damages, the larger the membership. Combining these two results, we get that the larger the gains from cooperation, the larger the participation — just the contrary of what is established by the small coalition paradox. Moreover, we find that only when marginal damages are large enough to justify the implementation of a "breakthrough" technology, the grand coalition is stable. In other words, participation increases with marginal damages but the grand coalition cannot be stable if the marginal damages are not larger than the threshold value that justifies an investment level big enough to completely eliminate emissions.

Finally, I would like to devote two minutes to compare these results with those derived by Nordhaus (2015). Professor Nordhaus, using the C-DICE model (Coalition Dynamic Integrated model of Climate and the Economy), solves numerically a coalition formation game with 15 regions very similar to the one I have just presented, and he finds that the grand coalition is stable with small tariff rates provided that the marginal damages are not very large ($12.5 or $25 per ton of CO2) but that participation falls drastically when the marginal damages are large. For a target price of $100 per ton of CO2, the maximum membership is 6 regions for a 10% tariff rate, the maximum tariff rate considered in the analysis, and participation decreases to 3 regions with a decrease of 1 point in the tariff rate. Thus, the Climate Club proposed by Nordhaus could not achieve a lot of the potential gains when these are large, i.e. when marginal damages are important. For a target price of $100 per ton of CO2, the club consisting of 6 regions only could achieve the 40% of the potential gains coming from full cooperation, and this percentage drops to a percentage below 10% with a decrease of 1 point in the tariff rate. Contrary to our results, Nordhaus's conclusions are consistent with the small coalition paradox.

To conclude, let me answer the question with which I opened this presentation: What kind of climate club? The answer is clear, it depends on how large is the social cost of carbon (marginal damages). For low and medium values, an international target carbon price with trade sanctions could promote a lot of participation but for large values we should look for other alternatives. One of these alternatives could be a technology agreement to promote the adoption of "breakthrough" technologies.[1]

Samuel Kortum

Now we have Scott Shelton.

Scott Shelton

I think I'm the lone administrator in the room. My presentation is not going to be modeling or economic theory. I have listened to a number of very thoughtful presentations and my presentation will take the approach that you have convinced me in a very decisive manner that carbon tax is the appropriate way to go and I will focus on how do you successfully implement that policy. I will look at the design of the taxing instrument from two bases; one being a country's ability to manage and implement that tax and two, the ability of the targeted tax base to understand the policy intent and comply with the law. If either of those two are frustrated by the design of the policy, they will frustrate or impede the successful implementation of the policy intent of the tax.

It's important in both developing and developed economies to take into account the institutional capacity to administer a new tax, but it's especially an important consideration in developing econ-

1 References

Barret, Scott.2006. "Climate Treaties and "Breakthrough" Technologies." *American Economic Review* 96(2):22-25.

Barret, Scott. 2009. "The Coming Global Climate-technology Revolution." *Journal of Economic Perspectives* 23(2):53-75.

El-Sayed, Abeer and Santiago J. Rubio.2014. "Sharing R&D Investments in Cleaner Technologies to Mitigate Climate Change." *Resource and Energy Economics* 38:168-80.

Kamien, M.I., E. Muller and I. Zang.1992. "Research Joint Ventures and R&D Cartels." *American Economic Review* 82:1293-1306.

Nordhaus, William. 2015. "Climate Clubs: Overcoming Free-riding in International Climate Policy." *American Economic Review* 105(4):1339-70.

omies where institutional capacity is generally weak. Another consideration is that institutional capacity where it does exist is normally concentrated. A tax policy that focuses on a specific economic sector which involves a number of regulatory agencies that have limited and/or concentrated experience and expertise emphasizes the need to consider the institutional capacity of agencies/departments within a government to monitor and manage the tax.

It's not my intent to say from an administration point of view that the number one aim should be eliminating the administrative complexity in designing law. Obviously, policy intent is paramount.

The first point, I would make is that an effective administration of a carbon tax or any other tax requires that you have a considered and well-defined tax base with a clear underlying policy objective. The larger the tax base that you identify, the harder and more complex it will be to manage. The more sophisticated that tax base is in complying with similar tax laws, the fewer compliance issues you're likely to encounter.

Defining your tax base is dependent on the methodology you choose to tax. So, you're going to have to select not only what you're going to tax (consumption vs. emissions), but at what point you are going to tax. As I take you through a number of options, I will discuss what I see as the complexities that might frustrate a successful implementation of a carbon tax. Ultimately, the message that I would deliver is to keep it simple so taxpayers can understand and comply and governments have the capacity to administer it.

So, let's talk about what you tax. You either tax emissions or you tax consumption. The first option, you tax all emissions. It has a clear, straightforward policy objective. People would see that as fair as everybody is effected by the law. It's comprehensive. It minimizes leakage. The only constraint is that there are some administrative practicalities. One of the pluses that comes from this is that you can use an upstream tax base to tax emissions indirectly as you would design it in relation to the carbon content of the combustible product. As you would be applying a tax to a product defined by its carbon content, the tax would be similar to an excise tax.

An upstream tax was talked about in an earlier presentation and I want to clearly define what I mean by upstream, which is different from the earlier presentation. Upstream is not production from a well or a mine face. The upstream process is taking carbon fossil fuels to a stage where they can be put into a process where they're combusted. So, you're talking about the outlet of a refinery or possibly the mouth of a coal mine, if the coal does not have to be processed further.

Audience

You're talking about taxing the production stage of a combustible product, how is that different from Robert's [Schmidt] proposed upstream tax?

Scott Shelton

I don't want to speak for Robert, about his proposal to tax at the upstream stage. My understanding

of Robert's proposal was that you're talking about taxing production, production from an oil well, for instance. In my scenario I'm not talking about that. I'm talking about the taxation point being at a finished product stage as it leaves the refinery.

The next scenario realizes that there are a number of pressures that have been talked about for governments to exempt parts of the economy that are going to be negatively affected by the implementation of the tax. There is a policy case to be considered for protecting any disadvantaged domestic business. A tax on emissions with some business exemptions included obviously increases administrative complexity. The negatives of introducing exemptions are they could cause leakage, probably will cause leakage, maybe frustrate the policy intent and increase global emissions. It has a less clear policy objective. The taxpayer base may not understand the policy objectives. It's not comprehensive. And it may require not utilizing an upstream but a downstream tax base. If you use an upstream tax base, you can't adjust, or it is more difficult to adjust for negatively affected domestic taxpayers who are further down the value chain. So, you may have to abandon the upstream tax base and go to one further down that value chain, which will increase the number of taxpayers that are going to be included in your tax base.

The last option I will consider, and there are probably others, falls under the concept of the polluter pays. This is a tax on consumption. The concept is that the tax would apply to all domestic activity at the point where the end user (polluter) acquires the product for use, which would also include a tax on emissions produced in the upstream process to produce the product. In this scenario there is a concern that you may miss the carbon content of imported goods that are consumed within the domestic economy. Therefore, there is a need to put a tax on imported carbon intensive goods coming into the country. Exporting countries would exempt carbon intensive goods and services being exported, as they would presumably be taxed in the destination country. This would be the case, unless the country is part of a carbon pricing club, as has been discussed in other presentations. The policy case for this option is clear: that it's to tax emissions produced to meet domestic consumer demand, if they're not taxed elsewhere.

Under this last option, what are the complexities you would need to consider before implementing a consumption tax? One, the complexity of measuring the carbon content of imported goods, is a difficult, if not impossible task to resolve. More than likely you would have to utilize an approximation of carbon content. Second, the WTO as you've heard in other presentations is a possible issue. The rules for taxing international flows will have to be within the WTO rules. Thirdly, the complexity around the administration of a carbon pricing club, from my perspective and I'm relatively new to the game is, who's in the club? You've set parameters for entry into the club. You have to monitor to make sure that members continue to meet those parameters. Otherwise, you would obviously want to remove those people from the club and there will be countries, once they see the value of being in the club, that will want to join. There has to be a due diligence process around entry into the pricing club and the maintenance of that membership. Again, something that increases the complexity.

In the interest of time, I will go to my conclusion on a carbon tax based on administrative simplicity. The process of implementing a carbon tax should first of all be an emissions tax starting with the fossil fuels. Other sources of emissions, as they would be more difficult to tax (if considered), should be at a later date. The point at which a country should establish liability for the tax should be at the upstream level. This establishes a tax base that is small in number and is easily identifiable. As an example, in the U.S., you're down to probably in the neighborhood of 1,500 sophisticated taxpayers to be administered.

The upstream outputs of this tax base are already subject to an excise tax in most countries. This means there is already a process in place to identify the outputs and it should be relatively simple to attach a carbon content to those outputs. It will also catch CO2 from non-energy use such as asphalt. So that is why you have a small, sophisticated tax base and you have easily identifiable outputs that you can tax. There may be synergies at some point for taxing methane emissions. An upstream tax will be a comprehensive tax on fossil fuel combustion and with no, or limited, exemptions, there's limited scope for avoidance.

Other practical concerns to consider and address:
A) You're going to have a number of different regimes worldwide that are going to be in place and continue to be in place. (1) You have a carbon comprehensive carbon tax model in a number of countries. (2) You have carbon tax models with exemption thresholds. (3) You have, what I would call, targeted carbon tax, a carbon tax for a limited number of sectors and/or activities. (4) You have emission trading schemes. (5) You have different CT rates. (6) And some regimes allow payment for the tax in carbon credits. These different regimes will need to be reconciled in order to establish a fully integrated international tax system for carbon tax. This will introduce monitoring issues for tax administrations. For example, how do emission trading schemes and carbon tax work together? As we see in Sweden, it is treated as a double taxation issue. In Europe, you have an ETS and Sweden domestically introduced a carbon tax. Sweden exempted those institutions from a carbon tax that were also subject to the ETS. This introduces a concern for the revenue administration about their ability to monitor whether the companies that claim to be under the ETS trading schemes are actually registered and complying with the ETS scheme.

B) Administratively you're going to have Ministries of Mines, Ministries of Petroleum and the Revenue Ministries involved in the process in defining carbon content and administering the fiscal framework. Especially in developing countries where you have limited and concentrated expertise, a cooperative and coordinated regulatory process is required and simplicity is mandated.

C) I think one of the most important considerations is that most countries have an excise tax regime in place and carbon taxes currently implemented in the world mirror an excise tax regime. Therefore, most tax administrations will have relevant experience and processes in place to administer a like tax.

So, what are my recommendations? (1) Apply carbon tax on fossil fuel CO2 emissions initially at an upstream level. (2) I'm Canadian, so I have to refer to one of our provinces, British Columbia, who implemented a carbon tax on a graduated basis. I think that has a couple of positive aspects. It allows you initially to address the policy or administrative glitches while minimizing their economic effects. As you move up the level of tax, which has a larger effect on the economy, you have hopefully worked out those bugs. (3) Utilize a self-assessment system in order to minimize the cost of administration and the compliance burden. (4) Design should be similar to an excise tax regime, which for a tax administration is one of the simplest taxes to administer. (But this is not a panacea, the importance and concern about excise taxes has diminished as the more important taxes, corporate tax, the VAT, have taken the attention of institutional administrations. Relevant administrative experience may have been lost which may need to considered)

Discussion

Samuel Kortum

I thought I'd break the ice by asking a question first. I was puzzling over the Nordhaus proposal and why he didn't like the carbon duties. And here's my explanation, but I want to see if he agrees and I think I'd like Carolyn to reflect on it as well.

Say that there was no trade at all in the world. You'd still have the free rider problem. And I feel like Bill's proposal is really about that and then it happens to be that if you think of the world, well what penalty can we impose? Trade is the one thing we have going as a club in the world. And so that's where the penalty can be applied. It really has nothing to do with anything about carbon. I think that's the reason he's pushing that because it's really detaching the penalty from any kind of carbon tax adjustment issue. And then you can make it as strong as you want.

My feeling is that maybe the kind of tax he's talking about of say about a two, four percent tariff would probably rule out all the carbon leakage anyway. The kind of carbon tax we're talking about would be — what were people saying — like 25 cents. So 10% of the value, but then mostly we're not importing gasoline. Most of the things don't have such a high carbon content. So, it seemed like that would solve that problem as well.

I guess a question is, if we think about it this way, maybe that would take some of the emphasis off thinking about tax adjustments for carbon leakage. And just try and get a big group of countries to comply and then those who don't, there's not going to be leakage from them because of the tariff imposed on all goods.

William Nordhaus

Part of the reason I went with this route when earlier studies have focused on leakage, which is a problem when you have differentiated or lack of participation. I think the real problem is participation. Leakage is trying to shift the ballast around on a sinking boat and try to get the boat so it doesn't tilt in one direction or the other. But I think the problem is to keep the boat from sinking and that means we have to have high participation. That's the first reason.

Secondly, if we didn't have existing WTO rules and we weren't try to shoe horn an agreement into WTO rules, but if we just said there are no rules. We're just setting up an agreement, but we want

to harmonize, we want to have a system that will actually make this effective, and at the same time we're setting up WTO, then we might say, well, okay. We don't have a whole history of WTO law that we have to conform with and we might just use the Uniform Tariff.

There are really two reasons to go with the uniform tariff. One is that the border tax adjustment has been shown by modeling not to work. I've done an earlier modeling that shows it's not going to induce participation because it's only on a small fraction of a country's production. And the second thing, it's really complex. When you think of how to impose these tariffs it becomes very difficult. We just know it's going to be really complex. It was raised a couple of times today in the discussion.

I realize that it is not the way trade lawyers and trade economists think about sanctions of the trade system. I realize that, but what you have to think is that we need to find a way to design sanctions that is going to do what we want, which is induce participation. The things that are clearly conformed with WTO law, according to the current modeling, back of the envelope calculations won't do it. I think that's the logic of going this route, a different route for the trade sanctions.

Discussion Participant

Two small things. You mentioned that there are agreements, environmental agreements with sanctions and I understood you as saying that it would not be WTO consistent. I think they could probably all be WTO consistent. It all depends on how they're implemented. But there are at least 25 of them at the moment. None has ever been challenged. Of course, I'm not entitled to say whether or not, but you can draw your own conclusion.

I think that it falls directly under WTO first rule that at the border, whatever you do should be MFN, whether it's a tariff, administrative paper, or license — all countries should be treated the same. Now if you make distinctions, discrimination, those outside are punished. The issue is not discrimination. The issue, and it's now 60% of all the disputes, is whether the discrimination can be justified. The whole debate and the whole case, if there is one would be justification.

If you can demonstrate that this is necessary to ensure participation, I don't know how it would be assessed, but I would not reach the conclusion that it's necessarily clashing with WTO rules. It clashes with the basic MFN, non-discrimination, yes. Whether this is justified, still depends on how it works in practice.

Carolyn Fischer

What's nice about your modeling exercise and the *ad valorem* tariff is that it's very simple and you get a clear sense of the dimension of the punishment necessary to induce participation. I was coming from a perspective of thinking, well what could really be implemented and be compatible? So, that's very interesting to hear that there might be a way to use a non-carbon based metric that would be compatible with the justification being participation and not leakage. And the proposal that our group sent would be necessary to qualify for an Article XX exemption.

Some of the other things that came up in our exercise, we were not overwhelmed by the complexity, although there are a lot of decisions to make. Part of the recommendations were not to go too far down the value chain and really focus on the key commodities that are energy intensive and highly traded and find simpler metrics.

But then there are also these issues of what countries to exempt. And there is a standard exemption for the least developed countries. So, maybe that's part of what could be done to enhance compatibility.

In terms of the leakage aspect, if the *ad valorem* tariff induces full participation then, yes, you've solved the leakage problem. In the case where we need a high social cost of carbon, a high tax, and you're not getting full participation, then the *ad valorem* tariff is not going to differentiate among the higher and lower emissions intensity products. So, it's not going to be as targeted towards dealing with leakage as a border carbon adjustment would be. But some interesting questions.

William Nordhaus

I've talked to a number of trade lawyers and what I've learned from them is the kind of trade sanction that is in the proposed club is not clearly outside existing law. It's not clearly inside existing law either. There's some ambiguity.

My thought on that is I don't think you want to put in place a mechanism that is not clearly justified by existing law. You don't want to put in all the effort, negotiate a treaty, go on for years and years and then have the 1st Circuit throw it out because it doesn't conform with U.S. law. I think it's clear you need, in part of the treaty, to have what I call climate amendments that make it clear that the mechanism that you're introducing, and particularly a regime of non-retaliation, is conforming with existing international law and domestic law as well.

Samuel Kortum

Thank you. Okay, now we have lots of questions. I'm going to work from the back. Richard Cooper?

Richard Cooper

I want to make a general point on Bill's proposal. He happens to choose trade, but trade is actually unrelated to the problem at hand. It's just a way to punish countries that don't comply with what you want them to do. That is a very general problem. It is not limited to climate change. We have many, many examples of treaties we'd like countries to sign on to, including, in some cases, the United States is the outlier. And I want to make the point that if trade were literally to be used in this context, it would set a precedent for using it in many, many contexts. The non-proliferation treaty and the ICC and so forth, countries that say well, we really want Country X in. Country X is a free rider or whatever you want to call it and, therefore, we're going to impose trade sanctions.

I think we need to think about, as I said yesterday, the system as a whole, not just climate change or the trading system. We have to think about the system as a whole and the precedents that this sets. We have many ways to make countries comply with what we want them to do. Going to war is one

extreme. I haven't heard anyone suggest that we should go to war over climate change. But we could deny them some of the benefits of the WHO. You can make an imaginative list of things, and the point I want to make is that Bill has chosen trade. His use of trade is unrelated to the issue on the table. It is a way to make another country comply with what you want to do. It's a long list of possibilities on the one hand and it creates a precedent for many, many areas on the other hand and we have to think about both of those.

William Nordhaus

I think there are a number of points and their implications that Dick raises. But I'll not get to all of them. Is it really true that there are other sets of sanctions that are as fine tuned as trade sanctions and can be used in the same way with the same affect? I actually think not. If you go back and read about the history of sanctions such as in Hufbauer and Schott, they're actually a very limited number of tools that can be used.

Secondly, one of the things I didn't talk about, but one of the questions you can ask is, how finely tuned is this to get at the transnational externality? It's an interesting question and within the confines of the Ossa Model and the other economic models, the Uniform Tariff is reasonably closely tuned to the transnational externality — not 100% but it actually captures the transnational externality of carbon emissions reasonably well.

Third, on your central point, I think it's a very important point and I completely agree that we need to think very carefully about whether we want to make exceptions and whether this is one we want to make. Is climate change a sufficiently important problem that we want to run the risk of changing the trade system in this way? And again, that comes back to your first point about are there alternative instruments that we can use that are also effective in inducing participation and that have the same incentive compatibility that the trade system has?

And finally, another reason that I didn't mention the climate amendments is that that sets up a threshold that says, okay, this has to be a sufficiently important problem. Are you actually willing to amend the fundamental principles of the agreement, international and domestic law, to change them to include this as a kind of generic exception? An explicit one, not just one that you can shoehorn into existing articles.

So, I think you raised a number of really important points, but I think the fundamental question is, is this an important enough issue? I think it is. Are we making progress? Absolutely not. Can we think of another instrument that will have the same effect in inducing high levels of participation, at least as Professor Rubio said, at relatively modest levels of social cost of carbon? I don't know of any.

Samuel Kortum

Adele?

Adele Morris

Everybody keeps talking about free riding and I just want to challenge the notion from the U.S. perspective. I would argue that the U.S. is not free riding. Let me explain what I mean by that. I think the Obama administration is offering everything in its power under existing law and maybe, arguably, then some. So the U.S. administration has nothing else to offer and it's participating to the extent it can. What's holding it back is Congress, and the absence of a comprehensive, economy-wide price on carbon or other comprehensive new authority. And what's holding that back? It's not that the U.S. is sitting around saying, hey we're going to benefit from everybody else's mitigation and that's why we're not taking action. It's a whole set of other reasons, a gross under estimate of the benefits of litigation, a gross over estimate of the cost of action, a concern around the distributional outcomes of the action.

I don't think the joint announcement with China, the U.S. part of that, was in any way contingent on China's action. I think it was a joint announcement, not an agreement. It was like we're doing everything we can and I think we would have made exactly the same announcement irrespective of what China did.

So, the question that comes to my mind is, would trade sanctions potentially imposed against the United States overcome all the barriers I just described with the U.S. Congress? And it's hard for me to see a scenario where the threat of trade sanctions — first of all, I don't think the U.S. would ever agree to make itself subject to trade sanctions in any kind of a priority agreement about clubs — it's unfathomable to me that the U.S. would agree to do that. And even if we were at some point subject to trade sanctions, it's hard for me to see how that does anything to meliorate all the barriers I just described with regard to new legislation.

So, as sympathetic as I am to this basic idea of free ridership, when I look at the U.S. at least, that's not the dynamic that I'm observing within the political and economic climate in the U.S. So, I'll just throw that out there as my observation. It's not to say that this model of free riding doesn't apply to other countries or maybe just kind of broadly conceptually, but within the U.S., I just don't see that as the right name for the dynamic we're experiencing.

Samuel Kortum

Jason Bordoff?

Jason Bordoff

I'll talk about this in my presentation in a minute. But the clean power plan from the EPA in terms of what it gets you from power sector reductions is probably on the order of a $10 a time carbon tax or something equivalent. If you look at the EIA modeling, there's not a ton of countries out there with a higher carbon price the last time I checked.

But really I was going to make the point that Dick Cooper made of why I think the idea, as intriguing as it is, actually strikes me as quite dangerous. There are ways in which sanctions, I think, are not

as blunt an instrument as some of the older literature suggests. Some of the recent experience with Iran and Russia has shown a lot of creative and innovative uses of sanctions targeted at very specific sectors of the energy sector, of the banking economy. And when we think about the potential — first, it wouldn't be like one policy mechanism. You'd think about a carbon price, but you'd have to account for the fact that other people are going to use other tools and regulatory approaches and whatever else. Then you need to draw those lines that Adele said yesterday are really hard to draw for the guy sitting at the Treasury Department, and it's easy to see how political considerations and interest groups come into play. That this ends up being used to the point about the chapeau who is not in the right spirit and from a protectionist standpoint, not necessarily an environmental exception justification.

Then more broadly what I worry about is I look at where the global economy is headed and Ernesto or others may have thoughts on this. As we see sanctions being applied against Iran and against Russia, the Asian Infrastructure Bank, there are a number of efforts underway to actually disentangle what had become a more integrated global economy. These sorts of tools create an extra risk that actually the response would not be to join the club, but to try to pull further away and expose yourself less to the threat of sanctions from any small group of countries. Or that retaliatory tariffs could be applied in response to something else. So I think that danger is one that is very real and should not be underestimated.

Samuel Kortum

Thanks. Grzegorz Peszko

Grzegorz Peszko

This is a fascinating discussion and I have a lot of comments that have been said here already, although, I'm kind of sympathetic because I think what Professor Nordhaus suggested is that we are stuck a little bit in this kind of small coalition corner. And we need to find other out-of-the-box ways to induce the incentives to form the coalition. Certainly every choice will be risky and have side effects.

But I'd like to switch the gear a little bit and focus on the consumption-based charges that Scott has mentioned. He said that carbon taxes are based on the carbon content on the goods and services. It has to be squared with WTO. There's literature that suggests that actually if you impose them in a non-discriminatory way in the national jurisdiction and they equally apply to the carbon content in the goods and services produced in the country as well as imported, then they are WTO irrelevant, because they are not discriminatory. Could you comment on that aspect? But the point is taken that it's extremely complex. That can be a killer, but from the point of view of the kind of WTO compliance, I'd like to hear the comments.

Zhongxiang Zhang

I have two questions. The first is for Carolyn on leakage. I reviewed the literature on this and it basically covers two priority channels — the leakage competitiveness channel and the international energy fossil fuels price channel. The common finding is that most of the leakage actually comes from

the international fossil fuels channel. That basically means if the U.S. and the EU cut emissions, the more fossil fuel prices go down, the more China and India might use them. Did you service a model in your work to see whether this is still the case, that the port adjustment now is still the leakage channel, and mid-channel it is still fossil fuels?

My second question is about the U.S carbon tariff proposal and the implication in China. We argue from the WTO based on a few cases that are, like yours, imagined that as long as you have comparative effectiveness, in the end it is okay. In the climate field, that might look a little bit different. You still have to look at the comparable effectiveness, which are more focused on the results compared to the efforts. So, as long as the U.S. in the proposal says that if you don't take the comparable efforts, then the products that come to us have a carbon tariff. So you have to decide what the carbon contents are. But suppose you didn't do it. If you look at the cases, you mentioned like U.S. and Mexico and others, you basically said you can use this Article XX, but the primary purpose has to be to protect the environment. That has to be the primary purpose. So, suppose that the U.S. is arguing that it is trying to comply with WTO law; so China and India could come and they have to buy the allowance from a designated program from the U.S. That case is very questionable because if you are really considering the environment too, and primary effectiveness, why can I not buy some other carbon certified things, which maybe can achieve similar effectiveness, but we don't necessarily have to buy yours.

Samuel Kortum

Thank you. I'm going to take two more questions and then I'll let everybody respond, starting with Scott Barrett.

Scott Barrett

Thanks very much. What a great five presentations and a great discussion. I've really enjoyed this. I was going to ask two questions but before I do that I may start off with a brief comment on what Adele said.

I think the central problem with climate change is free riding. But there are two aspects to free riding. One is greed and that's how we often think about it. But the other is fear. The greed is obviously just about self-interests. The fear is the fear that you'll act and others won't and the job won't get done. One of the key things that you want an agreement to do is to give an assurance to all the parties that if each one makes a sacrifice, all would make sacrifices and all, together, will be better off.

I think the United States would support this because the first paragraph of that 1,400 Waxman-Markey bill was not about the United States. It was all about China and India. And, as you know, from the previous senate non-binding resolution just before Kyoto was negotiated, it was also about the rest of the world.

I think the United States cares as much about that as any country. I completely agree with Dick Cooper's point. This problem is completely unprecedented and the institutions that we have available are

not equipped to deal with it. And I think what Bill is doing is throwing something out that I think is provocative in many ways. But I think it should be stimulating people into thinking, how are we going to deal with this unprecedented problem with institutions we have that were never designed to deal with it?

I have two questions. One is for Bill, which is that his analysis assumes that the non-members of the new climate coalition are really rather docile. So the members of the coalition adopt the tariff, but the others all abide by the trade agreement and they're really quite docile. I'm curious as to whether he has investigated how these countries may want to respond. He did mention that some of the countries are actually quite happy to face the tariff because the agreement that has the tariff also is reducing global emissions and they benefit from that. But I am wondering if he has looked more deeply into this question of retaliation. It does seem to me that there's a risk to the entire trade system of using a measure like this that would be worse than anything because you not only aren't dealing with climate, but now you're also dismantling the success we've had on the trade side.

And my other question is for Santiago. He's pointed to the importance of these so-called corner solutions, which I think are hugely important. It's a radically different way of thinking about cooperation. And I'm just curious about what is actually going on in the corner? There's zero abatement, but why is it that that would be stable. If one party deviates from that, does everything fall apart? There must be some mechanism like that at work. I couldn't understand what it was.

Samuel Kortum

I'm acknowledging the other questions, but I want to start hearing responses. So, could we start with Scott Shelton. I think there are questions for everybody, so you can pick and choose.

Scott Shelton

The only comment that I have in relation to one aspect of my presentation that I didn't get to was, there's been lots of talk about how do you deal with the revenues that are generated from the tax. That's very important in my mind to the tax base and the public in general as to whether they see the tax as fair and adhering to its policy objectives. And I wanted to refer to the ETI transparency initiative as a possible aspect that you might want to consider from an administrative point of view, so that the public, the tax paying public, is well aware of what funds are collected and how those funds are being utilized.

Samuel Kortum

Thank you. Santiago?

Santiago Rubio

I would like just to make a general comment on all this debate about trade sanctions. If one looks at Nordhaus' (2015) paper and examines his stability exercise, the debate we are having on trade sanctions only makes sense if the international carbon price is in an interval between $25 and $50 per ton

of CO2. If the carbon price is higher, it doesn't matter whether trade sanctions can be implemented or not. Why? Because for instance for a carbon price of $100 per ton of CO2, trade sanctions are not going to be useful to promote cooperation. The costs of controlling emissions are so high that even taking into account trade sanctions, what you get is a very low level of participation.

So, it means that although all the debate about legal and political feasibility of trade sanctions is really interesting, it makes sense only if we expect a not very high carbon price. If it is not the case and the target carbon price we expect is above $50 per ton of CO2. We should begin to think on another proposal, maybe, on a technology agreement.

So about Barrett's question on stability, what's explaining the result is something really simple. Although the signatories' investment is larger than the non-signatories' investment for any level of participation, this difference is decreasing with the number of signatories. The diminution in this difference is explained because the necessary level of effective investment to develop "breakthrough" technology operates as an upper bound on the effective investment of the countries. Thus, the signatories' investment decreases with the participation once they have implemented a "breakthrough" technology, and this causes the difference between the investments of signatories and non-signatories to decrease with the participation.

On the other hand, the energy production of signatories is larger than the energy production of non-signatories because the emission intensity is lower for signatories than for non-signatories. In fact, once signatories have eliminated the emissions, the energy marginal damages, which are equal to the marginal damages of emissions times the emission intensity, are zero because the emission intensity is zero, and then the energy production is the same for the different levels of participation that support the implementation of a "breakthrough" technology. Thus, if we compare the net benefits of a signatory belonging to the grand coalition with the net benefits of a coalition structure with a unique non-signatory to check the internal stability condition of the gran coalition, the result is that the non-signatory supports lower investment costs but that the level of energy production and consumption it enjoys is lower and the damages are larger because the non-signatory uses a polluting technology. With low differences in investments, the reduction in investment costs are more than compensated by the reduction of benefits coming from the consumption of energy and the increase in environmental damages, and the final result is that the grand coalition is stable. Briefly, this is the argument explaining the stability of the grand coalition when emissions are completely eliminated.

Samuel Kortum

Thank you. Carolyn?

Carolyn Fischer

Okay, quickly, again Greg's question and then Zhongxiang Zhang too. In terms of the consumption tax compliance, I think the growing consensus I'm hearing in the international community is that border

carbon adjustments can be designed in a way that's WTO compatible. If it's well done, there's less concern about that.

But I think you're right on your intuition that something that's designed more explicitly as a consumption tax avoids getting into that debate at all. I'm actually working with some colleagues in Europe thinking about using a consumption tax on energy intensive goods as a way of undoing the bad features of the free allocation to get the prices right for consumers. And they feel that that would have an even easier time with the WTO compliance.

In terms of the effectiveness of border carbon adjustments, you're right, it seems that more of the leakage is through this global energy channel. And you just can't get at that without a really, nearly global carbon price. But they do have a substantial effect. So, with border adjustments just on the major energy intensive exposed sectors, we were getting a reduction of about a third of the leakage. So, that's, that is significant. And the other way to maybe try to get at the other stuff would be a bigger push on clean technology. So, making the rest of the world that's not regulating carbon pricing make cleaner technologies more competitive for them. So, that might be a way to go.

An overall comment, as an economist we're used to thinking in very specific ways and thinking very clearly about what is in our self interests and assuming that countries are primarily behaving in their own self-interests. And I would certainly argue that self-interest is an important component of decisions, but not the only one. As Adele was saying the administration is putting out everything that it can in its power. It thinks this is an important issue. So there is will to act, but there are constraints. I don't see it as a pure free riding problem, but competitiveness is a big issue that came up over and over again. It still comes up in discussions about a carbon tax on The Hill and carbon leakage.

So being able to deal with that will actually induce participation in more significant levels on players, although I don't expect anything with this Congress. But I think it is an important aspect.

I have two research questions that I would love to collaborate with folks here. One is with Ion, that you've done all of this work estimating the co-benefits of carbon pricing, I would like to bring that back into some of the border adjustment studies and see — because, you know, Bill is right. Border adjustments alone, at least these kind of limited border adjusts, for a lot of countries, aren't enough. In China in particular they aren't enough to get them in a self-interested way to want to participate in the coalition. But I'm wondering, if we add in the co-benefits that they would experience anyway in terms of reduced conventional pollutants and other things, how many more countries is it really in their interest? And would border adjustments be enough of a nudge to put them over?

The other question is for Bill. From your study, you see that when you get up to the very high social cost of carbon, like $100 a ton, the trade sanctions aren't that effective. I'm wondering, how much more effective are border carbon adjustments at that point because then they would get very high and targeted towards energy intensive industries and have possibly different effects, both certainly

for leakage, but also potentially for compliance and looking for the kinds of countries that you definitely want to get into the coalition. I would love to collaborate with you on that. Thanks.

Samuel Kortum

Bill?

William Nordhaus

Well there have been a number of very interesting comments and I'll just give one line responses to them given the time.

Just standing back, I think we have to recognize that we're not actually making much progress on reducing, or taming, the climate beast and reducing climate change. Given all the modeling — Massimo is here and you can just shake your head if you think I'm wrong — we're not heading toward any of these aspirational goals like a 2% limit or even a 3% limit. We're basically on the path now of unrestrained climate change. And for whatever we're talking about, whatever the motivations, whatever you want to call it — free riding, obstructionists, right wing governments, whatever you want to call it — we're just not making any progress.

So, that's part of what my thought is just standing back, not as an economist necessarily, but as someone who has thought about this and looked at different mechanisms and looked at what different people are doing. We're just not anywhere and you can look at that in terms of decarbonization rates in the United States. You can look at decarbonization rates within the world and different countries. We are just not getting anywhere yet.

On the food rioting thing, in a way I've already answered that. Politics is the art of doing what you want and throwing up a smoke screen so people don't really know what you're doing. Are the senators really interested in the interests of the United States? Probably not. Wyoming? Probably not either. Ideology versus opportunism? Who knows? It's a very complicated mechanism.

The Obama administration is not going to be very effective. Why doesn't the Obama administration say what it actually knows, that we need to raise carbon prices? I've asked that of many people and they say, well, the administration is not over quite yet. Maybe just hold your breath and it will happen.

I think whether it is free riding, it looks like free riding--let's put it this way. The Congress is not acting in the interests of Indonesia. Whatever it's doing or whatever it thinks its interests are, it's not in the interests of Indonesia, Bangladesh, India and other countries when it sets climate policy.

On the question of other sanctions, which was raised earlier, I was very surprised to hear that. The idea to bring other countries in while for this country we use banking sanctions and in this country we're going to use energy sanctions, for that country we're going to use steel sanctions and for this country we're going to use shrimp sanctions or whatever. If you just look at what's going on with the EU and their sanctions with respect to Russia, that is exactly what you don't want to do, aside from

the fact it's probably going to hurt Europe. You don't want a sanctions regime that's going to take forever and everybody's going to be arguing. You want something simple, clear, that analytically you know the impact of.

On Scott's point about docility and then there was another point over here about stressing the WTO. Are we stressing the trade system by imposing all these rocks on it? It's already a strained system. We'll put the non-proliferation rock on it. We'll just keep loading rocks on it. The point that I think was being made is that you have to make sure you have enough surplus in the trade system so you can load some other obligations on it. And I think one question is, are we really sure that all these countries will actually decide to continue to participate in the trade system when you start loading on these emissions obligations? I think that's something we need to worry about.

The point you made about the system not being able to support high prices I found to be a very troubling one. This is with today's economy, today's technology, today's emissions — those are the prices. Few people are saying we should have $100 a ton prices today. Almost all models have $100 a ton of CO2 sometime in the middle of the century to get any reasonable climate outcomes. So, I do worry at lot about that. But I actually haven't looked to see what the 2050 economy, 2050 emissions, 2050 technology, whether that could support the high carbon prices. That's just an open question.

What I do think is capturing is a really important point, is that the stresses of free riding, the strains of free riding, the strains of countries acting in their self-interest — and this would be either not participating in an agreement or cheating or lying or finding false emissions or submitting all kinds of reports or subsidizing things at the same time they're taxing them — all the kinds of stresses and strains that would come from a very high carbon tax has shown up here. But they're going to be real world strains. If you think of some of the models that have $200, $300, $500 a ton carbon taxes, if you just think of what that does to the petrochemical industry or any other carbon intensive industry. The idea that we actually know the emissions, the CO2 content, from a ton of coal, that's not correct. We know from CH4, but we don't actually know from coal and are varied by a factor of five or ten percent, depending on the source of the call.

One of the things either as economists working in this area or as practitioners we haven't really coped with is the fact that when you get into these high prices, you not only have the stresses and strains of free riding, but you're going to have the stresses and strains on the fiscal system of having a tax on something that's actually not that well measured and where there's all kinds of tax arbitrage considerations.

Discussion Participant

I think that maybe I was not understood properly. My point is that thanks to the U.S., under the WTO if a measure affects trade, even if it's not actually affecting it, then the WTO is arguably exclusively responsible for deciding whether it's right or wrong if there's a challenge. So, with all due respect, I think that your club, to the extent that you would use a tariff at the border, if there's a challenge it

would be decided in the WTO. That's why the whole debate would then shift. Is it consistent with the flexibilities that exist?

Now, the other question by Jason is the tariff imposed on everyone and then environmental measures? I'm ignorant of the details of the program. It depends, but usually, yes, you have to prove that it's environment from the beginning and the example that we use as a non-environmental exception would be a government that imposes a border measure, let's say a tax, saying they are doing it for the environment and then they give the money to the country's own industry instead of investing it in environmental programs or CDM in the case of climate change.

So, it's quite demanding to comply and satisfy the requirements of Article XX, but it has introduced flexibilities that could be useful. You talked about a CO2 content tax and there's no discrimination. Well, some countries would still argue there's discrimination because two products that look identical, one polluting, the other one not polluting, are alike. So if you tax them differently, you shift again to Article XX. The benefit of XX is that it would allow you to work with averages, to the extent they make sense.

So the whole assessment now is on this justification, whether it's rational and how far you could get. The legitimacy issue is why is it that it would be WTO who would decide in a particular dispute?

Whatever trade is used for, if the United States tells another government "you violate human rights," under international law you can use counter-measures to punish. You violate a treaty, I'll violate another one. I'll violate trade and trade has always been historically the best counter-measure because it hurts in the short term. But thanks to the U.S., as I mentioned, there's a clear provision that says, if trade is affected for whatever reason, it comes to the WTO and unilateral measures cannot be accepted unless they're justified. So, we're back to justification.

Samuel Kortum
Thank you.

Global Harmonized Carbon Pricing: Looking Beyond Paris

Yale Center for the Study of Globalization, International Conference, May 27 and 28, 2015

Session Five:

The political economy of carbon pricing

Presentations and Discussion

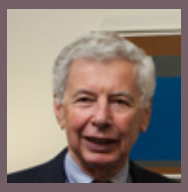
PARTICIPANTS

David Victor, Eric Toder, Robert Repetto, Jason Bordoff, James Stock, Matto Mildenberger

MODERATOR

Leonardo Martinez Diaz







Session Five — The political economy of carbon pricing

This session is intended to discuss the political economy implications of carbon pricing. It will deal with both the domestic (in each of the key players) as well as the international political economy challenges for the adoption of carbon pricing.

Presentations

Ernesto Zedillo

I have asked Leonardo Martinez, in addition to being a good friend of mine, and of our center, and who nowadays works as Deputy Assistant Secretary for Environment and Energy at the Department of the Treasury, to do my job as the moderator for this session.

Leonardo Martinez Diaz

Thank you very much, and thank you, first, for the invitation here. For me, it's a special pleasure just to be here and to be able to think about the larger picture issues, but also to be here with two of my immediate predecessors in this position, Matthew Kotchen and Gilbert Metcalf, who was here yesterday. So, it's a bit of a family reunion, as well.

This is a really important session, because here is where the rubber hits the road. It's about how some of these policy ideas that we've been working on actually have to get implemented, and that means engaging policy and politics, and that, of course, is the province of political economy.

So, today we'll have six speakers who will help us think through some of these issues. I think, as

a political economist myself, these are the three standard elements in literature that I think we have to touch on. The first is the configuration of interest groups; who wants what, and how powerful are they relative to others in a system. Those, of course, can be firms, they can be different constituencies that are competing for an outcome.

The second is institutions; institutions and the rules of those institutions help structure how power is contested in a particular case, and I think we'll hear about that in both the domestic and the international arenas. Finally, what academics call ideational change, meaning that over time, there can be shifts in those interests, shifts in ideas, that give rise to the positions that different actors play in the system.

So, let's start with David Victor. We have 90 minutes for the presentations. So, I ask folks, if you could please keep it to 12 minutes. I'll give a two-minute warning just before, so you can wrap up. Thank you.

David Victor

Ernesto, thank you so much for the invitation. It's really a pleasure to be back at Yale. I'm just here for today, because we're in the very end of the teaching quarter at San Diego. I was feeling sorry for myself that I was on the red-eye last night coming in and then flying back home today. And then Leonardo said a moment ago that his job involves going to Congress to ask them for money for the Green Climate Fund. Any self-pity has evaporated immediately. Good luck with that, Leonardo.

I've been asked to talk a little bit about the political economy of carbon taxation, and I just want to make four remarks. Along the way I will draw on academic work that I have been doing on climate diplomacy, including some new work with Chuck Sabel at Columbia Law School and Bob Keohane at Princeton. I will also draw on work I am doing in tandem with a Council convened by the World Economic Forum, which is looking at how governance might be approved on a wide range of topics related to sustainable development.

First, I'm a political scientist. I study international relations in the three buckets that Leonardo spoke about. I focus a lot on the interaction between interests, and organized interests, and institutions, especially institutions at the international level. Discussions, like today's, on carbon taxation are happening in an environment where the international diplomatic scene has just radically transformed.

It's shifted from, if you like, the old Plan A through which countries get together, they negotiate targets and time tables, and they go back home and they implement those commitments. Plan A is a kind of top-down treaty framework with all countries as members of the treaty, and so on. For more than 20 years, many of us have been saying this was never going to work.

The good news in this transformation is that the diplomatic community has been shifting from Plan A to what might be called Plan B, or somewhere deeper in the alphabet. This new plan is based on a scheme where you have countries making individual pledges or nominations. In the world of climate change, these are called right now Intended Nationally Determined Contributions, INDCs. People will get upset with that term at some point and so the diplomats will change the term, but the basic idea was still the same: these are pledges that countries are making, and that somehow they're going to get connected together into a larger international agreement.

I think it's important to pick up on a point that Bill Nordhaus made in the last session: we actually have no idea whether this new scheme is going to work. What we know is, enthusiasm around the new scheme arises because the old scheme has patently failed, and so people are excited about the new scheme, because it's new. But they haven't actually paid hardly any attention to the institutions and the arrangements you would need in order to make this bottom-up scheme function properly.

This new plan for creating more effective international cooperation is quite familiar to trade diplomats — some of you are in the room. At least until the Doha round, this is how trade rounds were negotiated. Countries would put packages on the table, and then other packages would go on the table, and then the diplomats negotiate back and forth. It created a negotiation process that was slow but, unlike in climate for the last two decades, focused around actual commitments that actual governments could implement. Trade accession agreements followed a similar process, and in my academic writing I have seen a lot of promise in framing climate diplomacy along the same lines.

The trick in all this is figuring out how all these national pledges compare and then stitching them together into something that is greater than the sum of the parts — something that is not purely autarkic. This is one of the many areas where greater use of carbon taxation can be helpful. If countries use taxes, at the margin, to influence emitting behavior then that will make it much easier — not trivial, but easier — to connect these different pledges into something that's larger than, basically, an autarkic situation. The trade world went through this experience as the trade agenda shifted from just focusing on border tariffs to a wide array of "behind the border" measures whose trade effects have been harder to quantify. Climate has not yet begun to deal with the difficulties of stitching together national pledges; taxation can help.

The most likely outcome from Paris is autarky, where countries are going to pretend that they are doing something together. In reality, they are just going to set up an umbrella and then go off and do what they're doing individually. The after-Paris period that Ernesto's so focused on is where individual autarkic efforts might be assembled into something greater than the sum of the parts.

It's particularly interesting to be talking about the role of prices in affecting emissions right now because we've just seen a massive shock to energy pricing — in the form of the big decline in oil prices. The impact of that on emissions will be mixed because when oil prices decline so does the price of gas in most of the world, and that could be good news for emissions where gas competes with coal. But politically the effect of this big decline in oil prices is good news for reformers — especially reformers who want to tackle subsidies. We see that in Thailand, we see that in Indonesia, and a handful of other countries. If these reforms stick that means more rational energy markets — and probably more rational handling of externalities like emissions. Some countries that have long subsidized energy now actually have a kind of implicit carbon tax because regulated final prices are higher than production costs. That's the point Arvind Subramanian has made in a recent piece about energy pricing in India. Serious policy makers are using this window of opportunity with lower oil prices to put energy and emissions pricing on the right footing.

All of this is interesting and auspicious. But the big challenge, diplomatically, still remains. How will real diplomats working within real political pressures put together the individual pledges into something larger and more coherent after Paris? Here is an area where carbon taxation offers a massive advantage. In our jargon, if there is greater use of taxation it will radically lower the transaction costs necessary to figure out how national diplomats stitch together the individual pledges. It will also make it easier to figure out how to make these pledges contingent. That is, it is crucial that bargaining over climate mitigation not just be the U.S. doing its own thing and China doing its own thing and so on. Rather, what you want is that each country do things beyond what they would have done if they thought about this in an autarkic way.

The second of the four points I want to make is perhaps a point about marketing. Maybe it is a point about realism.

This is a room full of believers. Everyone in this room is a believer in carbon taxation--I guess people who love cap and trade, and only cap and trade, were not invited. People who want regulation and nothing else were also not invited. So we're believers and we are here in this room talking to other believers. But talk among the believers often falls on deaf ears outside rooms like this because people don't know what we're talking about.

One way to think about all this is that there are "strong" versions of carbon taxation and "weak" versions.

The strong version of coordinated carbon taxes, or unified carbon taxes, is that you have an agreement that tells everybody that they need to adopt the same carbon tax.

That might be our ultimate goal. The probability of that happening in Paris or any time in the foreseeable future is zero, for the same reasons that Plan A never worked. Adopting the strong version of carbon taxation is very demanding politically and administratively. It has a huge impact on what

countries do internally to comply with their international commitments. Strong versions of cap and trade had the same political and administrative problem — if countries adopted strict targets and timetables for emissions then each of them would need to set up strict cap and trade systems internally because that's the only way that they could be sure to comply. That was never realistic.

The same will be true if our messages about carbon taxation are adopted in the strong version. Maybe there are folks in this room who think that only the strong version of carbon taxation makes sense. But I don't see how that could happen politically and administratively in the real world. For Ernesto and his team — and I think of myself as a member of this team — it is crucial that we portray these ideas in their "weak" form. As these ideas are rolled out inside the diplomatic community it is important to portray the opportunities in carbon taxation as indicators of levels of effort. You're not expecting every country to do the same thing at the outset. And you are not expecting every country to adopt no policy instruments other than pure, clean carbon taxes.

Politically and administratively it is crucial that this proposal be seen as a way to make it easier to connect national efforts while not squashing the inevitable diversity in national choices. We know this diversity is a reality because we have seen it play out already. In Europe there is the ETS, which is a multinational cap and trade system. But the ETS is being implemented on top of many other policy instruments, such as renewable energy and efficiency mandates. Indeed, that is one of the reasons the ETS is having such trouble — because the residual demand for emission credits is so low after all these other policy instruments have done their work. (One of the many advantages of carbon taxes is that they still have a useful economic effect even when implemented in tandem with other policies such as direct regulation.)

The same is true in California, my home state, where we're thrilled with ourselves about our cap and trade system. Yet when you look at the data it is clear that perhaps only one-quarter of the actual leverage on emissions in California is coming from cap and trade. All the rest of it is direct regulation mandates, and things like that. What we see in Europe and in California and everywhere else is that politicians aren't stupid — they know that price instruments are the most efficient economically. Yet they explicitly opt for other policies as well — and then tend to choose market instruments that have low visible prices and regulatory instruments that have higher costs that are more hidden from view. This is basic political economy. Political leaders favor instruments that bury the costs and make it seem like a lot more is getting done for lower visible expense. We see this not only in the places that have adopted cap and trade but also in the countries where more tax-like instruments have been used—such as British Columbia, Sweden, and until recently in Australia.

So, I think it's very important that we not set ourselves up to fail by making people think that what we're arguing for — at least on day one — is a strong version of carbon taxation that requires identical carbon taxes across all economies. It's helpful from a modeling point of view, it's helpful as a kind of metaphor, if you like. Politically and administratively, however, it is not in the cards. If we argue for what is not feasible we will fail.

The third message I want to talk about is the problem of free riding. That was a central focus of the previous panel. Let me say, to start, that we should eliminate the term "free riding," to describe most of the defection and avoidance that we see in the real world. That's because, as Adele said, a large amount of what's happening isn't simple strategic avoidance of commitments. It is, in Robert Putnam's terms, kind of involuntary defection. It's because countries have difficult domestic constituencies. It's not just the US but it is every country in different ways. Every nation has an excuse for why they haven't done things. All those excuses are understandable yet they have a pernicious effect on cooperation.

Yet there is no doubt that the problem of misaligned incentives to avoid costly commitment exists. A huge part of the diplomatic machinery in any effective agreement will involve dealing with these perverse incentives — it will require stitching together incentive-compatible national pledges into true collective action. It will require developing politically viable systems for enforcing commitments that countries make to each other.

Dealing with all that is a huge topic; here let me say just two things. One is that if we want to make it easier for future diplomats to stitch together national pledges we need to do with greenhouse gases something akin to what tarrification has done in the trade world, and the right ideas about how well tariffication worked. Carbon taxation will help with that because it will make it easier for countries to observe what others are actually doing at the margin. It will also make it easier — administratively and legally, as well as politically — to apply border tariff adjustments.

The other thing I'd like to say about perverse incentives concerns border tariffs themselves. I can appreciate why trade and development economists are wary of border adjustments. They rightly fear that the great progress made through trade will be undone, at least in part, if trade gets used as an enforcement weapon. But those fears are overblown. There is no serious way to develop and enforce deep cooperation on climate change without border measures, especially if that cooperation emerges through sub-universal agreements within "clubs" and "coalitions of the willing." Members of these small groups will need incentives to act within the group and to attract others. Outsiders will need to feel some pain from not acting. That's not just crucial for success on climate change, which is an important development problem in its own right, but can also be done to some degree within the existing set of GATT rules under Article XX.

I listened to this debate we had in the last session about whether it is best to keep border adjustments within the Article XX framework or whether it would be better to seek some kind of amendment to the GATT/WTO rules to allow fuller use of trade sanctions and to close other gaps in the trade rules.

I love, as a moral case, the argument for doing an amendment. I think it's a great idea in some ideal world where we want to get the law perfectly aligned with aspirations. But, we have to remember that if we think gridlock in climate diplomacy is bad we should take a look at the situation for trade diplomacy, which is no better. The trade world has been talking for 14 years on the Doha round

agenda. It is like an aging rock band that goes from city to city, and never dies. This year in Davos I remember a session with leading trade experts where the central topic, as far as I could tell, was finding ways to get rid of the Doha round. It has been going on so long, with persistent failure to yield a final agreement, that it is probably making practical cooperation harder to achieve. So, that gives you some sense of the political difficulty in the trade world. Gridlock in trade is easy to understand—countries have highly varied preferences and the membership of the WTO has grown so large that consensus diplomacy has become intractable. Climate started this way back in Rio. Trade has evolved to this state. Either way, we have gridlock in these two global forums.

So, I think, politically, it's not viable for us to expect an amendment that operates by consensus rules in the trade world. What I think we should do is see how far we can get with Article XX and border adjustments of various types, and learn. And, if we need to do more, then we might need to do more and might even take on the politically demanding task of a WTO/GATT amendment. But let's first see what is feasible with existing law. Put differently, lets think about border adjustments and other trade measures in experimental terms. Let's try some different approaches that the trade lawyers already tell us are likely to work and see what actually works in practice. And then let's scale up the best approaches. Chuck Sabel and I are writing a book on climate governance that takes this kind of experimental approach to the whole problem, and while that is still a work in progress I think it is proving to be a fruitful way to think about practical problem-solving.

As we start working on the problem of free riding and border adjustments it is also important that we not get paralyzed by the level of cost coordination that will be needed. In the analyst community we have tended to focus too much on the need to equalize costs across economies. Some of that is an artifact of how our trade, investment and mitigation models are structured. In most of these models, which assume perfect information and ignore political adjustment costs, if countries don't have equalized costs of effort then all kinds of disadvantages follow immediately. Investment, jobs and economic growth leak from the countries that adopt costly policies and flow into the free riders. In the real world, however, people are willing to tolerate a significant — not an infinite, but a significant--amount of inequality. You witness this today in the difference of energy costs between Europe and the United States. You see this now even in China, this point that was made in the last session about co-benefits is really important. New policies in China are having a massive negative effect on a very powerful sector — coal. Yet the Chinese government is willing to do that, even if it has differential impacts on energy costs with big implications for trade and investment.

So let's not impose on political leaders a set of requirements that they, themselves, don't see as strictly necessary. We shouldn't hold ourselves to the standard of trying to get all of the costs equal across all the economies, but we do need to have a politically-defensible argument for why one country is not able to free ride, and for the incentive structure to create participation.

I'll say one last word on this, which is, I think the argument that was made in the last session about how participation is a key problem is right. But we need to really think, is the point that Leonardo is

making about the game theoretic context here, because we know that if we don't play the participation strategy correctly that we'll get in a trap. Let me take the argument further. That trap is the world that climate has lived in for the last 20 years, where the early thinking was that we would have broad, high participation followed by deeper commitments that would somehow mysteriously emerge within this broad framework. Politically, the world has demonstrated that it is very good at adopting broad frameworks that are a micron deep in terms of actual commitments. That's the problem — a participation trap that has been devilishly difficult to fix.

So, participation is very important, but we need to understand how the incentives inside a coalition or club of nations will create incentives for the members of the group to do more — to make deeper commitments. Doing that requires creating some semi-appropriable rents so countries inside the club have an incentive to do more. In the real world, leader countries have tolerated some inequalities and still been willing to create effective clubs. So let's not get overly paralyzed on equalizing incentives and focus a bit more on the glide path — the strategy by which early club members will act to create bigger and more effective clubs over time. That has been a missing ingredient in most of today's climate clubs, which helps to explain why most clubs so far haven't actually done much.

Fourth and last, I want to talk about what the additional protocol on carbon taxation might actually contain. That's the subject of the session this afternoon. I want to suggest, politically, a few ideas that might be part of this. We need to think, in the trade sense, about plurilateral commitments. We need to have some sense of what the minimum level of participation would need to be, what the incentive structures would be inside the club, as well as what entry and exit standards might look like. There's a lot of loose talk about clubs and coalitions these days but practically none of the academic literature has looked closely at minimum standards for clubs.

It is also important that the architects of the protocol think about the geometry and content of commitments. Should core members of the carbon taxation club — that is, members of the protocol — agree to a common level (or minimum level) of taxation? If so, should they also commit NOT to adopt other policies that might interfere with taxation, such as subsidies, or should the protocol just begin with taxes?

I also want to flag the issue of revenue recycling. Quite often, talk about carbon taxes leads quickly to lots of fast talking about the need to set aside some or all of the revenues for special purposes, like energy R&D or low carbon subsidies. I would counsel against setting standards for how the revenue is spent as part of the protocol. To some degree we don't strictly care how the money is spent, so long as marginal emitters see proper marginal prices. And politically, we care a lot about the ability of national governments to recycle revenues in ways that let them build and sustain political support for carbon taxes. If we don't do that then the government support for the carbon taxation protocol will be small. Maybe the protocol should set up a process so that after a period of time the use of revenues gets examined and standards developed — much as the OECD and IMF and other international institutions have, over time, helped its members adopt smarter tax and economic policies. The process for

looking at revenues, over time, probably needs to put a sharp spotlight on perverse uses of revenues — such as for corruption, for carbon-intensive subsidy, and the like.

I think this protocol needs to include some discussion about what the border tax adjustment issues are going to be, and the strategy for addressing those. I'm convinced, as someone who's not a lawyer, that success in applying border adjustments will require a large enough group of protocol club members so that the border adjustments are seen as legitimate. We know that will be crucial to ensuring that border measures are consistent, broadly, with the existing jurisprudence in this area. We know that unilateral action will not be legitimate. And we know that universal action is not feasible. But what we don't know is what the middle ground looks like. And, we don't have a sense of strategy of how many countries would need to be involved in order to have the norm be legitimate. It almost certainly is going to be an issue that's challenged, then, inside the trading regime. If the protocol had some standards and strategies for border measures that would probably help raise the odds that these measures are seen as valid when they are challenged through the WTO dispute resolution system — the WTO's Appellate Body needs some political cover for finding that border measures are valid and legitimate. The protocol can help that process.

I have some big reservations about the world "protocol." One reason we should be concerned about this is that it immediately creates the image of a UNFCCC protocol. That puts us into the world of consensus decision-making, and it guarantees the participation trap that the protocol is trying to avoid. Consensus rules will empower the countries that want to block the club and block action. That is not a hypothetical risk — it has been a constant problem over the history of the UNFCCC and in other consensus organizations such as the IPCC.

And so, I think what you want is a "friends-of" process, or something like that, as opposed to a protocol. You want some kind of fast start countries to do something in a framework that seems plausibly legitimate and can sit under the umbrella of Paris. But you don't want something married to the framework convention on climate change.

That's going to make a lot of people very upset, especially people who get excluded, small countries. This was, of course, part of the explanation for what failed in Copenhagen, is the small countries got really pissed off because they weren't in the room when the core deal was done.

It is probably also important that you consider whether the protocol should have some content beyond mitigation — so that it isn't just seen as a cabal of large emitters. The smaller emitters, which tend to be poorer countries, are increasingly concerned about the impacts of climate warming.

Analytically, an emitters club focused on carbon taxation may not have much to say, strictly, about how the poor and most vulnerable adapt. But for optics and politics it is important not to ignore that a huge part of the legitimacy of any collective effort on climate change requires that the most vulnerable see some tangible benefit from the scheme. Maybe this shouldn't be part of the carbon taxation

club, but there might be other clubs developed in tandem--including clubs working on the things that those countries, that the most vulnerable, care a lot about.

We must be careful in creating the mechanics and political momentum for a carbon taxation club not to lose sight of the larger problem at hand. It is about massive transformation of energy and land use practices. It is about dealing with the inevitable reality of lots of climate change — more, probably much more, than the widely discussed 2 degrees. Analytically those other aspects of the problem often get ignored when we focus narrowly on one aspect of this problem. But politically it is viable to have a strategy for all the main fronts. Thank you.

Eric Toder

First of all, I want to thank Ernesto, and Bill, and Haynie, and everyone else involved in organizing this conference and for inviting me here. It's been a great pleasure and I've learned a lot from the comments of people over the last couple of days.

I have to make a disclaimer, as well as the usual disclaimer, that I'm speaking for myself and not for any institutions that have ever employed me. I'm also not a political expert of any kind; I'm a trained economist, and usually when reporters ask me to comment on particular prospects of particular legislation, I say no. Ask me what it will do, not whether it will pass. So, I'm out of my comfort zone a little bit, but here goes.

First of all, I'm going to talk about the United States issues mainly because that's what I'm most familiar with and also because I think there's realistically no chance of any kind of harmonized carbon price agreement unless the United States is on board with the concept of taxing carbon. So, a prerequisite is to get the United States on board, and that's going to be very challenging. In the current situation, I can assert there's no chance that anything will happen before the next administration.

There has been a lot of discussion about tax reform, and so tax reform could be the vehicle for something, and there actually is some conceptual agreement between the Obama Administration and Republicans on the shape of what corporate tax reforms look like. But, the areas of agreement are at a very high level, they are not on the details. There are an awful lot of details to be worked out and the window for acting before the campaign season is upon us is closing fast. If nothing is done by September, nothing will be done, because everything will be caught in a political season.

A main obstacle to action is that Congressional Republicans have not yet come to terms with how to talk about climate change. Many in the House will not acknowledge it as a man-made phenomenon, and even in the Senate, I was told only five Republicans were willing to vote for an amendment that simply stated the scientific consensus. So, there's a huge, huge political divide on this. The political environment is so bad that we can't even pass an increase in the gas tax to pay for highway funding. That was something that was routinely done in past years, including under Ronald Reagan.

There have been some rather bizarre proposals for funding highways, one of which came from a Republican member who asked us for some distributional estimates. His proposal was to have a gas tax, but to accompany that with a cut in income taxes focusing on low-income people, which would leave the whole tax change revenue-neutral. Of course, that means that would be deficit financing the highways; you would just get the money going in the trust fund and then take it out of general revenues.

The other proposal has been spoken of favorably by the Obama Administration and that's to use the revenue from a one-time repatriation tax on corporate assets held overseas to fund infrastructure. Of course, that's not a permanent source of funding, that's something that can only be used once, and even then, it's problematic, because it would require an agreement on international tax reforms, which will be difficult to get.

So, having started on a negative tone, I'll say a few positive things about what's going on. There certainly is, among the think tank community, among the so-called "policy-wonk" community much more support for carbon tax than there's been in the past. The thinking on carbon pricing is moving away from cap and trade, and towards a carbon tax. There have even been some proposals; Representative Delaney of Maryland introduced a proposal for a carbon tax, a corporate tax trade-off. There is support from Republican and Democratic think tanks.

We participated in an exercise funded by the Peterson Foundation recently. Peterson's main interest is in the long-term budget problems. They asked five think tanks — two from the left, two from the right, and one from the center — to put forth their ideas for how to deal with long-term budget issues, and it's interesting that there was some support for a carbon tax and also gas tax increases from both sides of the political spectrum.

The American Action Forum, one of the Conservative groups, did not propose anything, but the American Enterprise Institute scholars proposed to increase the gas tax by 30 cents per gallon, and index it to changes in the Consumer Price Index (CPI). That increase would be to fund highways. They also proposed a modest carbon tax starting at $4.00 per metric ton in 2018, and increasing at inflation plus 2 percent per year afterwards.

In the center, the Bipartisan Policy Center proposed increasing the gas tax by 15 cents per gallon and then indexing it to the CPI. They did not have a carbon tax proposal.

On the liberal side, the Center for American Progress favored increasing the gas tax and replacing it ultimately with a tax on vehicle miles traveled. They would also impose a carbon tax, beginning in 2027.

The Economic Policy Institute also favored increasing the gas tax, and imposing a carbon tax at $30 per ton, with the additional stipulation that half the money would be used to pay for lump sum rebates to low-income households. So, there's a lot of people interested. We had a conference that Adele Morris was participating in, and Adele and Ian Parry, were co-sponsors, along with Rob Williams. They have finished editing a very interesting book on carbon taxes. The event at which this book was released was held at the American Enterprise Institute, and Adele and Aparna Mathur of AEI, both spoke in support of a carbon tax.

We also had Representative Delaney and a former Republican Congressman Bob Inglis from South Carolina, both of whom spoke favorably of a carbon tax, corporate tax trade-off. So, those ideas are in the air. I think the corporate tax trade-off is particularly attractive politically, leaving aside what its economic benefits may or may not be.

It certainly would be a way of getting on board groups that would generally not be sympathetic to a carbon tax, who would favor lower corporate tax rates. Another way of looking at it, of course, is you might think of the carbon tax as a way of paying for corporate tax rate cuts, which are quite challenging to pay for by reducing corporate tax preferences alone.

So, that's the good news. The bad news is that even after 2017, there are major obstacles to any change. Opposition from the Republican Congressional leadership, and the Tea Party wing of the party will continue, and the political campaign may very well solidify this opposition. We'll have a lot of competitive primaries, and in competitive primaries there's a tendency for politicians to appeal to the most extreme elements in their parties. So, I think if progress on a carbon tax is to happen there

will need to be a lot of back-pedaling by Republicans after the election; not something that politicians haven't been known to do, but it raises some challenges.

As far as the environmental groups, they're focused now on the President's new rules for CO2 emissions on power plants. Many of them prefer a regulatory regime to a carbon tax. They view regulation as a more certain way to reduce emissions and are less concerned about the economic efficiency aspects. They might, nonetheless, support a tax, but for many of them, only if it is not premised on elimination of the EPA regulatory authority. So, they would not necessarily favor a trade-off between a carbon tax and regulations. They would want the tax in addition to the regulations.

So, what could change things? I made up a list, which is incomplete, in an effort to show some optimism. First, we might see pressure from industry for a tax-based regime. Once the EPA rules are in place and industry finds these obnoxious and stringent, they will be more inclined to support carbon taxes as a less unpalatable alternative. Second, the political fights, the court fights and the disputes over regulations including possible Congressional actions to block them, will increase the coverage of climate issues and increase public awareness.

Recent polls show the public is becoming more interested in climate change issues, and more concerned about climate. Anything that focuses the public on this will probably be helpful in the debate. If public opinion changes, some Republicans might start to become wary of maintaining a 'just say no' position on climate, so there's a possibility that they could be shaken loose.

One thing that was suggested to a friend of mine who works for an environmental group was that if the regulations survive all the court challenges, which seems likely, then the issue of climate, as a policy, will disappear. That will be baked into the policy baseline because we already will have climate policies in place. Then, a carbon tax will start becoming more of an ordinary environmental issue, rather than this sort of quasi-theological issue about whether climate change is real or not. So, that might improve the possibility for action.

Finally, I would add two things from the work I've been doing. One is the pressure for corporate tax reform. There's a huge amount of that. The U.S. corporate tax is way out of line, in many ways, with international practice. But the big obstacle to reducing the corporate rate is simply, how do you pay for it? Some of the various base-broadening options that would be required might actually be harmful to investment, such as cutting back on accelerated depreciation. Others are just not politically feasible.

If you look at the Administration's plan for a "reserve" to pay for corporate reform that's in their budget document — it's interesting that if you add up all their base-broadening proposals the numbers don't come near close to paying for the corporate rate cuts they favor. So, you're going to need to find something else, and a carbon tax would seem to be an attractive candidate.

Finally, the fiscal pressures and the general desire for tax reform may ultimately lead to some kind of action, and in that case, a carbon tax could well be part of the mix. And then, I would encourage you

not to think of — what three items might be used to balance a carbon tax, which is the context we've been discussing here about a carbon tax trade-off with other revenues.

Instead, a carbon tax may be included in a much larger package in which a whole lot of things are being done. So, it's not a necessity to pick this tax offset or that which is associated with the carbon tax. It's all part of some general package. And, I would encourage you, if a tax reform bill comes up, to weigh in, because when the train is running, you can get on the train. Once the train has left the station, it might not run again for a number of years. So, tax reform might be a good opportunity that should not be missed.

So, my conclusions: nothing is going to happen in the short-run. There's a huge ideological opposition to taking action on climate change in the United States. It represents a special obstacle, because the opposition is almost quasi-theological and ideological. It's also based on interest groups. Interest groups are very important here as in other places, but this additional ideological element makes it much harder to negotiate change than if it was just a matter of buying off the interest groups. Thank you.

Robert Repetto

Thank you. I'd like to also add my thanks to Ernesto and Haynie, and others here, for mounting this very valuable conference. I also don't have a Power Point, but I do have with me a flash drive, so I could give a copy of the paper I'm going to discuss to anybody who might want it.

I know almost nothing about the political economy of other countries so I'm going to talk mostly about the USA. What I have learned today is that the USA is not like China or Sweden. For example, we are not tax lovers like the Swedes are, nor do we have a state-dominated economy like China's. But I suspect that in all countries, national decisions regarding climate policy will reflect various domestic and international interests and may not always resemble those of a rational actor in game theory.

As I stand up here, you notice a lot of gray hairs. When I was at the World Resources Institute at the beginning of the Clinton Administration, we and others were putting forward a proposal for a revenue-neutral tax shift, including a carbon tax. At that time the Administration was more favorable and Congress was in Democratic hands; but that tax shift proposal did not survive the first budget negotiation.

Today, the political alignment is more unfavorable. Obama has indicated he will not put forward such a tax proposal. Congress is in Republican hands. So, as Eric [Toder] has said, the short-term prospects are not good. My former colleague here at Yale, Tony Leiserowitz, also does public opinion polling, and what he consistently finds is that a substantial majority of Americans now think the climate problem is important and that the government should do something about it. But, at the same time, a significant majority say no when asked if they would be in favor of an energy tax or a carbon tax. Taxes are not a favored instrument and I think one of the reasons is that although salience and a focal point might be useful in international negotiations, as Marty [Weitzman] said, the last thing you want in domestic politics is for the cost of an environmental policy to be salient. You want the cost submerged, so it's as hard to figure out as possible, both in magnitude and incidence.

That's a fairly pessimistic viewpoint but on the more positive side, at this point we don't have a clean slate. We sometimes talk as if we had a clean slate, but we don't. We have cap and trade systems up and running on both coasts, with buy-in from some Canadian provinces. We have a history of successful cap and trade programs dealing with other air pollution problems. Other countries, notably the European Union and China, have adopted cap and trade programs to deal with carbon emissions.

Given that experience, here's what I think is more likely to come about than a carbon tax, at least in the short run. If the Clean Power Act survives judicial challenges, then immediately we will start hearing utilities talking about the need for "flexibility" because they know that with flexibility, which is a way of talking about permit trading, they can reduce their compliance costs by 30 or 40 percent. As a matter of fact, you can already hear this kind of talk from business leaders and the EPA is encouraging states to adopt trading systems. So, what might well happen is that we'll find more states either creating or joining trading systems. In the absence of a national system, we'll see cap and trade regimes expanding from the state level upward.

And then, of course, it's possible that the same companies that are multi-state utilities and are operating in several states will say, well, we don't want to have to deal with three different systems in three different states. This will create pressure for larger or even a national permit trading system. Business interests will support cap and trade as their best compliance option. This will change the politics.

So, that's what I think about the politics. Of course, if the Clean Power Act doesn't survive court challenges, we're back to square one and a quarter, and then the possibilities of a carbon tax along the lines described here become much more plausible. However, that's, sometime after the presidential campaign and election and a new Congress is in office in 2017, at the earliest.

So much for domestic politics. On the economics side, I'd just like to make a couple of points. First, although we all know it, because so far nobody has said it, it's still worth saying that in an upstream cap and trade system, if the permits are auctioned, then there's fiscal equivalence. Everything that we've heard from Dale [Jorgenson] about a double dividend and from Gilbert Metcalf about tax incidence carry over from a carbon tax to an upstream cap and trade regime. Also, administratively, the

two are equivalent because the permitting and taxing points are the same. You have the same number of permits as you have entities subject to the tax.

The other point I want to make has to do with the high degree of uncertainty that many people have mentioned today. If there's some idea of what the policy goals are, either in terms of a carbon budget or a concentration limit or a temperature limit, then there's great uncertainty about what kind of a tax trajectory would be needed to get there. There's a great deal of model uncertainty, which we've seen in the work of the IMF and the work behind the social cost of carbon and in Massimo's presentation.

There are also a lot of parameter uncertainties. Last year I joined the army of people doing Monte Carlo studies with Bill Nordhaus's DICE model. My colleague and I have varied stochastically a number of parameters describing the generation and mitigation emissions and also some parameters on the climate damage side. We've used probability distributions reflecting the range of estimates in the literature and drawn randomly to solve the model hundreds of times.

In these hundreds of "optimal" solutions based on randomly chosen parameters, the cumulative emissions in the solutions and the resulting temperature increase have a much smaller dispersion than the associated carbon price that would be needed to achieve those outcomes. Or, to put it another way, the coefficient of variation for the carbon price was about twice as big as that from cumulative emissions in the optimal solutions over hundreds of runs.

So, in my mind, it's a serious problem if we don't really know what carbon tax rate to apply. It's made worse by the fact that short-run energy price elasticities are about an order of magnitude less than the long-run elasticities. So, if a tax rate is adopted, it would a decade before we know what it accomplished, even aside from interim business fluctuations.

So, I conclude that a policy instrument that focuses directly on the emissions reduction needed to get to some agreed policy goal would provide greater certainty and equal efficiency. The appropriate policy choice would be an upstream cap and trade system.

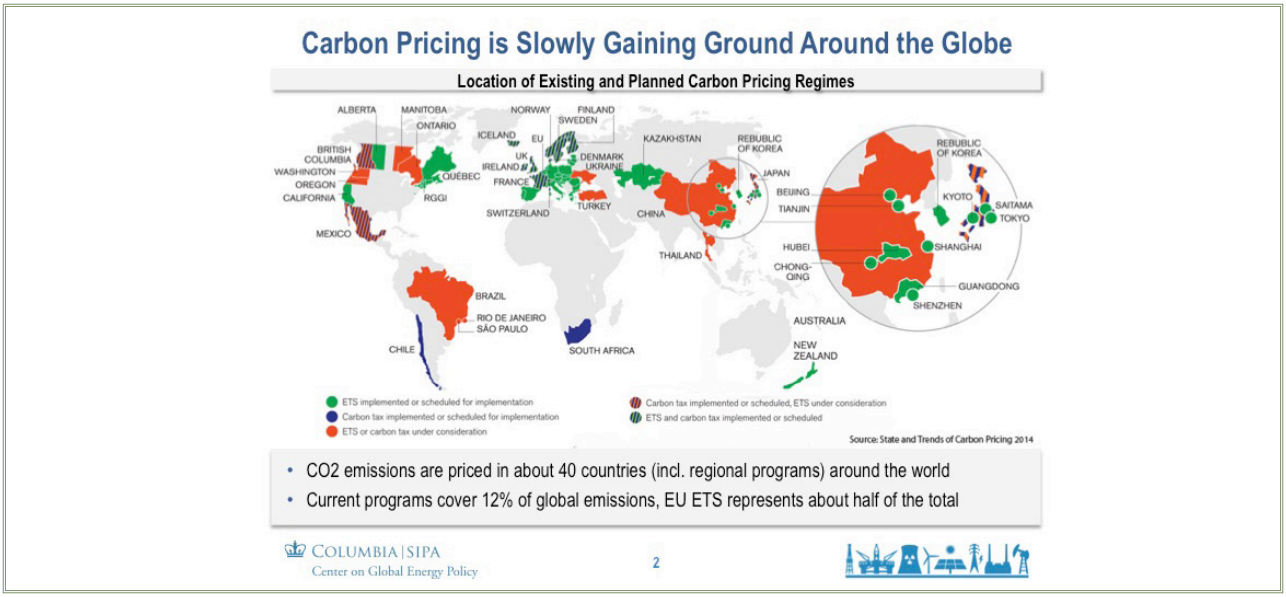
Nonetheless, what I have learned from this discussion is to think somewhat more positively about a hybrid system in which a carbon tax is either used to extend a cap and trade system to sectors that aren't covered by the cap, or to establish some sort of a price band, a minimum and maximum price, an approach that has been talked about over the years in the economics literature.

Thank you for your attention.

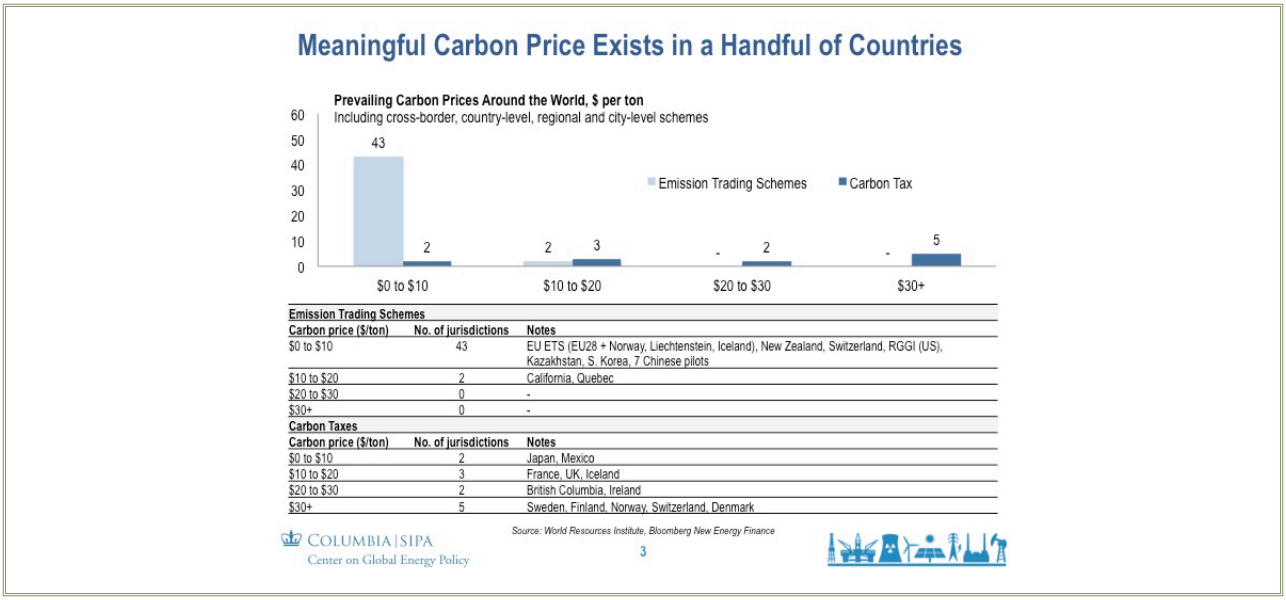
Jason Bordoff

I also want to thank Ernesto for hosting this, and for putting this extraordinary group of people together, and I appreciate the invitation very much. We have quite a large group here, so I'm going to go quickly.

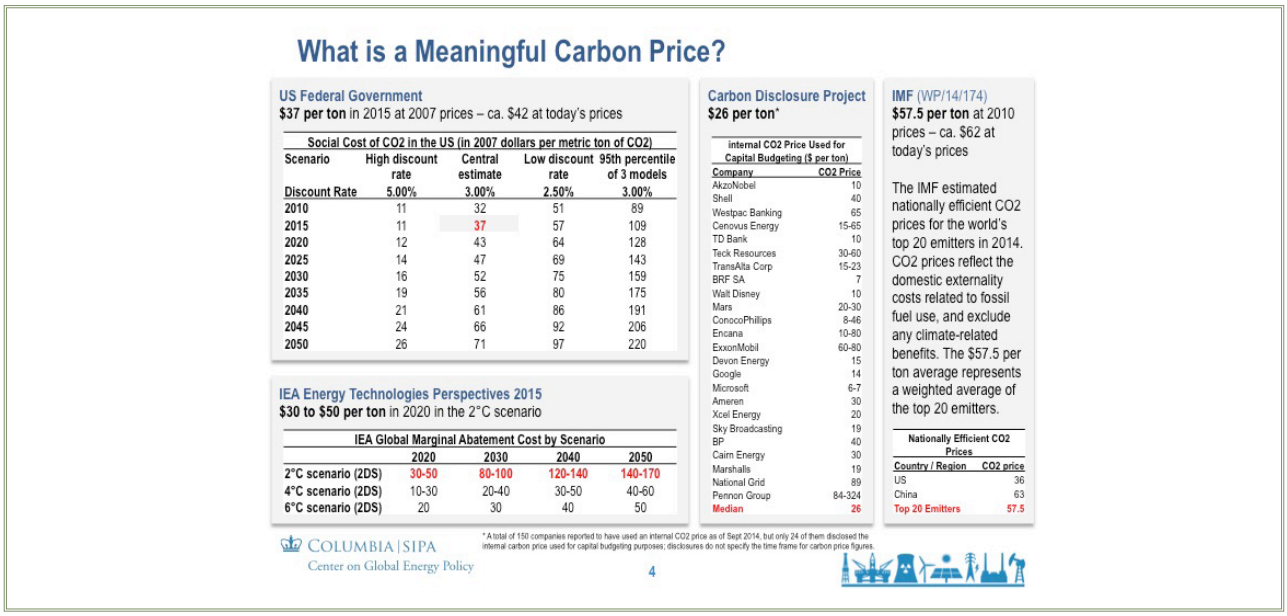
A lot of what I had planned to say has already been said. That's what happens when you go at the end of the second day, so I can move even more quickly, and make a couple of points on the political economy, of how we think about pricing carbon that I think are important to consider given the conversation, in particular, that we had yesterday. I'll talk mostly about what's happening here in the United States, but a lot of it can be applied outside the United States, as well.



So, we saw all this yesterday. We can move pretty quickly through this, in terms of where carbon pricing is happening, or is being considered around the world. Lots of places putting carbon prices in place, though lots of holes in how these are applied, in terms of how economy-wide they are, and also in terms of what the actual levels are. So, you can see that very few have what we heard yesterday in the form of Sweden.



Most carbon prices that exist are in the form of a trading system, not a tax, and most have a fairly low price. Very few have the kind of things we would expect or would want to see, in terms of what the social cost of carbon and other broad estimates would suggest. So, how high should the price on carbon be? There are lots of different ways to think about that.



You can take lots of different ways of looking at this, but in any scenario you look at, the kind of things we saw here are, for the most part, not anywhere close to where they should be.

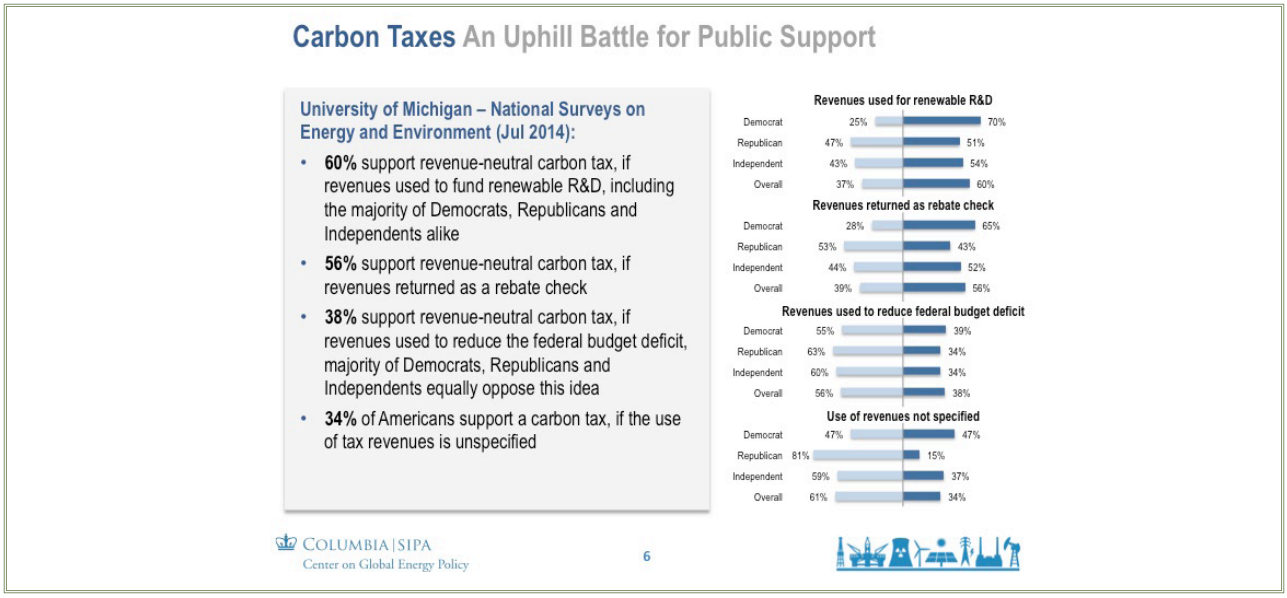
Exxon's gotten a lot of good press out of its supposed internal carbon price. My understanding is that this is a price that they impose internally as a hurdle rate for their projects, as they think about what they would need to pay for direct carbon emissions from new projects. If they think about global oil demand and where it's headed, if a price that high were actually to be put in place by nations, what that would do to oil demand. So, those are two quite different things.

So, what we've mostly seen are trading systems, and we've seen that those are quite difficult to implement. They have faced a host of problems that result in a low price, as we've seen in Europe and elsewhere, issues with who captures the rents, and free allowances. There is lots of overlap with other existing policies.

They create all sorts of inefficiencies in different places, and if you are a country, for example, that heavily subsidizes renewables, has a low price on carbon, doesn't like shale gas, doesn't like nuclear, it turns out you get more coal use, and we've obviously seen things like that start to play out in some European countries.

Carbon taxes are not hugely popular, either. There is some evidence to suggest that if you frame the question the right way, and depending on what you do with the revenue, you can start to see sup-

port for carbon pricing. So, this is what the University of Michigan did in one of their recent surveys where they asked people about carbon taxes.



People don't like carbon taxes. You start to see public support build, though, when you start to talk about what the revenue will be used for, which surprised me, actually. I hadn't expected to see that, given that politically, the idea that this is third rail, we can't possibly talk about taxes, is so prevalent.

So, as a general matter, I think it's still safe to say that the public is not supportive of broad-based carbon taxes, and certainly in Washington, DC, the perception that's true is so prevalent that people can't talk about it. Nevertheless, the fact is, as we just heard from Eric [Toder], many members of the Republican party won't even acknowledge the reality of climate change. But, you can frame the question and purpose it in ways that start to see an increase in public support for direct carbon pricing.

But, given that's where we are, what that means in Washington is that what we're left with are 2nd, 3rd, 4th, 10th-best regulatory approaches. I don't think they should be discounted, in terms of the potential impact that they can have. They're

clearly not optimal, in terms of what you would want to do, of getting rid of lots of these policies, and just pricing directly the externality that you're talking about.

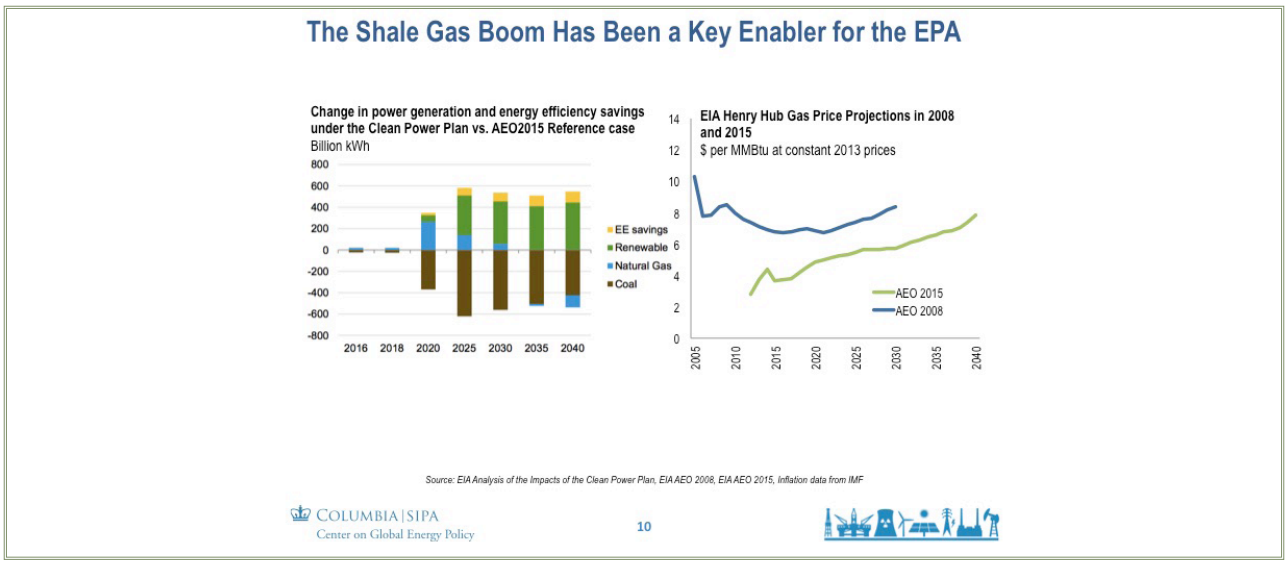
But, when you take fuel economy standards, and efficiency standards, and a host of other policies that impose costs, are duplicative, and you can have whole conversations about the renewable fuel standard, which the EPA will put out some numbers on probably in the next few days, and all sorts of unintended consequences, nevertheless, we're not sure what problem that policy is trying to solve.

But, when you put all these things together, given, as we heard from Adele [Morris] and others, that that's the reality of where our political process is, I don't think we should discount the impact that those can have in terms of achieving emissions reductions. And, why is that? I mean, there's broader public support when you talk about regulatory approaches, and we've heard the reason why, I think.

It's because from an efficiency standpoint, what you want is the most transparent price signal, and from a political reality standpoint, you want to mask the price signal, and that obviously has a cost associated with it, probably not as high as the cost of actual climate change impacts. But, it has a cost, and it's less efficient, so I think political feasibility sometimes means you need to mask the price signal.

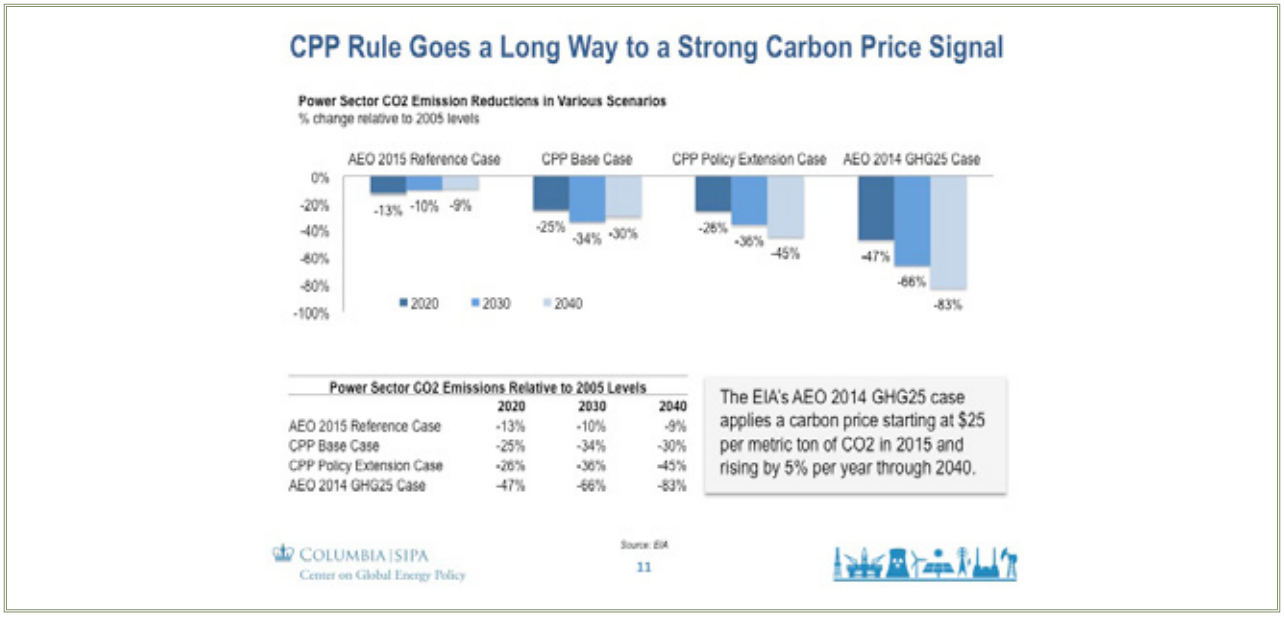
The public as a whole is broadly supportive of doing something about climate change, if you're not quite as specific about what that is. I think the Republican Party actually lags behind public opinion, and I hope this is the last Republican primary where candidates will debate whether they should actually say climate change exists and whether it's real. I think public opinion is moving somewhat quickly in that regard, so there's broad public support for taking action on climate change.

Though, obviously, it depends quite a bit on how you word the question, which is why I think there's support at a broad level, without getting into specifics, for what EPA is doing with the Clean Power Plan rule. I will note, as well, that I think the shale gas boom has significantly changed the political economy of the EPA's ability to move forward with aggressive rules in the power sector.



You can see on the left, there, the analysis that the Energy Information Administration put out a day or two ago, about what the impact would be of the Clean Power Plan, and what it does to natural demand over the reference case in the near term, and then what it does to renewables in the longer-term. You can see on the right the price projection for natural gas in the most recent annual energy outlook, versus what it looked like in 2008. I just picked 2008 because that was a peak year for gas prices; obviously significantly different.

So, the regulatory impact analysis, the cost benefit of the EPA's Clean Power Plan will look significantly different when you have very cheap natural gas in the U.S. I haven't checked the latest, but $2.60, or something like that, and reasonable in my view to think we're going to be at $3.00–$4.00 natural gas for many years to come, given the staggering production numbers we see coming out of the Marcellus, in particular.



So, where does that get you? You see here the reference case from the most recent Energy Information Administration outlook, and then the analysis they just put out about power sector. This is just power sector, obviously; emissions for the Clean Power Plant rule and the extension case assumes that those go beyond 2030, and then on the right, I took from the annual energy outlook their $25 a ton carbon scenario. Obviously, you get a bigger impact there. They also do a scenario of a $10 a ton carbon tax, and I didn't put that in there, but if I did, the numbers would be almost identical, very similar to what the power plant rule is achieving.

So, you can argue with exactly how the EIA has modeled all of this, but just as a ballpark estimate, when we see earlier on in the slide deck how few countries have imposed a carbon price above $10 a ton, and what regulatory approaches like this are able to get in the power sector, and then we can talk about what fuel economy standards are getting in the transportation sector, and other things.

These policies shouldn't be dismissed, in my view. So, I think where that leaves us is with the conversation yesterday such that we were talking about harmonization of standards, giving countries credit, trying to impose tariffs or border adjustments, depending on whether people are imposing the same standard. You heard Adele [Morris] say, I pity the Treasury official who has to sit there and figure out what the effective price of some regulatory approach is.

Therefore, the discussion yesterday suggested we need to keep it simple, we need to just focus directly on carbon prices, and not sort of give credit for many of those other regulatory approaches, and I think, from a political economy standpoint, that is not workable. It's not the reality of what many countries are doing with second-best alternatives to try to do something about climate change.

So, if we're going to have that conversation about how to bring people into the club, and figure out how to give credit for what people are doing, it has to figure out how to account for non-priced mechanisms, albeit inefficient ones, that countries are taking to reduce emissions. All these regulations, I would note as well, like the Clean Power Plant rule and other things, actually make it more likely that we may actually see public support and Congressional support build for carbon price in the longer term.

I think if we demonstrate effectiveness, that we can actually reduce emissions and not destroy the economy, and people see that we're doing these things whether they like or not, that people will recognize that if we're going to keep moving forward with reducing emissions, let's actually get behind the most cost-effective ways to do that. So, I think all these things are also consistent with, and don't undermine, the ability to put eventual carbon prices in place.

I do think there's hope for carbon price, still. We heard Eric [Toder] talk about the desperate need, that you hear many people on the Hill talking about, not to do something about climate change, but for revenue. Senators were talking about how to fund infrastructure, how to find revenue for the highway trust fund. I was talking to one Senator last week who — that was their motivation, and that led them to a whole series of other policies about sort of trades they could make, and where that revenue would come from.

The *Wall Street Journal* CEO Council did something recently, and they published the results in the journal, so there was a small group of about 15 CEOs focused on energy, and they asked me to sit down with them and moderate a session where they would put lots of energy proposals on the table, and they would vote on which ones were most important for the country to pursue, and explain why. I thought they'd come up with approving the Keystone Pipeline, or something that's utterly meaningless, but number one was to raise the gas tax to fund infrastructure.

So, I think when you're motivated by other things, like corporate tax reform, fiscal imperatives, and I do think this is probably going to need to be a Republican idea on the Hill, not a Democratic one, the idea that we want to tax carbon rather than labor or something else. Combined with the need for

corporate tax reform, it has the potential to build support over time. So, notwithstanding my general pessimism that we're going to do what needs to be done on climate change, it's still possible that we could see that happen.

I also don't think it needs to be a global deal from day one. We've heard a little bit in this day and half, too much maybe, being made of a free rider problem. I think the free rider problem is sometimes more an excuse than anything else. Although, Scott [Barrett], as you noted, if China and India showed much more aggressive and meaningful action taken on climate, I don't know if Congress would suddenly turn around. I think lots of people in coal states would find other reasons why they didn't think the United States should move.

So, I think the idea of moving on our own, with sensible policies that transition and escalate over time, working bi-laterally with other countries like China to set targets, and then see how close we can get to those targets, 17%, then 26% by 2028, and show that incrementally, we move a little bit, then you move a little bit and we'll keep going, and you keep going, this makes sense, and it's probably the most politically viable path forward. If in X number of years people in the U.S. discover that we're imposing costs on ourselves and no one is joining, and no one else is going along, I suspect political support for that will fade, and we'll walk those policies back, because we're in fact not solving the global problem, we're just incurring cost, and everyone else is free riding.

But, that probably feels more viable in how you build support than the idea that certainly not the entire UNFCCC, but at least even the major emitters will get together on day one, and agree on an approach that solves all concerns about the free rider problem. I look forward to the conversation. Thank you.

James Stock

Thank you very much. This has been a fascinating conference and I am grateful for the opportunity to make a few remarks.

I admit at the outset that I feel like a bit of a carpetbagger in this room, which is full of people who have spent their careers working on climate issues, while I have not. But I have been working on climate issues a great deal for the past several years. I spent a couple of years as a Member of the Council of Economic Advisors until last fall, and my portfolio included energy and environment issues. In particular, I led the CEA efforts (and was the senior White House economist) on the proposed Clean Power Plan, the Social Cost of Carbon (SCC), and a number of other climate and energy issues.

At a very high level, there are three roads that the U.S. might take on climate policy. One is the road that we were on for a long time, which includes clean energy subsidies, energy efficiency rules, regional and state renewable portfolio standards, and other such policies. While those policies are well-intended, overall they make only small contributions to emissions reductions, certainly contributions that are small relative to the enormous magnitude of the emissions reduction challenge. This

path is better than do-nothing, but it is far from enough

A second path is adopting a carbon tax. That path has a broad constituency among PhD economists. Indeed, if the climate problem were just left to the American Economics Association, we would have solved it a long time ago. But there isn't an AEA caucus in Congress, and the politics of a carbon tax are daunting at the moment to say the least.

Then, there's the third path, which is the path that the Administration has gone down. Under this third path, the Administration is aggressively using existing authorities, mainly under the Clean Air Act but also under other laws such as the Energy Independence and Security Act, while being careful to stay within the law. My goal in this talk is to lay out some details on path three and to make the case that path three might go a very long ways towards constituting a sufficient climate policy. I should be clear that, like almost all economists, my preference is for a single economy-wide price on carbon (path two), but absent that, there are reasons to believe that the regulatory approach could yield very significant emissions reductions and transform at least the power sector into a low or even zero-carbon sector.

Let me digress for a moment to add that part of path three is the Administration's emphasis on education surrounding climate change. In his first press conference after his 2012 reelection, the President was asked a question about climate change. He could have ducked the question, but instead he went on eloquently about how while we're not ready for a carbon tax at this point, there's a lot of education that needs to be done, and we need to move forward under existing authorities. So, the use of administrative authorities has been partnered with education from the beginning of the term. And there have been a lot of educational materials, one of the first of which was a chapter in the Economic Report of the President a few months later, in 2013, on the economics of climate change. Many government agencies, including National Oceanic and Atmospheric Administration (NOAA) and Department of Energy (DOE), have written and disseminated a large amount of excellent material going over the science of climate change for use by the general public.

Aspects of what I'll be calling path three, which is using existing authorities, has been discussed, and so I'm going to add some gloss, then address the question: if we are going down path three, does going

down path three make it more or less likely that we actually adopt a carbon tax? I will argue that it makes it more likely, but I might be wrong.

The fact that I might be wrong — and of course, we don't know — is really important and has two big implications. One big implication is that we had better do path three as well as we possibly can, in a way that will efficiently affect meaningful long-term change. I'm going to argue that is possible. The second big implication is that we need to bear in mind that the United States might remain on path three as we discuss the structure of international agreements.

The most important mitigation elements of path three (and the President's Climate Action Plan) are the Clean Power Plan and the Corporate Average Fuel Economy (CAFE) standards, which have been completed for light duty vehicles and which are gearing up for heavy duty vehicles. What I want to focus on is something that hasn't come up so far, which is that the proposed Clean Power Plan compliance deadline is 2030 in the EPA's Option 1, and that the plan is silent about what happens after the final compliance deadline. But the legal requirement to regulate under the Clean Air Act does not expire — that requirement was triggered by the EPA's previous CO2 endangerment finding, so the requirement to regulate continues even after the 2030 compliance deadline. What this means is that at some point in the early- or mid-2020's there will need to be a second round of rulemaking for post-2030 emissions. This fact has received very little discussion, but is extremely important for thinking about the efficacy of path three.

If we go back to Section 111(d) basics, the framework for thinking about what those standards might be is thinking about what the best system of emissions reduction (BSER) might be, standing in say 2023 when the proposed post-2030 rule could be circulated. People who are familiar with the proposed Clean Power Plan rule are familiar with the four building blocks which EPA has very carefully laid out. Those four building blocks are grounded in technological options that are currently available — in the language of the Clean Air Act, emissions reduction technologies that have been "adequately demonstrated." In the proposed rule, those adequately demonstrated technologies involve maintenance at fossil-fuel fired facilities, reprioritizing dispatching, extending nuclear plant lifetimes or building renewables, and so forth — a very detailed command-and-control approach to the best system of emissions reductions. But what's the BSER technology going to look like for reducing emissions in 2023?

Well, presumably, by 2023 there will be a fair number of regional cap and trade programs--in fact, there could be a large number of them if the final rule were to preference trading systems in terms of ease of administrative compliance and if the Federal Implementation Plan were to favor cap-and-trade methods over far less efficient command-and-control methods. Those regional cap and trade programs will have been put in place to reduce emissions in the electric utility generating sector. So I would argue that in 2023 the best (most efficient) system of emissions reductions that has been adequately demonstrated is one that many states will have chosen to implement. At that point, then, the BSER, becomes regional cap and trade programs.

If in 2023 the preferred emissions reduction technology is a regional trading system, then the main remaining technical question is how the emissions rates should be set. At that point, any economist can tell you that the emissions rates should be set so that the marginal benefit from emissions reductions equals the marginal cost of the reduction. Under that logic, the post-2030 Clean Power Plan would be regional (or possibly even national) cap and trade systems in which the emissions caps (mass or rate) would be set so that the shadow price of the permits would equal, say, the social cost of carbon.

The requirement to regulate under the Clean Air Act also extends beyond the power sector. This suggests that the next round of regulation would extend to non-power sector stationary sources such as refineries and manufacturing.

You can imagine a similar process working there, in which the first round of BSER is command-and-control heat rate reductions and so forth, but allowing compliance by regional trading; then the second round of BSER would be regional trading so that the shadow price on carbon can be set to the SCC. I don't know enough about the legal history of the Clean Air Act to know whether you could permit trading across a sector, for example a utility could build a solar farm and sell the credits to a manufacturer who would find it very costly to shut down a particular fossil-fuel fired facility. If that cross-sector trading is possible, then you could see a path for all major emitters to be in a national cap and trade system by the early 2030s, where emissions targets are set by back-solving from a permit price that equals the SCC. There would be efficiency losses if these markets had to be sector-by-sector, but perhaps those efficiency losses would be modest. So, you can imagine, through the Clean Air Act authorities, in the most optimistic scenario, actually moving in a direction that would be a workable second-best, nearly first-best, solution.

Let me digress for a moment and point out that this regulatory, path-three approach also works for non-CO2 GHGs, an issue we have not spent much time on at this conference. Indeed I am persuaded that in many circumstances a regulatory approach, as opposed to a tax, is the most efficacious way to deal with non-CO2 GHGs. For example, fugitive methane emissions from oil and gas operations are very difficult to measure (the sensor/continuous time monitoring requirements are prohibitive) so any price mechanism would not work well. But it is easy to mandate and spot-check operational procedures for say liquids unloading, or certain specs for valves and seals, and in such applications the regulatory approach seems to me to be preferred to a fee approach.

It is true that this long-term path three vision is not first best because it is not economy-wide, and in particular the tools available for the transportation sector, and its dispersed many-emitter nature, makes a cap-and-trade system for the transportation sector under the Clean Air Act seem like a stretch (although this is a great topic for economists and lawyers to join forces on to research). And although I'd prefer to see a path two, economy-wide solution, I think we have to be responsible by thinking about how we can make the path-three second-best solution as effective and efficient as possible. As I have tried to argue, on a longer horizon I can imagine path three being nearly first-best, with the main exception of not dealing very well with the transportation sector. I am willing to go

out on a limb and say that, once this is understood, the incentives for decarbonization will increase and, extrapolating from the large-model (NEMS and IPM) computer simulations I've seen, I think that there is a very good chance that this path will effectively decarbonize the power and major point source sectors by the middle of this century, possibly before.

Let me turn to the question of whether not going down path three makes a carbon tax more or less likely. A number of previous speakers have talked about the uphill fight of price regulation, as opposed to quantity regulation. I'm just going to add a small anecdote here. In the 2014 election, Massachusetts had a ballot referendum that proposed to repeal our current indexation of the gasoline tax to the CPI. Funds from the state gas tax are used for roads and bridges. What was at stake, in the first year, was an expenditure of $3.60 for the average Massachusetts driver, but that shortfall would grow and would deplete transportation repair funding over time. Well, despite the opposition of every Massachusetts Ph.D. economist I spoke with on the topic, the proposition passed, and our gas tax, like the Federal tax, is no longer indexed. Of course, this is just an anecdote. But this is a $3.60 issue, our roads are in serious disrepair, and this is Massachusetts! So, if we can't maintain gas tax indexation in Massachusetts, you know that's an uphill fight for a carbon tax. And, of course, the prospects for raising the federal gas tax (which has been frozen at 18.3 cents/gallon since 1993, are not good--even the current Administration has backed away from this very sensible way to solve the upcoming shortfall in the federal Highway Trust Fund.

The uphill fight for a carbon tax is exacerbated by its regressivity. I have no issues with Dale Jorgenson's economics and his detailed and thoughtful modeling. But, thinking about a simple, straight carbon tax designed to maximize the double dividend is not going to adequately address its regressivity, and without doing so any such proposal is, I think, a non-starter.

Let me make a few comments on the political economy of a possible transition from path three to path two. It is, of course, natural to expect opposition to a carbon tax from the fossil fuel extraction and distribution sector, and with some notable exceptions (e.g. BP) that is what we have seen. One can imagine scenarios, however, that there could be substantial movement in favor of a carbon tax among manufacturing. If a carbon tax were packaged with a winding down and eventual elimination of CO2 emissions under the Clean Air Act, I can imagine manufacturers preferring the simplicity of a carbon tax to invasive regulatory measures.

On the environmental left, there has been a significant willingness to embrace the SCC, which I will reinterpret as a very positive sign about willingness to adopt price mechanisms rather than command-and-control regulation. I'll just give you one example, in which Wild Earth Guardians and the Sierra Club sued the Department of Interior and the BLM over their authority to issue some permits for coal mining. The reason that they sued, and the reason they won their suit, was because the NEPA review that was associated with the lease this didn't use the social cost of carbon to value the climate impacts of the lease.

I should mention that path three has its own risks. First, a subsequent administration might decide to water down or slow-walk the Clean Power Plan rules, although that would be legally difficult for them to do. Second, the Clean Power Plan will be litigated, and there is legal risk involved. Is there more that could be done within existing legal authority? Adele [Morris] said that, basically, we're doing everything--I would actually argue that that's not completely true.

There's still at least one more major tool in our arsenal. It has appeal that's akin to Yale adopting a carbon tax. Even though we do not have a price on carbon, the federal government could still apply a carbon price to its own resources. In particular, 40% of the coal that we burn in the United States comes from Federal land, mainly (but not solely) out of the Powder River Basin.

For Federal coal, it turns out, under the Mineral Leasing Act of 1920, we have a lot of authority to set the royalty rate as long as it is done for a solid reason (non-capriciously). There's a nice analysis of this, actually, recently, by a Resources for the Future paper a couple of months ago by Alan Krupnick, Joel Darmstadter, Nathan Richardson, and Katrina McLaughlin. They point out that the Federal government has legal authority to add a carbon adder to the Federal coal royalty. Because Federal coal comprises 40% of domestic consumption, if coal royalty were pegged to some fraction of the SCC it would have significant aggregate effects on emissions. The effect would depend on the amount of the carbon adder and how that adder interacts with the Clean Power Plan (and we don't yet have the final CPP rule). I suspect that the effect of this action would be the same order of magnitude as the CPP, relative to the no-CPP baseline, and in that sense this proposal provides a backstop to the CPP if important elements of the CPP are thrown out by the courts. And, again depending on the interaction with the CPP, an increase in coal royalties could have some degree of economic efficiency because it is simply a price mechanism, although it covers only a portion of coal, which is only part of fossil fuels.

Let me just leave with four questions, or really action items, for this group and for economists in general.

First, as I mentioned above, we need to think about the optimal carbon tax with the side constraint not just of revenue neutrality but also subject to distributional neutrality (no regressivity). Even with this side constraint, there will still be considerable revenues for recycling. What is the best way, from the perspective of economic growth, to recycle the revenues and obtain a double dividend while maintaining distributional neutrality?

Second, if we had a carbon tax, what would it actually be? We all know that there is considerable uncertainty surrounding the social cost of carbon, and coming up with a single number is always hard for economists. But if you're going to have legislation, it needs a number. The numbers that are being used now, for example in Whitehouse-Schatz, are just using the USG SCC, but I bet if we started actually paying it, that'll be getting even closer scrutiny, and so additional research in that area's more than warranted.

Third question is, we know whatever we choose, that the social cost of carbon and our understanding of damage functions is going to be evolving. So, how do we make sure that whatever taxing regime we go into is going to be one that can take into account evolving understanding, and the evolving nature of the science. Is there a way to index the carbon tax or adjust it as the science evolves, which will prove politically acceptable?

I think a fourth question is what options do we have in path three. I've listed one, which is the Federal coal, and maybe there are others. I don't know if there are any others that provide meaningful emissions reductions, but that's a question.

Let me close by turning to the basic issue of the conference, which is an international carbon tax arrangement, or at least an international carbon price arrangement. As a practical reality, given the problems we have domestically, I would argue that we need to think about an international regime that allows for much more heterogeneity in terms of ways that individual countries accomplish their goals. I firmly believe that the United States is taking leadership in this area now, and can continue to lead, while using existing authorities and pursuing the regulatory path three. It is important that an international regime can accept a country that makes meaningful progress and has ambitious goals, but accomplishes them by means other than the first-best carbon tax.

Matto Mildenberger

Thanks so much. As one of the handful of political science interlopers here, I appreciate the invitation to speak about the political economy of carbon pricing. I'll offer reflections on some political complications that we need to address to coordinate a globally harmonized carbon price.

Much of my recent work has involved detailed empirical examinations of the political histories of carbon pricing across advanced economies. These have included Norway, Australia, Germany, and the United States. Now, climate policymaking is a collective action problem, and I think that a number of the scholars here have already thoughtfully described the free rider aspect of the climate problem.

But climate policymaking is simultaneously a distributive conflict problem at the domestic level. So, even if we can solve the participation problem and create a carbon club in which there are net welfare benefits for different countries to join, this won't by itself guarantee that individual economic stakeholders within each country — stakeholders that may be politically connected or politically influential - will also enjoy net economic benefits. There will always be individual economic losers from climate policy who will contest national climate policymaking efforts.

So, we need to pay more attention to the distribution of resources and the distribution of influence amongst these economic stakeholders and carbon polluters at the domestic level. And we need to find ways to solve the domestic distributive conflict problem simultaneously with the global free rider collective action problem.

What I'll suggest today is a series of principles that we can use to supplement our economic evaluations of different climate policy instruments. I'll argue there is a lot of value in thinking about the political properties of different instruments to shed light on the political viability of different carbon pricing policy designs.

Let me make three points that cast, I think, some light on the trajectory of political conflict at the domestic level over carbon pricing. During our conversations, we've talked quite a bit about policy feasibility. Can we create a political coalition at the domestic level of economic winners that will enact national climate policies with net benefits for the entire country?

We've also talked a bit about some of the struggles to implement such an efficient carbon tax policy in the U.S. I know some scholars — David [Victor] has written about this in the past — have described how specific policy instruments can provide particular political benefits. For instance, emissions trading may provide benefits for politicians seeking to build a support coalition because emissions trading creates a new set of assets (e.g. allowances) that can be used to compensate producers and economic losers. Even better, these assets are somewhat submerged and non-transparent, so they make good pork.

More broadly, I think policy durability is a really important political dimension to bring into these debates. It's important that policies are not only enacted, but have some form of institutionally and politically durable support over time. And, I think, here, thinking about the Australian case is quite instructive.

Australia struggled for a very long time to implement an emissions trading scheme, and eventually managed to in 2011. However, there was a lot of political controversy over what the carbon pollution reduction target should be in that scheme. The strange political compromise that Australian legislators came to is to create an emissions trading system, but defer a decision on what the carbon pollution reduction target would be — that is, what the cap in that system would be — for four years.

But then, they needed some carbon price in that interim bridge period, and so they created a fixed price for that period. So, we talk about Australia having had a carbon tax — it was effectively that — but it was technically a temporary fixed price within an emissions trading framework. Now, at the same time, there was enormous political uncertainty about that policy. The opposition party at the time, the Liberals, promised to repeal the policy outright if they came into government.

As a result, many companies, rather than making long-term investments in the carbon intensity of their economic practices, they instead chose to treat the fixed price as a short-term levy, gambling on its potential repeal in the coming years. Subsequently, when the conservative Liberal party, did, in fact, win government in 2013, they pushed through a repeal. And, in part, that's because the fixed price carbon tax that had been around for the last three years had created a lot of economic losers, but hadn't created economic winners or stakeholders with a vested stake in the policy's continued existence.

In this way, I think that one property of emissions trading that we don't often think about, is whether there's a certain institutional durability built into the nature of a policy instrument. Allowances, as an asset class — particularly when there's some tradability with future banking, allowance banking, or borrowing from the future — creates a series of assets that are forward-looking, and are on company's balance sheets in the present. So, it brings a class of future benefits into current political debates.

I suspect that Australia would have had a very hard time repealing their carbon price if the system was already in its floating emissions trading scheme phase, because that would have involved the government destroying assets that were already in existence on corporate books.

We also ought to think about the durability of the link between the revenue source and the benefit source, that is between the costs and the benefits of a carbon pricing system. Imagine we get a grand bargain where a carbon tax is introduced as a trade off for cuts in corporate income taxes. Can we guarantee in 10 years that the linkage between these taxes will still be around? Isn't it just as possible that, in the context of a new financial crisis, or in some new political environment, politicians will find a new revenue source to fund the benefit side of the equation — or simply cut the carbon tax altogether because its to their political advantage to do so in the future. This means we need to think about mechanisms that can enhance the durability of any carbon tax bargains.

We also need to think about adaptability. There is so much uncertainty about what the appropriate carbon price, or carbon tax, should be. We should expect that as climate science improves, as economic models become more sophisticated and measurement improves, we'll need to calibrate and recalibrate the level of carbon taxation, or the cap in a system, over time. And, finding ways to think about how we can make that process of adjustment more politically viable in five years, or in 10 years matters a lot.

We might imagine that a cap is somewhat more adjustable in the future, simply because the cost of a cap adjustment on, for example, consumers will be more indirect and more difficult to mobilize politically against. By contrast, if we depend on a grand bargain to implement a carbon tax, can we depend on the existence of another grand bargain five or 10 years down the road to facilitate necessary changes to the tax level?

Now, I don't want to suggest that there is necessarily a rank order of the political viability of these different policy instruments. I think that probably the political economy of these different policy instruments is differentiated by the domestic political institutions that exist in different countries. But, I chose these examples — given the sort of conversation we have been having — to make a brief, defense of emissions trading when the political economy of carbon pricing is considered.

That is not to say that emissions trading is the way to go, but to say that we must at least consider the political properties of these different policy instruments, and the particular political economic benefits that each offers. For emissions trading, this includes the creation of the easily distributable assets, forward-looking assets protecting against repeal, and more submerged and non-transparent costs to facilitate future recalibration of the policy costs.

Let me make just two more points. I know we're running dangerously close to lunch right now. Climate policy making from a political perspective is not a one-shot game. It's going to involve not just an initial reform, but a series of reforms over multiple decades. So, from a political economy perspective, we would do well to think about the way in which the current actions we take now shape what is politically possible in the future. You know, which political actors will face costs in the short term, how will those costs reshape the distribution of power and influence during future rounds of policy-making conflict.

And, I think this raises a somewhat provocative idea that it's not clear, in the short-term, that the sequence of carbon pollution reductions is immaterial. The choice of who and where to impose the initial units of carbon pollution reduction can have quite significant implications if these choices reshape the distribution of future resources.

Take for example the Clean Power Plan. This is a quite inefficient policy. However, by imposing direct costs on the coal industry it might actually reshape the political economy of the carbon taxation debate in five, or six, or seven years. This will happen if the political influence of coal industry on the debate weakens as a result of costs imposed by the Clean Power Plan. In this way, short-term policy inefficiencies might distribute costs in politically relevant ways to help unlock future political capacity to implement long-term, more efficient policy outcomes.

Let me make one more point, and that's that even if we look across advanced economies, there's significant variation in climate policy design. Often these policies, from a global economy perspective, are designed to moderate perceived costs on producers or consumers. So, even if the consumers are ultimately paying in the long run, there are significant differences in how different constituencies perceive those costs, and these have a lot of implications for the electoral and legislative incentives associated with climate policy enactment.

Robert [Schmidt] touched briefly on the BTU tax, but I think it's worth at least putting that episode on the table, given that it was this very significant domestic debate we had in this country in 1993. In fact, there was some appetite within some parts of the Clinton transition team for a carbon tax at the time. Al Gore really wanted a carbon tax, and the office of tax policy at the time modeled a number of carbon taxes as part of its deficit reduction package policy design process.

Ultimately, because of the implicit veto power of the coal states and coal legislators, there was a decision to go with an energy tax, the BTU tax. But, I think the political history of how that tax changed in design is instructive. Initially it was proposed as a very upstream tax. A number of the impacted carbon incentive stakeholders then tried to bargain with the Administration to redesign the policy to change its liability points to be more downstream.

They had quite a bit of success in this. For example, they succeeded in forcing the Administration to allow utility companies to include the BTU tax as a line-item charge on residential electricity bills.

Having demanded those compromises as a condition of their tacit support for the package, they then pivoted immediately to use these new consumer-facing policy costs as a way of mobilizing political sentiment against the tax. Ultimately, this helped undermine legislative incentives for enactment — and the policy would stall in the Senate.

You can contrast that experience with the Norwegian or Scandinavian set of carbon taxes, which are extremely producer-facing. They have often been negotiated behind closed doors within corporatist institutions — involving political bargaining between labor interests and business stakeholders, and economic and finance ministries. The result of this different policymaking context is that these taxes have tended to impose a relative distributive burden on consumers, or at least a perceived distributive burden on consumers. But, because of the sort of institutional dynamics that have surrounded policy design in these countries, carbon taxes have never been mobilized into the political and electoral domain in the way that we've seen in the U.S.

Let me leave you not with the idea that there is not a necessarily better or worse policy instrument to enact a carbon price. Instead, as we think about the development of a carbon club, and as we think about ways to engineer a group of countries to come together to solve the climate policy participation problem, we should make sure climate policy design at the national level can be sufficiently flexible. That way, domestic actors can respond to differentiated institutional contexts and political economy concerns in a way that allows them to manage domestic distributive conflict. We should work towards a globally integrated carbon price — but not towards global homogeneity in climate policy instrument choice. Thanks so much.

Discussion

Leonardo Martinez Diaz

If I could invite the speakers to please join us up here. Well, thank you for those presentations. You gave us a lot to think about. I don't know if you caught this, but I heard three ideas here that were actually highly subversive to what has come before us in this conference, and that should make for some interesting exchanges.

The first subversive idea I heard is that what we need is an international regime that allows for more heterogeneity, as each country develops its own sets of politically acceptable solutions. Now, that of course clashes directly with the idea of a harmonized tax, so I'm curious to see how we can find some way forward on this.

The second subversive idea I heard was what I would call, or what others call, choice architecture. In other words, are you for a carbon tax? No. Are you for a carbon tax to pay for subsidies for clean energy? Maybe. Are you for a carbon tax that would pay for corporate tax rebates, or for individual income tax rebates? Sure, I'll vote for that. So the outcome largely depends on the choice and how you structured it. I'm wondering if there are, then, opportunities for political outcomes that we might not have visualized.

The third highly subversive idea I heard here is bring back the emissions trading system idea. That seems to have very powerful things going for it, from a political economy standpoint. One is that they may have greater political durability, because they're harder to reverse because of this creation of assets that then creates some stickiness in the system.

So, in this context, then, where does the carbon tax come in? Is there still room for that? Is there a way to complement the two? How do we think about that? So, three good ideas. Please, Adele, the first question.

Adele Morris

I have a couple of questions. One question for Jim about taxing Federal coal. So, we might have 40% of coal use from Federal lands now, but if we tax Federal coal, the question is, how long would that last, and would you just simply lose market share to net gains? I'm sure you've thought about that, and I'm curious what you've learned in looking at that question.

With regard to the assets created by an emissions trading system, I've thought about this, and I think there is an analogy for a carbon tax. In an emissions trading system you create an asset when you allocate the allowances, right? So, if you give them away, obviously you have a large body of assets, but if you just give them away you have foregone revenue, and all the foregone opportunity for efficient revenue recycling, so that's a challenge.

If you auction them, there might be some limit to how much forward procurement of these allowances firms might want to acquire. Therefore, you might have a limited amount of those assets on the books, depending on firms' demands for having this stock of assets. But, you could do the same thing with a tax. I mean, the Treasury Department could allow firms to procure tradable tax compliance credits for future years of tax obligations.

And, there would be the same demand for those as there would be for auctioned allowances for future compliance years. And, those tradable tax credits--and, there are precedences within other parts of tax law--those assets of tradable tax credits would carry exactly the same asset value dynamic in terms of the incentive to perpetuate the program, as prior auctioned allowances would, under an emissions trading system.

Leonardo Martinez Diaz

Do you want to address that?

James Stock

Let me just very quickly on the Federal coal issue. Yes, of course there's a question of whether it would get supplanted, would there just be substitution of non-federal for federal coal. The numerical answer to that is going to require, fundamentally, a pretty complicated calculation that could be done using NEMS or IPM.

But, you can do back-of-the-envelopes based on what supply curves might look like in, for example, Appalachian coal or Illinois basin coal, and then taking into account some institutional details about how private coal is interspersed with public coal of Federal lands in the west, and it looks as though there'd be much less than one-for-one substitution.

So, you could end up with, I suspect, meaningful reductions in emissions. It would drive overall coal prices higher, but the supply curves are pretty steep for a lot of the eastern coal, and as national coal prices rise more natural gas is used. So, the actual numerical work would require sitting down with one of those large models.

Jason Bordoff

Do you think it would be net revenue positive or negative if the government raises rates, but then Federal production declines?

James Stock
Oh, positive, for sure.

Leonardo Martinez Diaz
David Victor?

David Victor
I appreciate the argument that Matto has made about the stickiness in policies that's created by, in effect, creating an asset that then people are going to organize and protect. My own view is that this argument is second-order at best, and has been radically overstated. Because, people are looking at these assets, and they watch real carbon markets, where they watch the real tax policy, they're seeing governments change it all the time.

So, the assets in play to a much greater degree. I think that might play a role here. For me, the much bigger issue is the way that a carbon tax interacts with the other policies that are operating in the same space, because in a cap and trade system, as happens all the time, every single cap and trade system is like this: you have all these other policies that then affect the value of the asset, and basically drive the prices down. Whereas, the carbon tax still remains there at the margin, sending a cleaner signal. I think that's actually a more dominant affect.

Leonardo Martinez Diaz
Eric, do you have a view on Adele's point on issuing tradable tax credits. Would that work in real life?

Eric Toder
I'm not really sure how that works, but I do think there is a set of interests that the high prices produce that would be sustained. There will be industries that develop and expand — renewables, for example — and then will have a strong interest in seeing the credits maintained, so I think anything you're going to do will have some vested interest created in favor of continuing it.

Leonardo Martinez Diaz
Prof. Nordhaus?

William Nordhaus
There are very many interesting things that have been said this morning, and I just want to address one of them. The title of this conference is "Globally Harmonized Carbon Pricing," and I don't know whether Ernesto and I are completely on the same page, but actually, I think the key point is pricing rather than taxing. So, I didn't spend much time on it, but I was quite explicit when I wrote that what a club or treaty should do is agree on a minimum international carbon price.

How individual countries would reach that price would be up to individual countries, although it has to be with a mechanism that can be verified according to a set of rules. I personally think there are great advantages, at least in some countries, of taxes. We've seen the failures and the difficulties of

quantity regimes, and you'd have to worry about how you're going to institute a floor on those if you actually do have an international harmonized minimum carbon price.

But the point that's been made here, and I think it's a very powerful one, is the purpose of this is the price. It's not to get people to adopt a tax, it's to get a minimum price, so I think the idea that this was trying to be forced into a tax mold is just incorrect. Now, I would say, just to come back to the durability stickiness point, one advantage of the treaty is that it actually does give a certain impediment to repealing — whether it's a floor in a cap and trade system or a tax, because there actually are international implications. You're not just changing international domestic law, you're also running afoul of some international obligations. Whether to include regulations in this price regime I think is really troubling. The idea that the U.S. would be able to substitute its Clean Power Plant rule and its café standards and all that, and maybe it's ethanol subsidies, and so on — well, you didn't say that, but someone will say that.

If you go down the rule of regulations, then you're opening a door. I know tariffication exists, but I haven't looked into it. I think it's a very difficult problem, and I think it's going to be very, very difficult here. So, my first inclination is not to allow carbon price-ization of regulations, but more generally, the other ways of raising carbon price would be, at least in my view, quite consistent with an international protocol.

Leonardo Martinez Diaz

David?

David Victor

The price comment is a very helpful reminder. I think this is where the protocol comes in, because it could be that what you want to do in the protocol is set that the standards for being a core member of the protocol, or the club, is you really are using price instruments, and then you lay out a set of procedures to figure out which of the regulatory instruments can be tariffied, or can be turned into price-like instruments for purposes of comparison, and which of them are truly pernicious.

I agree with you, Bill, it would be great not to have to go down that road at all, but there's going to be a real trade-off here, because the real world — you said it was a subversive idea to allow more heterogeneity — I call it gravity. This is just what's happened. The real world has all of these different instruments in it, and I think we're trying to move in the direction of more price-based instruments, but we need to find some strategy.

The other thing the protocol could do here, much as was done in the Montreal Protocol, is set up expert committees that go off and work on these problems for the benefit of the members of the protocol. So, then you've got advice that leads to clear, strategic plans with numbers on them, and ratchets, so that once a country puts something into place, it's harder to back off from that. And, that's the most important lesson we learned from the Montreal Protocol experience in the ozone layer. We could bring that experience in here, directly.

Eric Toder

I just want to throw out something completely out of left field, and I don't know if it works or not, but a question was raised the other day about our tax agreements, and the World Trade Organization (WTO) was mentioned. Of course, we do have a series of tax treaties in the international tax area with about 70 different countries. They are bilateral rather than multi-lateral. And, they address mutual interests in avoiding double-taxation. If the United States were to have some kind of carbon pricing scheme, we might have an interest in reaching agreements with other countries to do similar things.

So, there might be things we could do on a bilateral rather than a multi-lateral basis, just following that model. I haven't thought through what they are, but I'm just raising that as one thing, because that then could address very specific issues about whether we want to accept another country's policies, or they want to accept ours. That might be a different variation to achieving carbon pricing.

Leonardo Martinez Diaz

Let me collect these three comments, and then go back to the panel. Let me start on the left side, here.

Carolyn Fischer

My comment is a bit of a follow-on to Bill. We're thinking about allowing more heterogeneity in the policies. In some sense, to me, it sounds like we're getting a little bit back to the framework that we're in, the pledge and review. The distinction here is we want to keep it to be a club, and so then we need to worry that there may be some tensions with our club enforcement mechanism, especially if we're thinking about using something like border carbon adjustments for that.

In the process we went through thinking about what can you adjust, it was very clear that you really only have a good case for border carbon adjustments if you're using a price, and you're pricing embodied carbon. That's what you're asking imports to pay, implicit tariff on the embodied carbon, and then it also has to be the case that you are asking your firms producing those products to be paying for their embodied carbon. And, only a price mechanism does that, and also, that price mechanism can't be undone with allocations.

So, if you have an allocation regime that gives free allocation to your energy-intensive industries, you're going to be limited in your ability to apply border carbon adjustments in a consistent manner, to the extent that you allow a lot of heterogeneity. So, I just want to bring back the price emphasis there, and the need for that for designing trade-compatible adjustment mechanisms.

Leonardo Martinez Diaz

Thanks, Carolyn. Grzegorz?

Grzegorz Peszko

I have a comment on the instrument choice. One part of the comment is about the overlapping effects of different instruments, and often the EU ETS is called an example of the failure, because other

instruments, especially renewables support policies have interacted with the pricing on the ETS, and reduced it, and we see some unfavorable substitution in the power sector between coal and gas as a kind of side effect of it.

But tax is more immune at the margin, when it comes to the pricing. The reality is that the governments and societies have multiple objectives, and there will always be a presence of multiple policies in place. If you look at the history of renewable support policies, it has not been introduced as a climate policy in Europe. It has been introduced mainly and designed as an industrial policy. It was quite successful as an industrial policy.

A lot of European companies have been quite successful in increasing their market shares globally. They reaped their primary mover margins, then they lost them to Chinese companies. But, nonetheless, it has been a very successful policy from the point of view of the designers of the policy. Yes, it interacted with another policy, which was a climate policy, so now there is a kind of learning process, and in Europe there is now discussion, and the revision of the renewable support systems, in order to reduce these impacts.

The same goes with the design of ETS. When I moved to the U.S., I kept hearing that the EU ETS is a failure. If you give me an example which design element of ETS failed, I would be surprised, because I don't think that any of the design elements have been a failure. We discovered that pricing now was not immune to the kind of cyclical business cycles. True. So, we learned it, and now there is a decision to rectify it. But, in a way, the two main objectives of the scheme proved to be completely immune to any changes.

We first objected to this environmental one; the quotas have not been exceeded, on the contrary. The ETS is delivering the emission reduction among the regulated entities, and the costs have been contained. The markets reacted perfectly well to the changes in the economic climate, with the economic crisis and output decline, certainly emission reduction achieved by the adjusted output, so the prices reacted perfectly corrected; it went down.

We are now concerned about the long-term investment signal, and this is what triggered the correction, and the new proposal which has passed the Parliament now. So, I think it speaks to being very open-minded and very flexible when it comes to the choice of instruments, and certainly what we see from the World Bank in many different countries, it is extremely important to allow countries to really experiment with different economic instruments, and certainly I think the preference for price-based instruments is important, so I was very relieved by what Professor Nordhaus said.

At the end of the day, it is the carbon pricing that is important, and not exactly how this carbon pricing is implemented. We shouldn't be religious about whether it's a tax or cap and trade system; what we should care about is to design whichever of these instruments in a way that is efficient, that is politically feasible, and design them in a way that there is a fair amount of compatibility between them.

And, as Adele said, you can design different elements of tax systems in a way that makes it compatible with this durability advantage of the cap and trade system. In the same way, you can design emissions trading in a way that makes it very much compatible as the tax. So, I'd like to just leave it with that reflection.

Leonardo Martinez Diaz

Thank you. Last comment.

Thomas Sterner

Thanks very much. I was saying that we tend to focus so much on optimal design of policy instruments, but we need to think a lot more about what is politically feasible, and I tend to believe that, particularly in this area, policies are really made by lobbies, to a much larger extent, in many countries, and that's something that should be recognized and taken front on in a session like this. I think we hear people speak more about regressivity, for instance, than about lobbies.

But, who is the more powerful here — the poor who might be possibly disadvantaged in some occasion, or the lobbyists who have massively influenced policy-making in many countries. I think that we need to understand lobbies better. Maybe the coal lobby will be somewhat weaker now, but I worry that the gas lobby will become extremely strong, and that gas is also, obviously, a big problem with methane emissions. The smaller carbon emissions can be completely an illusion, if you take that into account.

And so, one of the hopes for policy-making, and for treaties in the future, may actually be to strengthen the green lobbies. That is done by technology policy. For reasons that we don't always understand, and that might appear strange to us sometimes, a number of countries are very prone to supporting new technologies, for instance, renewable technologies. And, there are lots of problems with this related to picking the winners, and so on.

But, it seems that at least some of these technologies have very strong increases with scale, and learning by doing, and that of course makes the point that if you put money into that, you change the cost structure. You change the relative weight of the lobbies, and you change the preconditions for the next round of negotiations about policy. This applies both on the domestic level and the international level.

I think it would be interesting, in the games that were mentioned before, for instance, by Bill. What is the lobby of the oil and coal producers? What is that coalition going to do — that's something we need to think about more. There are many areas where we need to think more clearly about lobbies. Thank you.

Leonardo Martinez Diaz

I think if you look at the cost curves for solar and wind in this country and others, I think it's pretty clear that the game has shifted, to some extent, as a result of subsidy policies. Three points out here — any reactions you want to make?

Jason Bordoff
I'm going to jump in just to say thanks, because I need to leave. We're about 25 minutes over, but I appreciate the invitation, and I'll leave my closing comments to the other five people.

Leonardo Martinez Diaz
Thank you. Any other closing — Matto?

Matto Mildenberger
Well, I might just follow up on that point, because I think if you look, for instance, at the extremely successful German subsidies for renewable energy that brought down the cost curve, in many ways that was a policy implemented because there was a political interest in doing something on industrial policy, on energy policy, but there was a political inability or unwillingness to impose costs, for instance, on the domestic coal industry.

So, coal was exempted from the German eco-tax until forced by the European Union in 2006 to bring it into their energy tax system. So, they're taxing nuclear and not coal up until 2006. So, in some ways you might say the same with the Norwegian investment in CCS. These subsidy policies are often efforts to deliver some desired political goal, when the political economy of imposing costs is very difficult within these domestic institutional systems.

I think we should be careful not to abandon those subsidy policies without making sure that there's the domestic institutional conditions necessary to replace them with some other effective policy that really drives changes in the cost structure in the economy.

Leonardo Martinez Diaz
Other thoughts?

James Stock
Let me just say one. Thinking through all of the different lobbies seems really important, I'm just going to flag one that's of concern, which is the energy efficiency lobby. And, I know you normally don't think of them as necessarily bad guys, but I think it's a potential. There's an awful lot of wide support for increasing conservation and increasing energy efficiency, but whether that's actually really an effective strategy to combat any of these issues is questionable. There's a risk of getting trapped in the wrong space in that area, in particular.

Leonardo Martinez Diaz
David, you had a point?

David Victor
Since we're wrapping up, I just want to come back to this point about multiple goals in policies, because I think there's always going to be multiple goals in policies. You really do have a big trade-off

here, because if you lay this out as a clean, price-oriented system that we would love, I think you're going to get Sweden and British Columbia as members, and then the list tapers off pretty quickly.

We do know from other areas of policy that although it's really complicated, we know something about how you can start to chip away the equivalence issue, and figure out which regulatory incentives are maybe not price-like, but are closer to price-like mechanisms than others, and create maybe the equivalent of some green boxes, and some red boxes, and so on, to help create an incentive for the membership in this protocol, or the pricing club, to be as large as possible, and to move in the right direction over time.

I think that is almost guaranteed to lead you to a "friends-of" kind of process, as I said in my main remarks, or a side agreement, as opposed to something that's actually a protocol or a treaty, because if you just look at what's going on right now in negotiations, they can't even agree on how to set up a review mechanism to review the INDCs that the countries themselves have submitted, let alone submit the INDCs on time.

So, if they can't agree on that stuff, the idea that they would be able to formally agree to a protocol that would actually set up the kinds of equivalents processes that we've used in some areas of trade, so that we help put pressure on governments to move away from regulation and into pricing instruments, that just seems completely impossible to me.

Leonardo Martinez Diaz

Robert or Eric, do you want to close with anything?

Robert Repetto

Yes, I'd mention two points that I didn't have time to state. When thinking about international agreements, one should bear in mind the huge co-benefits, largely from reduced air pollution in developing countries, especially in large middle-income countries such as China and India. We've seen some estimates of co-benefits per ton of carbon reduction that are much higher than any carbon price that exists today. This implies that those countries have nationalistic incentives to reduce emissions, even unilaterally, to gain those co-benefits.

Secondly, one should think about the broad scope of win-win mitigation options in those countries. As detailed in my book *America's Climate Problem: The Way Forward*, India, for example, would strengthen its growth prospects by electricity sector reform, reduction in energy subsidies, better urban construction standards, watershed reforestation and many other measures. I know many of you don't believe that there are win-win options, but I will say this: when I was on the faculty here at Yale, my wife was showing houseguests around the campus, and on Hillhouse Avenue, outside the Economics building where Bill has his office, she found a $20 bill on the sidewalk. So, if you actually go look in developing countries, as I did, you'll see that the win-win options are huge. Somehow, that ought to figure into thinking about potential agreements.

Eric Toder

All right, so if there's one point I haven't made, I'll make it. It's part of the reason I like Bill's idea. There are two ways of looking at social change. One is the grand bargain. Everybody sits down and agrees and does it all at once, and that's the 1986 tax reform model, and it was mentioned by several people, including me, for the carbon tax. But, the other approach is to start small and get things done by stealth.

There have been huge changes, I know, in the income tax system, with Earned Income Credit or 401Ks, where things started really small and seemed very insignificant at the time they started, and yet they've become very important. So, thinking of ways both in terms of domestic carbon tax and Bill's idea of clubs, where you started at a small scale and built out, is a very important way to look at the problem.

Leonardo Martinez Diaz

Thank you very much.

Global Harmonized Carbon Pricing: Looking Beyond Paris

Yale Center for the Study of Globalization, International Conference, May 27 and 28, 2015

Session Six:

The elements (term sheet) of an Additional Protocol

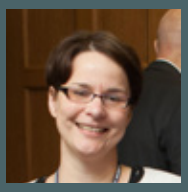
Presentations and Discussion

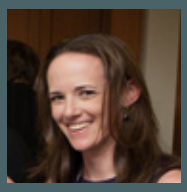
PARTICIPANTS

Silke Goldberg, Matthew McCullough, Kate Brown de Vejar, Scott Barrett

MODERATOR

Scott Shapiro





Session Six — The elements (term sheet) of an Additional Protocol

Even if a new protocol were universally agreed at the 21st session of the Conference of the Parties to the UNFCCC in Paris, in all likelihood it would not yield the necessary emission reductions commitments. If this were the case, one would want to consider the possibility that a group of key emitters could form a coalition to complement the Paris agreement with an "additional protocol" and commit to explicit carbon pricing. The purpose of our own conference would be that the presentations and debates will lead us to identify the issues along with the basis for their conceptualization and thus provide the elements necessary to draft a "term sheet" with a view to an Additional Protocol.

Presentations

Scott Shapiro

I'm Scott Shapiro, a teacher here at the Yale Law School. We saved the best for last, what everyone always waits for; legal drafting. We will be talking about what a term sheet might look like in case there was an opportunity for any additional protocol. I'm going to dispense any preliminary comments that I had, and we'll move directly to our first speaker, Silke Goldberg.

Silke Goldberg

First of all, let me start by thanking President Zedillo for inviting me here. As a lawyer, it has been a particular privilege to listen to such an erudite assembly of economists during the past two days. A lot of the discussions here were of course quite new to lawyers, so in my presentation I will try and pick up trends and issues that have emerged over last couple of days and translate them into legal issues and drafting with a view to giving you an initial glimpse of the issues that would need to be addressed in a term sheet for a treaty for a carbon floor price.

A lot of the discussions in this conference centered around what might be economically efficient. International agreements are always part of negotiations and part of politics, and, if I may quote Otto von Bismarck briefly, politics is the art of the possible.

In the art of what is possible in international climate change negotiations, the first issue that will need to be addressed is the parties to such a carbon floor price agreement. Then, the scope of that

agreement, and its institutional anchorage (ie, where it will sit from a contractual architecture perspective and which institution, if any, will act as the umbrella organization) will need to be covered. Next, the mechanics of setting the carbon price for which we have discussed a number of different methodologies at this conference will need to be considered. A key issue will be the body who will be in charge of setting it for the purposes of an international agreement and any international and national implementation and enforcement mechanisms to ensure compliance.

In a number of sessions of this conference, the question of the interface of an international carbon floor price agreement with existing international treaties out to be addressed has been discussed. An important part of this interface aspect will be dispute resolution as we cannot be certain that the relationship between the parties will be smooth-sailing all of the time. At some point there will be disputes, either within the "club" of states who are parties to the agreement or between those states who are party to the agreement and those that are not. Finally, this talk will also address necessary next steps on the road towards an international carbon floor price agreement.

In terms of the parties, a lot of discussion in this conference centered around voluntary participation of a small club. So, by necessity, the parties to the agreement will be a "club of the willing". There was a lot of focus on the necessity of having big emitters at the heart of this club and different approaches and methodologies of how states might be persuaded to join the club. A central argument in this regard is that if countries who emit 80% of the global emissions agree to join the club, then the

international success of the carbon floor price agreement is much more likely. On the flip side of that argument, there was some warning against having far too many smaller state parties involved as this might actually limit the negotiation success due to consensus issues.

From a legal perspective, it is interesting to examine whether there will or should be any criteria as to who will be allowed to join the "club". Some of these criteria might be linked to the methodologies of how carbon pricing is set, for instance, will jurisdictions with carbon tax be allowed to join (or indeed will this be the only criterion) — or will jurisdictions with a carbon floor price that is introduced and enforced by other means also be allowed to join the club? These issues will need to be addressed *ab initio* by the convening party or institution of the club.

A lot of attention has been spent on the problem of "free riding", ie, the risk that carbon-intensive industries will shift from jurisdictions with regulated industries to those with unregulated industries. It is most likely that this will be addressed in the agreement through wider participation: The more emitters, large emitters, participate, the less likely it is that "free riding" might be a major issue.

From a legal perspective, it may be desirable to start the club with a small pilot group of large emitters, and then have accession rules for other countries who might wish to join this club of the willing.

The status of this protocol has been debated on a couple of occasions in this conference. Some have argued it should be an additional protocol to the UNFCCC international climate agreement that is being negotiated in Paris.

However, from a legal and political perspective it might be easier to communicate this as a separate agreement that might later be adopted by the UNFCCC for procedural reasons in order to benefit from existing decision-making mechanisms in the existing international agreements.

Looking at the scope of the agreement, one of the first issues to be addressed is which greenhouse gasses might be covered by it. Internationally, most carbon tax regimes and most cap-and-trade regimes seem to focus on CO2.

There is a question whether greenhouse gases (GHGs) other than CO2 might be included such as methane for instance and Chlorofluorocarbons. It seems to be that there are convincing arguments in favor of starting with CO2 in that there seems to be a large consensus in terms of the measurement, reporting and verification (MRV) regimes that are already established.

When you discuss scope, by necessity, the agreement will need to include pricing issues, in particular the price-setting mechanism. How is the price established? Is the price ever reviewed? For how long will the carbon floor price be valid? Is it valid for a year? For two, five, or seven years? One of the experiences from the EU ETS has been that longer validity terms for a particular policy instrument bring more regulatory stability and will send the right investment signals, particularly if the policy regime has an in-built price review mechanism, without having to review all the other parameters.

There was a lot of discussion during this conference about a universal minimum price. The question is, in what currency might this agreement be expressed? For ease of reference, many expressed a preference for this price to be expressed in U.S. dollars. However, it is also possible that this price would be expressed in a basket of currencies of all participating nations. It is also not beyond the realm of possibilities that there might be regional minimum prices above the universal minimum price.

A number of presentations have highlighted the issue of sector differentiation. This is something that this term sheet would address, and this would need to be addressed as part of the scope, together with the price-setting mechanism.

One aspect of the discussion of the scope of the agreement is taxation. I think this was a theme that ran through a lot of the presentations at various points over the last couple of days. What sort of industries will be covered? Where will the emissions be taxed — at source, in the jurisdiction of the headquarters of the emitters or where the relevant products are being consumed? How will a taxation regime relate to the "polluter pays" principle?

I think another issue to be considered is also to what extent an international regime would feature any exemptions. For example, incentives for certain types of technologies in, for example, the New Entrants Reserve 300 (NER 300) in the European Union emission trading system, a policy instrument that facilitates the investment in particularly advanced technologies such as carbon capture and storage (CCS). Another question to be addressed in this context is to what extent are tax credits given for valid emission reductions achieved against a certain baseline by renewable energy technologies?

One of the central elements that emerged from various presentations at this conference has been a plea for simplicity of an international agreement, which might militate against a more sophisticated regime of exemptions. To make any draft of a term sheet acceptable at an international level, it is likely that some exemptions and some infra-marginal exemptions might need to be given, in particular, in relation to resource transfers.

My next point is the question of institutional anchorage. Which institution will host this agreement? Is it necessary to create a whole new institution and whole new organization, or can the agreement be concluded under the umbrella of an existing regime and its relevant institutions, such as the UNFCCC? In any event, it will be necessary to consider the decision-making mechanism. For example, will "the club" take decisions by consensus, or will there be majority voting in order to, for example, admit new members and agree new rules and carbon price-setting.

It might be possible to anchor and integrate the agreement with a number of existing global organizations and the relevant international agreements. The most logical approach might be to attach it to the UNFCCC, either as an additional protocol to the agreement to be adopted in Paris in December 2015 by the COP or, perhaps depending on the identity and number of "club members" as a separate agreement that adopts the decision making rules of the UNFCCC regime.

Anchoring the agreement with the UNFCCC does not preclude other organizations from playing a part in the carbon price regime. In an earlier session, it has already been suggested that perhaps the IMF should be given the job of monitoring and enforcing any taxes collected by the club, or the World Bank might also be of assistance, because these are both organizations with some experience in carbon pricing and trading.

Carbon price-setting will be the heart of the term sheet, and indeed the heart of the agreement. There are a number of policy considerations in relation to the actual price setting mechanism. Again, in this part of the presentation I have tried to pick up a number of arguments that have been voiced as part of this conference. Regardless of the policy goal that is ultimately adopted by the club, it will be necessary to formulate a very clear policy, and to have a clear and transparent price-setting mechanism, undertaken or advised by a committee composed of experts nominated from all participating nations, anchored at the relevant anchorage institution.

It will also be important to have a price review mechanism so that the price set by the relevant committee can withstand economic crises, be adjusted in function of economic cycles, and accommodate other changes to the regime. A number of presentations at this conference have explored the question of whether taxes or a cap and trade system would be appropriate for the "club" to implement a carbon floor price. In order to keep it simple and not to get lost in too much detail in a term sheet, it might be easier just to focus on an international minimum price for carbon, then the local or regional mechanism with which that is achieved might actually be secondary, at least from a legal perspective.

This might seem incredibly unorthodox to most economists, but from a political perspective, it may be easier and more palatable to a number of participating nations. It might be possible — from a political and legal perspective - to have regional taxes or national taxes that reflect the relevant carbon floor price, but established cap-and-trade regimes could exist alongside tax regimes so that for instance, in the European Union the EU ETS continues to exist (as this is quite likely anyway even post 2020) A carbon floor price could be integrated into and enforced by the EU ETS by a reserve price equal to the international carbon floor price in EU ETS auctions. Given the range of possibilities for policy and enforcement regimes with which an international carbon floor price could be achieved, it is important that the international agreement is a "light touch" agreement that provides scope for international guidelines and a differentiated regional implementation to increase the likelihood of acceptability internationally.

Another issue that it may be opportune to address in the term sheet is the question of where the revenue from the international carbon floor price goes. There have been many powerful arguments in a number of sessions that any revenue should remain in-country, either to address and abate other forms of taxes, and to be used in the relevant states as the relevant legislators see fit. However, it may also be politically opportune, in particular in the context of the discussion on resource transfers, that a certain percentage be used and allocated for carbon abatement projects in less developed countries, or even as funding for the Green Climate Fund.

This may be not a very palatable proposition to economists. At the same time, many countries have already committed to funding the Green Climate Fund to the tune of about $100 billion U.S. dollars per year. Therefore, such an allocation of the revenue raised by the carbon floor price might be a source of some of the money to fund this particular institution.

The implementation regime for the carbon floor price will also need to address the question of exemptions. There are a variety of mechanisms with which such exemptions could be achieved, some of which have already been discussed in this conference, such as a tax that might be higher in some sectors, or lower in some other sectors, as long as there is an average tax or price that is equal to the international minimum floor price.

It is important to note that the floor price functions as a minimum, not as a maximum, and the drafting of the term sheet should allow for this. The drafting of the term sheet will also need a robust enforcement mechanism, in particular, in relation to methodologies linked to monitoring, reporting, and verification. There are some lessons that can be drawn from especially the first phase of the EU ETS in relation to these issues in particular.

Whatever mechanism is chosen will need to be robust and easily enforceable. There are a number of issues in relation to the enforcement regime that my colleagues will address in the following presentations, such as, is enforcement possible through the WTO route; and will it be possible to enforce the international minimum for carbon price through a tariff-based penalty, or are there some other possibilities that might actually work much better?

It has already been mentioned on a number of occasions, that inconsistency at the international carbon floor price agreement might lead to inconsistencies and uncertainties with international trade law, and might actually throw into question some of the existing regimes. These issues pertaining to the interface of the carbon floor price agreement with existing treaties will be addressed in a lot more detail by Matt [McCullough].

Finally, the agreement will need to feature a dispute resolution mechanism that addresses in-club disputes, and ultimately, it is also likely that those outside the club might feel aggrieved by some of the policies implemented by the club, and there will need to be an appropriate forum for such disputes – Kate [Brown de Vejar] will address that in a lot more detail.

Now that we have addressed the structural framework for a term sheet and the various elements that will need to be considered, the question is — where do we go from here? Thank you very much.

Scott Shapiro

Okay, by the way, I warn you that discussions of legal drafting are not normally that interesting. Next up, Matt McCollough.

Matt McCullough

First of all, thank you, President Zedillo, and everyone, for allowing me to attend and — first and foremost, attend and hear some really thoughtful discussion on how to address this problem. There are a lot of solutions, there's some overlap, there's some disagreement, and somehow, I got put on the last panel to decide which one is best, in terms of a term sheet.

I come to this as a trade practitioner. I do WTO dispute settlement. My area of emphasis is subsidies law, but also other aspects of international trade remedy law, anti-dumping duties, and safeguards. So, I do have something to say about this, and I've heard a lot of discussion, and hopefully I can add a little bit to what's going on in terms of the international trade dynamics and the existing legal frameworks governing trade in goods. So, we have this panel, and the idea is we have a baseline protocol, and perhaps it's not going to get us to the carbon reduction level that we need, and so we're going to bring together a club of key emitters to do a protocol-plus arrangement among them.

I started out thinking that a carbon tax seemed to be the preferred method, but then there was a lot pushback today, and obviously there was a lot of good discussion, but I guess I'm going to approach this from, if you're talking about price, I'm going to look at this as a carbon tax issue, and part of that is the simplicity in its application, and how you might make it work in relation to existing trade disciplines.

So, what would a protocol look like? First of all, the idea of carbon taxes under existing international trade law, and how you might apply border measures, I'm not bringing a whole lot of new intellectual property to that question. It's been studied a fair amount. Gabrielle [Marceau] covered a lot of the important issues you have to consider. Others have written about it. I believe Jennifer Hillman wrote a paper back in 2013 that outlined some of the issues, and I think there's been, actually, some very good work on top of that paper in terms of challenging some of Jennifer's solutions, but also probing the problems a little more deeply, and looking at other potential solutions.

What I'd like to do is take it to the next level and assume, okay, we're going to go down this path. We're going to have a carbon tax, we're going to have a border adjustment, and let's play this scenario out. Let's see what happens when you do that, or what could happen. If you have a carbon tax — and, this was addressed, and so I'm overlapping here again — you've got three principal problems that you need to deal with. First, you have a club that's going to do this, you have to worry about a level playing field and how best to preserve the competitiveness of industries subject to the pricing regime.

The second issue is leakage avoidance and how best to discourage industries from moving offshore to jurisdictions where such pricing regimes do not exist.

And then, third, there is the free rider problem, and how to discipline unwilling participants.

I think the consensus solution — and, I put a question mark there, because we can talk about it — is a border tax adjustment, or the alternative is some kind of penalty tax to compel, or to entice, or to discipline parties, or to bring them to the table and become part of the club. So, immediately, when you start talking about border measures of any kind on products, there is an intersection with existing international trade rules. In fact, it's unavoidable; you cannot avoid it.

You have a WTO, you have numerous signatories, and they're not all going to be signing on to the club. Yet, they still have rights, and they can assert those rights against things the club might do. Any agreement the club might have, in terms of how they will manage their arrangement, isn't going to eliminate those rights. So, you have to have a plan, and you have to think out, well, how am I going to approach the term sheet? How am I going to structure this so I can comply with broader WTO rules, yet have some kind of effective progress toward carbon reduction?

So, there's different ways to do this. You could try to write around the WTO disciplines. I don't think that's going to happen within the timeframe that you would like in order to get something done on carbon reduction on a timely basis. Because, you can't negotiate it within the club, you would actually have to bring all the parties together, and those are the same parties that you couldn't convince to be in the club to begin with.

So, I do think that given the sense of urgency and the need to move forward, you're going to have to find a way to work within the disciplines that are in place, and the legal mechanisms that are in place.

So, what are those existing disciplines and mechanisms, and how might you make it work with respect to border adjustment? Well, you have GATT Article III.2 and then you have the exceptions that are permitted under Article XX, with respect to exhaustible resources, and with respect to protecting animal, plant, and human health. I think, as others have said, there is a fair consensus that a border adjustment tax is workable under the WTO and the existing disciplines.

And, I heard — Bill [Nordhaus], you said it earlier today, and it's entirely true — there is no clear guidance on this. This has not been tested head-on at the WTO, what would fly and what wouldn't fly, but I think there is some jurisprudence to rely upon that gives you relatively good support one way or another. I was sharing some thoughts with Gabrielle [Marceau] earlier about whether you could fit a border adjustment within Article III.2, in terms of a carbon footprint tax, and whether that's really a tax on the product, or you're looking at processes, there may be a couple of different ways around that using corollaries in some of the jurisprudence.

One approach would be to treat these as like products, and focus on some physical aspect of the product that you taxed. The other approach would be to treat them as unlike products. Yes, you know, one shoe on one side of the border, and one shoe on the other. But, focused on not the traditional commercial considerations that go into the like product analysis of the WTO, but go into some less-traditional factors such as consumer perceptions about toxicity, or human health, and how that affects commercial decisions. And, there are corollaries on that.

So, let's go and have a border measure, and it's put in place. You are going to have actors outside the club that have rights under the WTO, and I think, without question, you're going to get one or more of them to challenge the border measure through WTO dispute settlement.

But, I still believe if you craft it well, the measure would survive. You know, even if there are some concerns, or if it's a coin toss, through experience, I do know that, in particular, the secretariat and the appellate body, the WTO is still a political animal, and they do read the political winds. I feel if you brought a club together of enough key emitters, and it's an important enough issue, you will have the appellate body checking the wind. If it's a close call, they will steer and find a way.

What you would want to do is, you would craft a measure that would allow you to make arguments under both Article III.2 and Article XX to give you the best chance before dispute settlement at the WTO, to give the appellate body the most options possible to find the solution.

The thing I like about Article 3 is, atmospherically, it leads to, in some sense, the most equitable result, which is the charges that you are applying to your domestic producers are the same charges you're going to be applying to the imports, because that's part of the mandate under Article 3. So, from an equitable point of view, it's more compelling. It raises other issues, of course, and we can talk about that in Q&A.

I'm approaching this from a carbon tax — I'm not sure what's going to happen if we're still dealing with different regimes and different price-setting mechanisms in different countries, because you need the simplicity of a carbon tax to implement this efficiently. If you're dealing with other price-setting mechanisms like cap and trade in another country, that's not an indirect tax. That's not a tax that could be remitted at the border of the country that's exporting.

Then, you get into the question, well, then, they need some credit for that, as part of the border tax adjustment coming into your country. That gets into equivalency, and who's going to measure what is the same, and you're going to get more litigation, most likely from outside the club about what the proper border adjustment should be, and whether there's MFN violations.

So, honestly, I think, to keep it simple, to avoid as much litigation risk as possible from a WTO context, if there was a way to do it, I think a tax, a uniform tax in every country, would be the best way to do it. Whether that's feasible, I don't know. But, as a legal solution, it works the best. The penalty tariff discussion, that's going to put you into Article XX because you're not really connecting it, it's not equivalent, it's not connected directly to what you're trying to address.

I think it would be a hard time justifying that before the appellate body which is why I would try to draft something that can meet all of these, or that you could make arguments under all. If you went into Article XX, I would still seek to have some kind of equivalence in terms of the charge, and have it more directly related to the objective of carbon reduction. You can try to shoehorn a penalty tax in such a way as to entice or to bring people to the table to induce behavior, but it's a bigger stretch of the WTO to make that work.

Beyond the border measure issue, another issue that was mentioned was subsidies. You have all this revenue you're generating from these mechanisms; what are you going to do with it? There's a lot of discussion of targeting the development of industries, and technology, and granting tax credits or exemptions. Well, you are going to have actors outside the club with their rights under the Subsidies and Countervailing Measures (SCM) agreement who will have the ability to go after that.

And, it would be an interesting dynamic, because if you're talking about products that are benefitting that are being exported, those actors outside the club could get their own nation authorities to go investigate, and impose countervailing duties against you. Not very palatable, based on my own experience litigating before the Department of Commerce. It's a very political and biased exercise, and you can imagine the kind of retribution that might be exerted on very unhappy actors outside the club.

So, obviously, you would want to go into this, structure a term sheet in a way to eliminate as much risk of the WTO challenge as possible.

Then there is the nuclear option — one other option is for this club to say, you know what? If you find these measures not in compliance, fine, I'm still not going to comply. Go ahead, Ecuador, if you want to retaliate, be my guest.

And, it's not unprecedented; it's rare, but what you see is, when you get into asymmetrical situations where you have a little country that needs your markets, and also needs your goods, they don't have a whole lot of leverage to get you to comply, and there's not a whole lot of interest in trying to retaliate against you by withdrawing concessions they've given you. And, the cost is minimal to a country like the U.S., when you're dealing with smaller players. Now, that will grow, depending on how many outside actors are involved. But, it is a solution. The downside, of course, is you really undermine faith in the global trading system, and it may blow up if you go that route.

I've talked a little bit about compliance from outside. Some of these same rights that you can exert under the WTO could be exerted by club members against each other. For example, if someone's not collecting the tax they needed to be within the club, you could go to the WTO, or you could use measures, if you're dealing with exports, the national authorities imposing countervailing duties.

Again, I don't know if club members would want that. They certainly could negotiate a deal where they wouldn't do that. WTO's dispute settlement, in this context, I don't think works. I think you would want something more effective. WTO enforcement and compliance is relatively soft. It's only prospective; there's no prospect for damages. It can take a long time, and in some instances, depending on the novelty of the issue, there may not be competency to address particular problems. So, you would probably want to look at a different enforcement mechanism. And, on that, that's, I think, my segue to Kate [Brown de Vejar], who may address some of that. Thank you.

Scott Shapiro

Thank you very much. Kate Brown is up next.

Kate Brown de Vejar

My discussion proceeds on the basis that the instrument we are developing consists of two key measures. One is a uniform price for carbon implemented by states (members of our "club" of states), by enacting some form of domestic carbon tax which, as we have heard, may form part of a broader collection of tax measures. The second element is a border measure, whether a simple ad valorum tax on all imports from non-club states, or some sort of more-targeted carbon adjustment applied at the border. In either case, we're talking about a tariff applicable to goods imported from non-club states.

In this scenario, there are two particular areas where a dispute resolution mechanism is important. The first category, which has already received some attention during this conference, relates to disputes between a state that is a club member on the one hand, and a non-club state on the other. The second category is disputes among states who are all club members.

Looking at the first category, we have discussed the potential for disputes between states which are club members and which have implemented these measures, and non-club states which are members of the WTO and which claim that the measures in question violate the WTO agreements. Still within this first category, one area which has not yet received attention in this forum is the potential for

disputes between state club members and their non-club, bilateral, or multi-lateral trade partners. There is obviously a wide area of overlap here (many of those trade partners will also be WTO members). But importantly, these bilateral, or multi-lateral arrangements, whether they're free trade agreements (FTAs) or bilateral investment treaties (BITs) or multi-lateral investment treaties (the Energy Charter Treaty comes to mind), contain guarantees that are different from WTO obligations. They contain national treatment obligations, most-favored nation obligations, non-discrimination obligations, no expropriation without compensation obligations, and under the Energy Charter treaty, a transit obligation. Claims of this type may be brought state-to-state. Many of these instruments contain state-to-state dispute resolution mechanisms. But importantly, many also provide for claims by the investors of these states directly against the host state (the club member which has enacted the measures). Now, that's another whole category of potential claimants, over which the state parties to the BIT or FTA have no control. They don't decide whether those claims get brought or not. The corporate actor, the investor, does.

If you think that measures adopted by club members in good faith to combat climate change would be unlikely to form the basis of a legitimate claim by an investor from a non-club state that the measures constitute a breach of international law, at the end of the day, you might be right, but that may not be the primary consideration. Why? Because investors will bring those claims in any case, and they'll bring them for a multitude of reasons. They'll obviously bring them if they think they've got a chance of achieving some form of awarded damages, but investors may also bring claims under a BIT for tactical reasons unrelated to the ultimate success of the case. For example, recently, Philip Morris brought a claim against the Australian government on the basis of its decision to adopt "plain packaging" tobacco legislation. That regulatory measure was challenged on the basis of guarantees found in the Hong Kong-Australia bilateral investment treaty. Most people's instinctive reaction when they hear about the claim is that that it should fail because the measure in question is clearly within the sphere of legitimate regulatory powers of the state, in an area of public interest — human health. However, the cynical strategist in me says that that's not really the point. Philip Morris has brought similar claims against Norway under European legislation, and against Uruguay. It's doing this, in my view, not necessarily because it believes it will ultimately win, but because there's pending legislation,

similar to Australia's plain packaging legislation, before the UK Parliament and in other jurisdictions. The objective may well be to cause those jurisdictions to think twice, and perhaps to delay the enactment of this legislation pending the outcome of the claims against Australia and Uruguay. Meanwhile Australia and Uruguay have had to bear the expense of defending these claims — something other states would no doubt like to avoid.

Thus, irrespective of the ultimate success of its claim, simply by bringing the claim, an investor may achieve some other purpose, including postponing the enactment of similar legislation by other states. A similar litigation strategy could be applied to the enactment of carbon taxes and border adjustments by states, even though the bona fide objective of such measures is to combat climate change.

So the question is, what can we do about the fact that a carbon tax and border tariff combo (whether the border tariff is a uniform tax on all products from a non-club state, or whether it's a carbon adjustment at the border) may attract these types of claims by investors? The answer is: very little. The network of FTAs, BITs and multi-lateral investment treaties exists. And, as was mentioned earlier in relation to the WTO agreements, whatever the states who are members of the club decide to do at the state-to-state level will not change the content of those treaties unless all the same states are involved and they negotiate what is effectively an amendment to their existing treaty obligations.

If you think that it might be difficult to negotiate an amendment to the existing WTO agreements to provide for some sort of "green" carve out, then it is absolutely the other side of impossible that you would be able to amend the 3,000 odd bilateral and multi-lateral investment treaties that are out there. So, the chance of achieving some form of blanket exemption for climate-change related measures in relation to these trade and investment instruments is just about zero.

I think it is important to mention here that these kinds of green carve-outs (and not just green carve-outs, but also carve-outs in relation to measures adopted by the state for health reasons or for reasons of cultural preservation) are starting to be included in treaties which are being negotiated now, and which will apply going forwards. But, you have a body of approximately 3,000 international instruments that are already in existence that don't have those carve-outs. So, in respect of these instruments and these obligations, I echo what our speakers on potential WTO claims have said. The only thing we can do is think about how we craft this carbon tax and border measure package so that it is least likely to give rise to meritorious claims that the measures are in violation of existing international treaty obligations.

Now, all of what I have discussed so far relates to disputes between a state which is a club member and has enacted the carbon tax and border tariff measures on the one hand, and a state which is not a club member or investors from the non-club state on the other. A second area where a dispute resolution mechanism is going to be important in relation to this instrument is in respect of disputes among club members regarding the interpretation and implementation of the obligations that are contained within the instrument.

Here, I would like to recall Bill Nordhaus's challenge: how do we incentivize states to agree to this initiative? And, I posit (and I believe that this was one of the outcomes of the game theory presented by Bill) that one element of incentivizing states to sign onto an initiative of this type is that they have to be satisfied that the obligations contained in this instrument are going to be enforceable against other club members, and that there are going to be consequences for non-compliance.

So, what might this kind of dispute resolution mechanism or enforcement mechanism look like? First, I want to make clear that I am not talking about ongoing reporting or monitoring. That's obviously a very important element of an initiative of this sort, but the dispute resolution mechanism I'm considering kicks in at a point beyond regular monitoring and reporting. Rather, at this point, a dispute among club members already exists. That dispute might be a claim by one club member that another club member is not fulfilling its obligation to collect the carbon tax, or that it is somehow undermining the club members' agreement through subsidies, or by remitting the carbon tax in another form which is inconsistent with the objectives of the agreement. It may simply be a matter of interpretation of the agreement, or it may be that during a periodic review of the agreed carbon price, the club members cannot agree, or the club members' relationship may be affected by some form of external event (a global economic crisis, an oil shock … the dissolution of the European Union). You need to have a mechanism in place for that to be dealt with by somebody. So, what should that internal club member versus club member dispute resolution mechanism look like?

There is a whole range of options and we can draw upon a wealth of treaties and other international agreements which use a variety of mechanisms. Frequently, we see some combination of mediation, non-binding conciliation, with acceleration to binding arbitration. You can refer the dispute to existing external bodies (the International Court of Justice (ICJ), the Permanent Court of Arbitration), or provide for a new ad hoc body to hear the dispute. There is a plethora of options and this is not the time or the place to provide a blow-by-blow discussion of the advantages and disadvantages of each. One important consideration is that the types of disputes we're talking about may well involve more than two club members, so you're going to have to have capacity for multi-party dispute settlement. Even if the dispute itself is just between two club members, it is likely that the other club members are going to have an interest in the outcome of the dispute, and you're going to have to have some way for them to participate or provide observations in relation to the dispute.

A model that is worth looking at is the one which was adopted in relation to the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, entered into under the auspices of the Vienna Convention for the Protection of the Ozone Layer. The Vienna Convention contains an escalating dispute resolution provision, which states that the parties to a dispute shall first negotiate. They may then jointly request that a third party act as an intermediary or mediator. This is followed by either binding ad hoc arbitration or referral of the dispute to the ICJ. A party may also request the formation of a conciliation commission.

This escalating dispute resolution procedure exists side-by-side with the Montreal Protocol's own non-compliance procedure. According to this procedure, a party which has reservations regarding another party's implementation of its obligations under the Protocol may address its concerns in writing to the Protocol Secretariat. There is a procedure for notification and reply, then a period of information gathering, reporting, and determining what may be done to encourage compliance. Ultimately, non-compliance may result in the provision of additional assistance, issuance of cautions, or suspension of specific rights and privileges under the Protocol. As I said, it's a model which could be interesting in the context of the type of instrument we are considering here.

I conclude by reiterating that whatever form of dispute resolution mechanism we choose for disputes among club members, it must result in robust, transparent dispute resolution by decision makers with the requisite expertise. There must be adequate provision for fact-finding, and it must result in a decision that is binding and enforceable. Ernesto, the International Bar Association's Arbitration Committee would be privileged to continue to work with the Yale Center for the Study of Globalization in the development of such a mechanism. Thank you.

Scott Shapiro

Scott Barrett.

Scott Barrett

I spent a sabbatical here some years ago with the Yale Center for the Study of Globalization, and Bill Nordhaus said to me, this must feel like your third home, and it does. And, that's thanks to you, Ernesto, and to Haynie. Haynie's not here right now, but I'd like to thank her as well. Both of you have always made me feel at home, and I appreciate that very much.

Now, for today's conference, you started off, Ernesto, with your introduction. You just repeated it, a kind of warning to me. So you think I'm going to be the skeptic and the difficult customer — the spoiler, as it were — and, you also put me at the very end of the conference, so I was trying to figure out what your thinking was. Was it that, by now most people would have left, and therefore I wouldn't have much to spoil, or was it that, having sat through the conference, maybe I would have been converted.

I've actually found the conference very enlightening; in fact, challenging. I've been spending a lot of time thinking. It amazes me that I've worked on this topic for so many years and I still cannot understand even some basic things. So, let me just try to share some thoughts I have about what I've been hearing at the conference.

Okay, a carbon tax. I think most economists start off thinking about a carbon tax in a first-best world, more or less. That's fairly rough language for what I want to say. But, the case for a carbon tax is extremely strong, as both Marty [Weitzman] and Bill [Nordhaus] have made clear. Jim [Stock] said that if we polled members of the American Economic Association, there would be strong support for this. I think this is absolutely clear, and also, I think it's very important and shouldn't be forgotten.

But, you also want to know would a carbon tax be the right way to go in the real world, and there I'm very open-minded. I see nothing particularly against it as compared with the alternatives. I guess the question I have is whether there's something particularly for it, but I'm open-minded about that. The real world, by the way, the thing that I think is absolutely central about this, is the simple fact that the world is decentralized, and you don't have one country that can adopt a tax or a particular policy on climate, but we have something like 197 of them. I think that is the central problem.

Now, Bill [Nordhaus] started off by saying that there are four different issues around climate, and the last two were particularly important and relevant for this meeting. The first being, is it easier to negotiate a P or Q, a price or a quantity? And, the second being, is it easier to enforce an agreement on price, as compared with an agreement on quantities. And, I agree, these are two central questions. And then, Marty [Weitzman] spent a lot of time addressing the first point, about which is easier to negotiate, a P or a Q, and I think he made the strongest case you can, that the carbon tax has the edge.

He also is very honest and clear about this, that he doesn't have a theorem that makes that point exactly. He can't pin it down, so he has a feeling, he has an instinct, he has a hunch, that the price has an advantage. And, I'm open-minded to that. I think my inclinations are the same, but I'm not 100% convinced that the price is necessarily better. By the way, I also don't think that the choice is only between a P or a Q. This has come up with a number of things that people have mentioned about the range of types of policies we can adopt to address climate change.

And, the issue about the second question that Bill [Nordhaus], especially, was addressing, was free riding, which I really do believe is the most important thing. Now, I spent a lot of time studying international cooperation on a range of issues, and I've come to the conclusion that the world is very bad at cooperation, and very good at coordination. And, by cooperation, I mean developing an agreement among parties. They all agree that they're better off if they adopt the agreement, but they can't enforce the agreement.

And, Bill is addressing that head-on. Coordination is a little different. Coordination would be, we're all better off if we do one thing rather than another, and given that we all do that one thing that makes

us all better off, all of us want to do it. You don't have any of the same tensions, everyone's kind of with you on that. At the global level, the world is very good at coordination. The one area that's different, by the way, may seem to be trade, but trade is special. Trade is not a public good; trade is bilateral. Bilateral means you have built-in opportunities for reciprocity.

But, for an issue like climate change, we don't have that. I think Bill referred to this as a distinction between internal and external punishment mechanisms, and I think that's an excellent point. Let's look backwards, briefly, where we've been. We had an agreement on quantities; it's called the Kyoto Protocol. So, there was an agreement; numbers were negotiated, they were agreed. But, that agreement couldn't be enforced. The reason for that is that the Kyoto Protocol framed the climate problem as requiring cooperation.

So, everyone was going to make a sacrifice, as it were, and everyone would be better off, that was the presumption behind Kyoto. But, there was no basis for enforcing the agreement externally, so when the United States decided not to ratify, there were no repercussions for the United States. When Canada had the choice of complying or withdrawing, it withdrew; again, with no repercussions.

So, that agreement was always going to fail for that particular reason. Where are we now? We're getting up to Paris. What's new about Paris? There are really two things, there are these INDCs, or intended nationally determined contributions, and they're coming in now. We're starting to see what they look like. They will be submitted. Why? Because they're intended. I don't know about you, but I intend to do all sorts of things. Pretty much every day I wake up with very good intentions. They're also nationally determined. So, countries are going to submit these, but will they amount to anything?

The thing that's really potentially new, I think, is the review process. This means that countries' pledges are going to be open to some kind of review. Although this hasn't been negotiated, there is a question about whether this review process might actually affect behavior. At a meeting at Columbia not long ago with the two co-chairs of the Paris meeting, I asked two questions.

One, do you agree with me that the one thing that's new about Paris, as you read the so-called Geneva Document right now, is the review process? And, number two, do you think it will make a difference? And, they didn't answer my first question, but they both answered the second question, and they both said no, it won't make a difference. So, I'm thinking, well this is interesting. Two co-chairs of a meeting believe that the one thing that's an innovation is not going to make a difference.

So, that's where we are. I'm actually more open-minded to it. David Victor and I had just a couple words about this. It's not usual that he and I would be the more optimistic people in the room, but he and I are actually a little bit open-minded about what might happen. I'm also hoping to do some experiments on this. But, most people are not expecting very much. I think the main concern is that, if people think that Paris is it, and all they do is focus on Paris, then that will be a major mistake. Please, let's not do that, again. We did that after Kyoto; a major mistake. We should be looking now to build on Paris, to negotiate additional protocols.

I actually have always felt that we need a lot of protocols. But, what's interesting is we are going to get another one, I'm pretty sure of that. I'll call it a protocol, but it's actually another amendment to the Montreal Protocol that Kate [Brown de Vejar] had just mentioned. This would control a chemical called hydro-fluorocarbons, which are one of the greenhouse gasses. But, they also are very similar to the CFCs in this basket of chemicals, and in fact, were developed as a substitute for the CFCs that were damaging to the ozone layer.

This agreement would be adopted, this will work; I'm absolutely convinced of that. Because, we know that Montreal has worked, and one thing about this that's different from the approach we've taken to climate, is that it addresses production and consumption, both of them. And, consumption is defined as production plus imports minus exports. So the obligations in Montreal were defined in terms of trade. Montreal also included financial transfers, and this is really important.

Marty [Weitzman] wasn't really looking at financial transfers. Bill, you're not really looking at financial transfers. You actually have them in the Montreal Protocol, but they're determined in very concrete terms, based on compensating developing countries for the extra costs of using the new chemical, as compared with the ones being used before. And, in terms of financing this, there is a focal point. The focal point is the United Nations' scale of assessments, which is how we fund the whole United Nations budget.

The UN has 193 members right now, and they agree every three years on how to fund the UN. Now, that's a small amount of money compared to what we're talking about with climate change, but nonetheless, they are able to reach agreement on that. And, the final aspect of this is that the Montreal Protocol, and an amendment under the Montreal Protocol incorporates a trade ban. It's not on everything, of course, but on the HFCs, products containing HFCs, and so on.

An amendment to Montreal is going to work because this agreement has the character of creating a coordination game. I don't have time to tell you the whole story about how it works, but what you get here is a situation in which the threat to restrict trade is credible and deters anyone from not participating. In the end, what happens is, trade is never restricted, everyone participates, and the agreement is fully implemented. Now, in the future, I think we need other agreements. Montreal is just one that it looks like we're going to get.

Myself, I've worked on how to devise coordination agreements. And, these are oriented around individual sectors and gasses. So, they're much more narrowly defined. And, although I think some of these would work, when you add them all up, I don't think they can do enough to deal with this problem. So, that's one reason I'm excited about Bill Nordhaus' work, because he's going at it in a very big, blunt, and bold way.

So, let's think about a carbon tax agreement. Now, we're talking about a cooperation agreement, okay? It's not going to be like a coordination game; it's different. And, I said the world's not good at

this, but let's start off by being rather limited in ambition, and suppose that we were negotiating a carbon tax like we're negotiating quantities, more or less, now, for Paris, for countries that are going to make their declarations of what they would agree to do. What would it look like?

Well, I think we'd see that the tax rates that individual countries declare would be different. They're not all going to be the same. The baselines that they're going to choose would also be different. What I mean is that the other policies countries adopt throughout their economy, would affect the efficacy of the carbon tax, and these other policies may vary. There will be exemptions. One important feature of the Swedish tax, like all the carbon taxes that I'm aware of, is that there are exemptions.

I also think it's possible that there'll be conditionalities. So, countries might agree to adopt a tax, and be willing to go higher, but only if other countries were joining in. That's capturing the collective action problem. Plus, the exemptions are capturing the trade leakage issue.

Now I want to introduce one piece of jargon, that's the Nash equilibrium. This is basically what the world would do absent an effective agreement to cooperate. And, I'm wondering whether we really have a grip on what this means. Focusing on taxes, different countries would have different tax rates. Bill has actually calculated the social cost of carbon for individual countries. So, imagine that you line them up, and you called the country with the highest social cost of carbon for itself number one, the country with the second-highest value number two, and so on, and so forth.

You know, that would be the Nash equilibrium for the game, although the rules of the game would be defined as not allowing trade between the countries, and limiting emissions. But, of course, country 1 would be willing to pay country 2 to abate a bit more, because they would be better off. If you take the numbers seriously, that's the implication of that. Country 2 would be willing to pay country 3, and so on, and so forth.

So, actually, I wonder whether there might be an opportunity for an agreement where you're basically ratcheting up the global carbon tax so that it's at the value of the social cost of carbon for country 1 everywhere. Now, here I think there's still going to be a bargaining problem, because there are going to have to be some financial transfers, so that's not trivial.

And, on top of that, I'm not 100% sure (I haven't done the modeling) about whether there would be a need for enforcement. And then, the real question is, can we achieve more than that? So, what most of us would want to achieve, and what Bill is basically aiming at in his paper, is the social cost of carbon for the world would be applied uniformly. I think that's the ultimate aim, Ernesto, for what you would like to see. That value is going to be bigger than the biggest single value for any individual country.

Now, there will be some question, and Kate asked about this before, about agreeing on what this number is. I think, yes, we don't know what the number is, but I don't see agreement on the number, necessarily, to be a big issue. There will be a bargaining around side payments. That will be big. Enforcement is going to be very big, and this is what Bill's paper is really about. What's interesting

about this, and Dick Cooper pointed this out, the mechanism that Bill's using for enforcement is really independent of the instrument that's used.

So, I don't see the tariff mechanism as making the case for a carbon tax; it could be used to enforce something else. And, I do have a concern. I don't know, but I do have a concern about how countries would react to the unilateral imposition of a tariff. Matt [McCullough] was talking about blowing up, I'm thinking of war. Okay, it's bit emotional, but if some countries feel that this was not a legitimate process that gave rise to this, they felt that they weren't getting the deal they wanted, I think there could be repercussions.

Whereas, under the Montreal Protocol, the trade restrictions were negotiated from the very beginning. Countries accepted them. In the bargain, they also have provisions for financial transfers.

Moreover, and as Santiago Rubio pointed out, with Bill's work, if we wanted to go for the full cooperative outcome, for a high social cost of carbon, it's not even obvious that this approach would work, which I find disappointing.

But, as I said earlier, this is the hardest collective action problem in history. We're not ready for it.

To conclude, is there a case for a global harmonized carbon tax? Well, from the perspective of first best, absolutely. And, actually, I think that's an important point; it's not a purely academic point. Is there a case for unilateral carbon taxes? Well, we already have some, and I think the answer to that is, obviously, yes.

But, there will be allowances for leakage, that's where, particularly, the exemptions are coming in, and there may pressure for a border tax adjustments, too. Is there a case for a multilateral agreement on a low value? Not necessarily the global social cost of carbon value — actually, that seems to me to be plausible. That might be something worth considering. Is there a case for a multilateral agreement at the very high level? I don't hear that, yet. I don't hear that, yet.

But, the one important thing, the last thing I want to say, is, what are the alternatives? We don't have any other good alternatives, so I would never be critical of the carbon tax. I don't see it as being remotely worse than anything else. It's better than many other categories. But, I don't see this instrument as changing, fundamentally, the ability of the world to bring about collective action on climate change. And with that, I conclude.

Discussion

Scott Shapiro

I'm going to ask the first question, since we're not constrained by anything in this room. I was curious, what if the Security Council were to bless the club? The Security Council has superpowers, and a good argument can be made that this implicates international peace and security. So, I mean, if you had the big emitters of the P5, perhaps that might work. That's a question.

Scott Barrett

Great question. I've thought of this. Dick Cooper said earlier that Bill's use of the trade restrictions could have applied to other issues, which is true, because, as he also pointed out, the trade restrictions are directly linked to the instruments that are used to address climate change. We're choosing the trade system, or he's choosing the trade system. And, it is alluring.

But, it's not the only one that we have, and the other one that would come to my mind would be the Security Council, and climate change has come up before the Security Council twice so far. So, if the world believes that this is — I wouldn't say existential, but if they believe this is of grave concern to peace and security worldwide, this is possible.

Now, then you have to ask, would the Permanent Five not only say this, but would they prescribe measures that they themselves, collectively, would be willing to enforce? And that, I think, again, that's asking quite a lot, but if it were a matter of peace and security, this would be binding on all states. So, if the P5 were willing to enforce this, this is conceivable. I actually think this is the right way to think about climate change; and if you're a consumer of drama like I am, I think it's the natural way to think about it.

Richard Cooper

Just a comment on this. I think you can't only have the P5 members. You need a much bigger club. Some in that group could vote against it. The P5 are necessary, but not sufficient.

Scott Shapiro

Right, you'd have to have a majority for this. Okay, Adele Morris?

Adele Morris

Well, thanks very much for this useful discussion. I think it's important to think about how such an

institution might evolve. A couple of thoughts; one, I don't know that we would start this way, in thinking about a new collective institution, because the U.S. couldn't be part of it until the U.S. domestic politics allow a discussion of a price on carbon, and when that happens, I think it'll be critical to have the U.S. in there as a key player.

In the meantime, if you want to have a conversation about pricing carbon, it's better to do it in a consultative process than with an explicit goal to be starting the negotiation around prices. I have a paper on how you might do that. But, eventually, it's critical that we evolve to this sort of framework. I want to give Marty a few talking points on why he's right.

Let me just start with the experience we've had in negotiating quantities. We know negotiating quantities, the effort is opaque, and we get BAU (business-as-usual) targets, we get hot air targets, we get all kinds of targets that really have zero or negative additionalities. When you're talking about prices, particularly if you're accounting for fiscal cushioning, that's additional. So, that seems to me like a critical point in the favor of prices. But, there are also a bunch of other advantages.

If you negotiate around prices, your effort is capped, and that gives reassurance to countries most worried about their economic growth. Also, a price-based agreement is more likely to be negotiated by finance ministers and trade ministers who actually know what they're talking about. Part of the reason our quantity-based negotiations have failed is because they're negotiated by environment ministers who really don't have any clue about the economic implications of the agreements they're trying to strike.

In my observation, having been part of this, we need to turn it into an economic negotiation. The way to do that is to change the framework and be talking about prices. The other advantage of prices is that enforcement, or the determination of compliance, is nearly contemporaneous. We can tell who's imposing what prices, and what revenue flows occur, whereas if you have quantity targets you have multi-year targets with cumulative emissions bounds, and then you have to wait until the emissions inventories are done, which typically takes two years after a five-year compliance period.

So, it might be seven years by the time you start, technically, the compliance period — before you've known whether anybody complied. I don't think you have that problem at all in price-based agreements. I also think price-based agreements directly mitigate concerns about trade, and as Carolyn has so eloquently said, that's a key point and a concern of the interlocutors, and if you're just talking about quantities, you get into these situations where everybody's squabbling over which base year they're going to use for the departures of their emissions relative to. And, everybody has different incentives on which base year to pick, because depending on which base year, you could take a bigger percentage reduction for the exact same emissions target. But everybody wants the optics of their target to look more stringent than somebody else's optics of their target, even for the exact same emissions quantities.

So, if you're just negotiating around prices, you get around this stupidity of the formulation of the emissions targets and base years. You just can't believe how much time is wasted on that kind of squabbling over formulas.

Just a few other thoughts. You said that the quantities were determined in Kyoto, but they actually weren't. What was determined in Kyoto were the targets against which compliance was going to be determined. But, the inventories that were going to be compared to those targets were never concluded, because you had to have an accounting system for land exchange and forestry, aforestation, reforestation, and deforestation, under Article 3.3, and additional activities under Article 3.4. Those talks collapsed in the fall of 2000 at The Hague.

So, we actually never got to the point where the quantities that would be compared to the targets, which I agree were concluded, that critical compliance emissions were never concluded, and then the U.S. withdrew before those negotiations were done. That just illustrates further the difficulty of the quantity-based target. So we have a proposal on how you could introduce pricing into the negotiations in our Asian and Pacific Policy Studies paper, and I'd be happy to share with anybody who's interested.

Scott Shapiro

I enjoyed that. David Victor.

David Victor

Very briefly, I guess you should look for lots of friendly clubs, and maybe the Security Council is one of them. I'm very skeptical of that. You've got the full membership of the Security Council, which is not organized in a way that aligns with your goal of getting important countries, at least initially, with minimum carbon prices. And then of the P5, you've got one, Russia, which is a pain in the ass, and is also once warming, to some degree. So, I think that's going to produce a volatile arrangement.

But, be that as it may, I was struck at all four of these presentations, especially the presentations from the lawyers, that there are all these moving parts. And, I want to make a comment which is more a bit of advice to Ernesto, and wherever you go with this, which is to figure out the parts that really matter the most, and articulate that as a core, and then articulate other elements, because I think it's going to be hard for a lot of people, especially with all the chaos leading up to Paris.

What you want in Paris is a door to be left open to this kind of stuff, and then you want people in Paris, when they realize the Paris agreement is going to produce, more or less, business as usual, you want them at the final day to be saying, in addition to all this business as usual, I'm doing this. It's a process, as opposed to an actual outcome, because you can't get the outcome between now and then.

You want a really clean core set of articulations about the minimum price, about equivalence — as I said in the earlier panel, I think equivalence issues are going to be very important for creating a large enough group where we can deal with the participation problem — about what internal enforcement

would look like, about where and how you could use trade for enforcement, with all of the issues of compatibility with the WTO/GATT standards.

To somehow excerpt from all the complicated legal stuff into a handful of things that really matter the most, I think it's going to be very, very important. Otherwise, people are going to have no idea what to actually do and say in that last week in Paris.

Scott Shapiro

Why don't we just go down the panel?

Scott Barrett

When I was explaining how the Security Council might be involved, obviously I'm not thinking they're going to do it next week. But if you think about this problem, the range of possibilities for what might happen in the future, and the inability of the system as it stands to do anything about the problem, something is going to give. Now, it wouldn't necessarily be that, it could be something else. But, I don't think it's inconceivable.

The Security Council has acted in other areas on, for example, securing nuclear materials, basically prescribing regulations for the whole world. I never followed up to see how much that's being enforced, but if the reason they did that was because the treaty system was failing, because the only countries that were going to be at risk were the ones that were not participating in the treaties — it's the classic problem.

So, I think it's conceivable, and I'm not thinking about the world as it is today, I'm thinking about a different kind of world where people see this as being a very large risk. Also, the responses may not be about reducing emissions in the kind of leisurely way we often think about it. Maybe emergency kinds of measures, like what you've written on, David, geo-engineering, or something like that.

Silke Goldberg

Let me start by saying that climate change is of a magnitude that is actually an existential threat to humankind. So, from that perspective, it might be politically proper to have it addressed at Security Council level.

However, and this is the proviso: in the Security Council, whether it's P5, P15, or any other sort of configuration, it's the same countries, the same participants who participate in the Kyoto Protocol, in the Paris negotiations, and who might participate in the additional protocol negotiations.

So, it is not necessarily set as a given, that just because this happens at the Security Council level, the outcome might be different. It might certainly help in giving these sort of negotiations a different impetus, and it might be a political signal, I'm just not sure that the outcome would necessarily be different.

The second point I wanted to make is in relation to the moving parts; I completely agree. What I tried to do in my presentation is to show what the moving parts might be in each of the various categories. I think it would be important to come to negotiations, discussions, whichever way you want to label it, with a core proposal, because whatever is the first iteration of a draft, it's not going to look anything like the final draft that might eventually be adopted. But, if you're clear about a core set of policies that you want to achieve, there is a higher chance of success of these goals being reflected in the ultimate agreement.

Scott Shapiro

Just to be clear on the issue of the Security Council--when I asked my question, I wasn't imagining that the Security Council would set the carbon price. The thought was that that there might be issues having to do with WTO compliance or something, and they might bless that. They might say, look, countervailing duties in this club, should be deemed presumptively valid, or something like that. That was the thought, just like when the Security Council, under Chapter 7, imposes sanctions, people don't worry about the WTO. So, that was the thought. Number two, about the lawyers scaring everyone — that's their job.

Silke Goldberg

A small thought on the business community: I was involved in a different project with a number of NGOs in Europe in relation to climate change liability. One of the questions raised in that project was the impact of a regime that governs liability for the effect of climate change. One of the things we found was that to the extent that there was a regulatory regime of any kind, whether that be price, whether that be quantity, as long as it was big enough and internationally enforceable, companies would embrace and welcome that regime and it would bring legal certainty and would lessen the possibility of lawsuits for non-compliance by, for instance, local NGOs.

Matthew McCullough

I think if you look at the G2 approach, which I think is good, you have to look back at the United States. We've talked a lot about sticks to bring people in, but there wasn't as much discussion of carrots to convince players to come in. And when I look at the U.S.-China bilateral relationship, there are various economic and political concessions I could see the U.S. making to try to bring China into that grouping.

One area that I live and breathe every day is the trade remedy area, and the kind of treatment that the United States gives China in terms of treating them as a non-market economy, some of the arbitrary trade rules that apply that have come up, that's worth something to China, both economically, but politically. You just can't tell China to come play ball with us, you have to think more creatively, to use some tools to bring them to the table. But if you could get the United States and China together, it would be important.

Scott Shapiro
Bill Nordhaus.

William Nordhaus
I predicted to myself that this would be a very sobering panel, and it was. I live in a family of lawyers, and I know whenever you ask a question, the answer is much more complicated than you ever could have imagined. And, I did not imagine.

I've been watching this for many years, and watching it evolve — the science, the economics, the politics. I take a rather longer view. I just assume that Paris is not going to do anything, and that we'll carry on a little bit longer. And, I ask myself, what would I like my students who I'm teaching now, when they get to where you are, what are the key things I would like them to know, or to have absorbed if they were here today.

One is, we didn't actually talk about the seriousness of climate change. We usually have at least one climatologist to frighten us and show us the latest things, but maybe we're beyond that; I think it's always useful to remind ourselves. When I give a talk, I always spend at least 15 minutes on the latest roundup of where we are. I think the roundup of where we are is that things are very serious. Maybe we're not yet in Marty Weitzman's far tails, but we're surely not on the benign tails.

The second thing, which I think has changed a lot over the last decade, is the importance of price. I think people who have not been working on this for a long time cannot remember what it was like 15 years ago when you would mention carbon price or carbon tax, and somebody would just stare at you as if you were speaking a foreign language. And, particularly in the environmental community, partly in response to what's happened with the SO2 program, but also as a result of the failure of the Kyoto Protocol, I think in a wide variety of communities it is widespread among people. Jim Hanson, for example, has been in favor of a carbon tax for many years, and he's one of the most pessimistic of the climatologists.

It is not surprising that economists particularly like it, because it came out of that discipline, but I think it's a very widespread view. Not just a carbon tax, but the role of prices; not just in abatement, but also inducing innovation. That's one of the lessons that I would like people to hear or, if we were to do a manifesto, to emphasize the importance of price. And, I won't say the failure of quantities, but let's say the lack of success.

And then, the third thing, which is maybe not so controversial, but which Scott has emphasized is the importance of what is called free riding, although that doesn't capture what really is at work here, which is that countries in any regime we have developed to date do not take the kinds of deep abatement measures that are necessary to really slow climate change.

You could call it free riding, you could call it ideology, you could call it obfuscation, bloviation. Whatever you call it, it's clear that no country, no region, is really taking these actions. I see it in the framework of game theory as free riding, but it's basically that you haven't gotten collective behavior to take the kinds of actions that are necessary. And that's one of the points that I want to emphasize.

I also want to emphasize that where we've come from 1929 to today is really astounding in terms of the trade regime. It's been a long slog, but there are now, for example, 80 lawyers at the WTO, up from six. This one is probably going to take a lot of lawyers as well, but it's also going to take a lot of time and negotiation, and getting people to change their mindset about what the issues are. The panel was really interesting in pointing out that this isn't going to be done overnight, that there are lots of issues along the way that we're going to have to resolve.

Scott Shapiro

Thomas Sterner.

Thomas Sterner

Thanks very much. Now I can make a comment and then have to run. I was thinking that at the end of two days we've gotten to the raw power core of things, and of course, nothing will work if the U.S. and China aren't on board. So, it becomes sort of androgynous. The Kyoto Protocol wasn't well designed, but another reason it didn't work was, of course, that the U.S. and China didn't join.

Now that we've gotten down to this G2 kind of thinking, I think it's very important to remember the poor world, as well. Even if the U.S. and China could enforce a lot on their own, it is very important to, for example, take India as a symbol. It's a billion and a half people, and with a level of poverty that is completely different from China. It's very important that somehow India is included in the negotiations.

Ernesto Zedillo

We are approaching the end of our conference. I would like to say a little bit of what I'm thinking will be next steps, at least for my Center. And of course this is subject to your consideration, opinion, and approval.

I think the time for having done this is right. I don't think we are being negative about Paris, but evidently there is a very robust consensus that we are not going to get anything really meaningful in Paris. And I don't know whether next steps that could produce something meaningful will be right after to Paris, or five years after Paris, or 10 years after Paris. I don't care. But, I think it is our intellectual and societal duty to start thinking ahead.

Quite frankly, I haven't heard anything in this meeting that has discouraged me from doing this. It is clear to me that if rather sooner than later the world doesn't start to deal seriously with this problem, then we are going to have very serious consequences, not in my lifetime, but in my grandchildren's lifetime.

I think there are two objectives. One is to make the intellectual statement that we get together to look for alternatives — alternatives to a process which has failed dramatically, and whose failure will be reiterated in December— and on that we are being good citizens of the world.

And, second, who knows? If we start to socialize this, we may get some adherence from people who might sympathize and start talking about it. I was mentioning an anecdote about my fellow Elders, the group that was established by Nelson Mandela, who was the first Chairman, and then Desmond Tutu was the second Chairman. We have people like Mary Robinson and Gro Harlem Brundtland, Kofi Annan and so on, and so forth, none of whom really cares or knows about the technical matters of this, and who were very much on the Kyoto approach. I tried to explain about this using arguments that I have heard from others, and I ended up convincing them that what we have been doing is wrong, and that as a group with some influence, we should go out and say the world has to negotiate a harmonized carbon price.

The more arguments I have, and ideally the work that our friends from the International Bar Association give us, then I think we have — every one of us — a better chance to socialize this. In my view, as compared with other endeavors of a similar nature, in this meeting we have been more interdisciplinary than in other discussions, and I think that's great news. I have heard the hard economic arguments; I have heard the political economy arguments -- which typically tend to be very negative because seemingly people don't trust political systems to produce the right solutions, nowadays; and I have heard legal arguments. There is, in my view, enormous value added in the exercise that we have undertaken. As I mentioned, David Rivkin, President of the International Bar Association, unfortunately could not make it here, but he is fully behind this exercise. So, I am glad that he had these three fantastic representatives. It was so stimulating to see you digesting and then processing a lot of the things that were said here.

Having said that, I only need to tell you, again, thank you very much for coming here, and you will continue hearing from us. We don't give up, okay? Thank you.