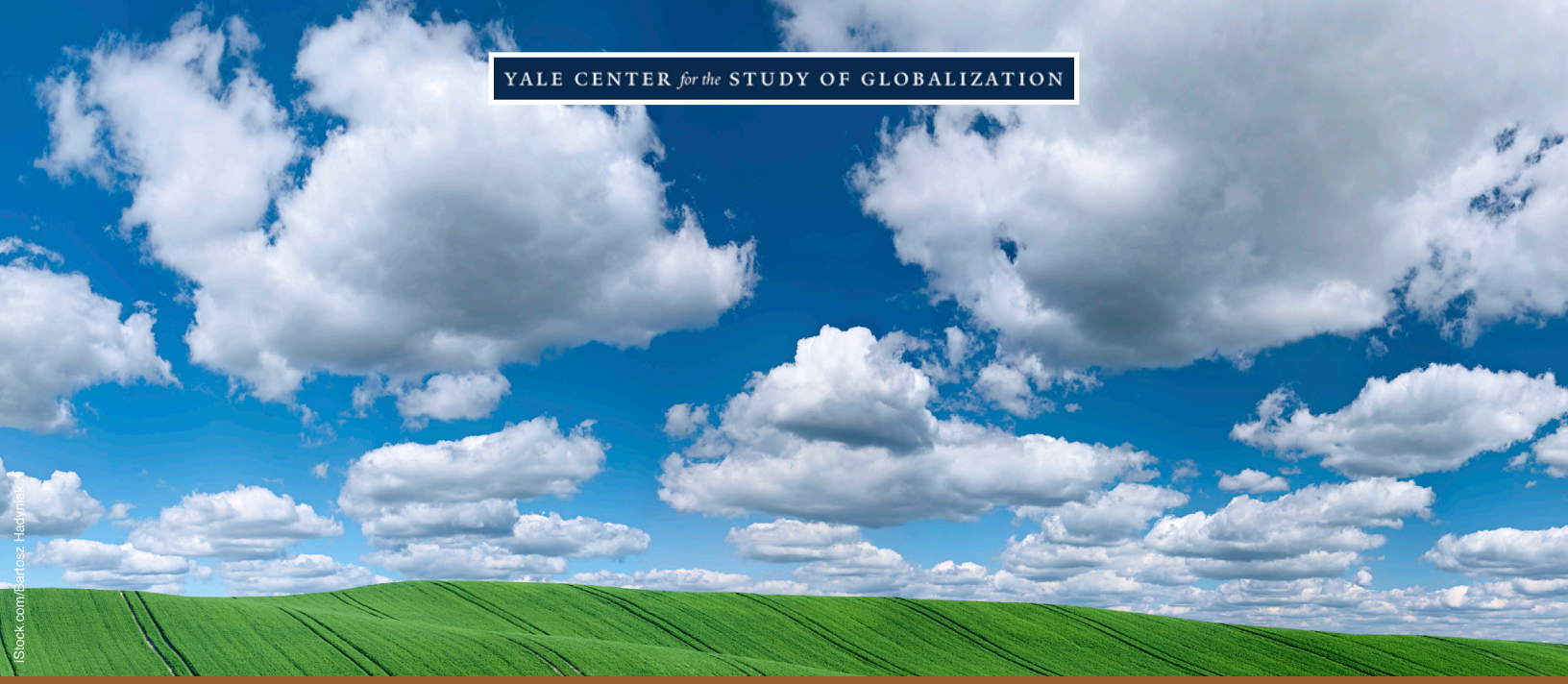


iStock.com/Bartosz Hadyniak

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.

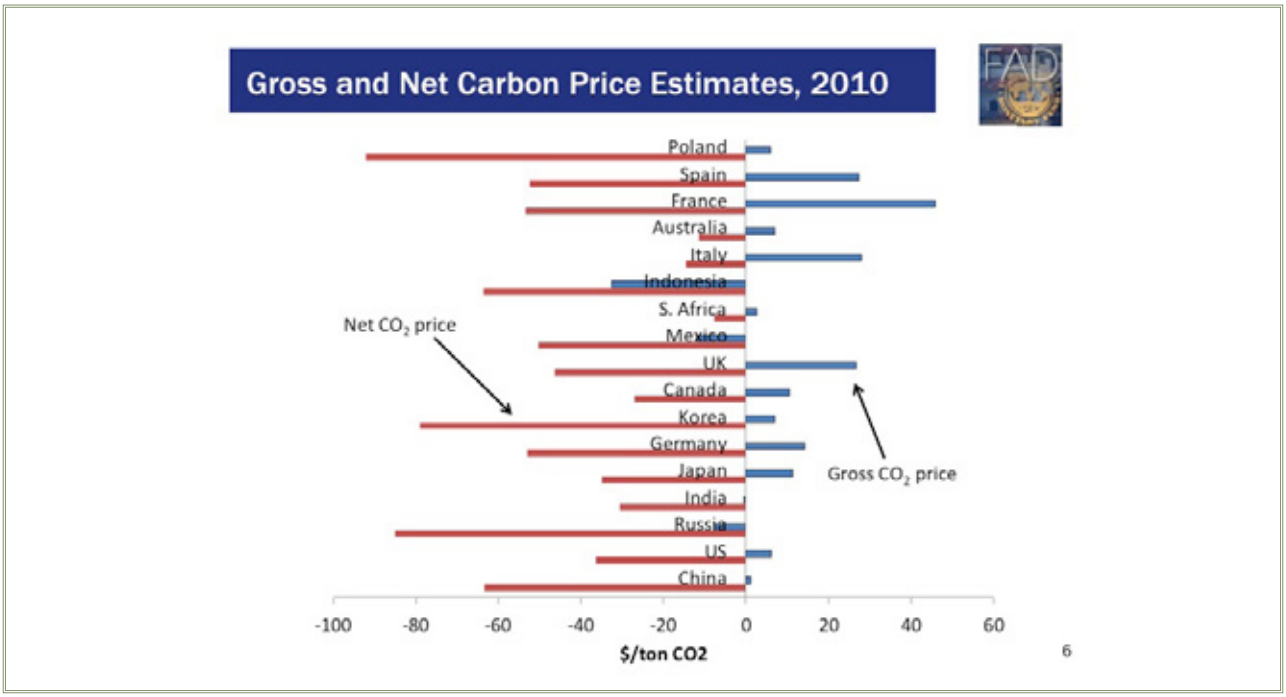
Maybe we differ a bit on this, but in my own view the agreement should just focus on fiscal or pricing instruments. I agree with Adele [Morris] that incorporating implicit CO2 prices from a regulatory instrument, such as standards for energy efficiency or renewables, would be practical and manageable 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

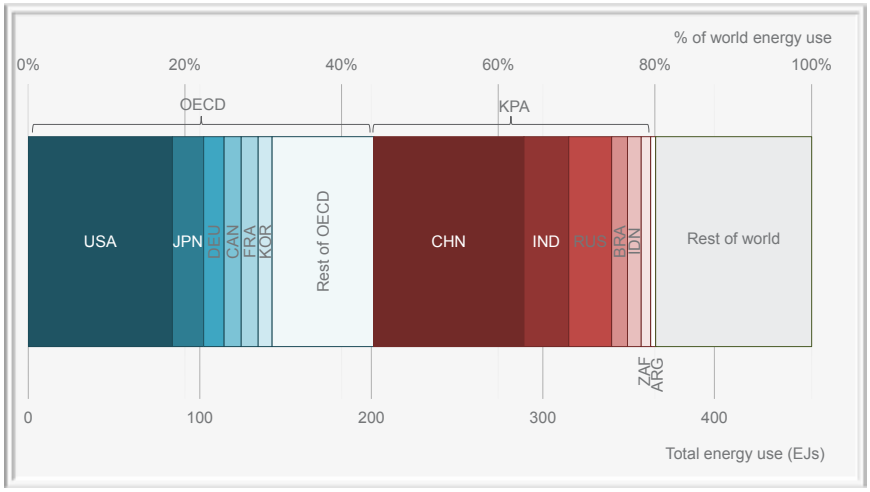
3. OECD, 2015, *Aligning Policies for a Low-carbon Economy*, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/9789264233294-en

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

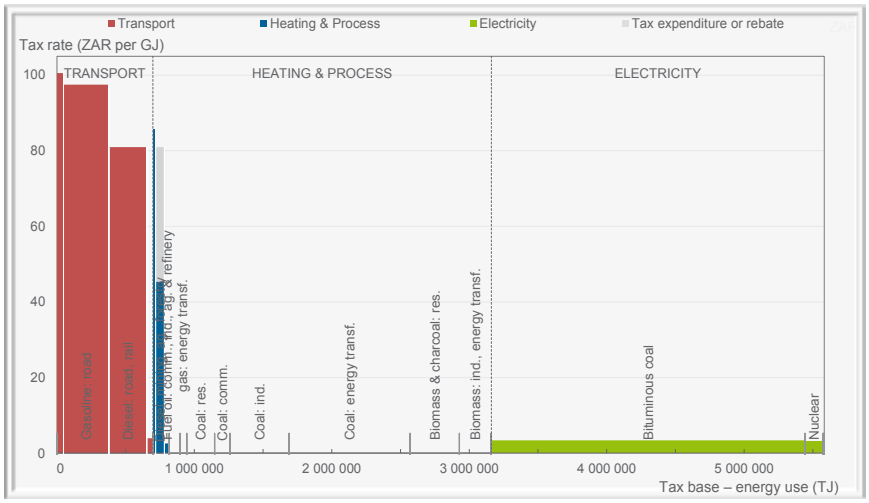


Source: OECD, 2015, Taxing Energy Use 2015 – OECD and Selected Partner Economies, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/9789264232334-en

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



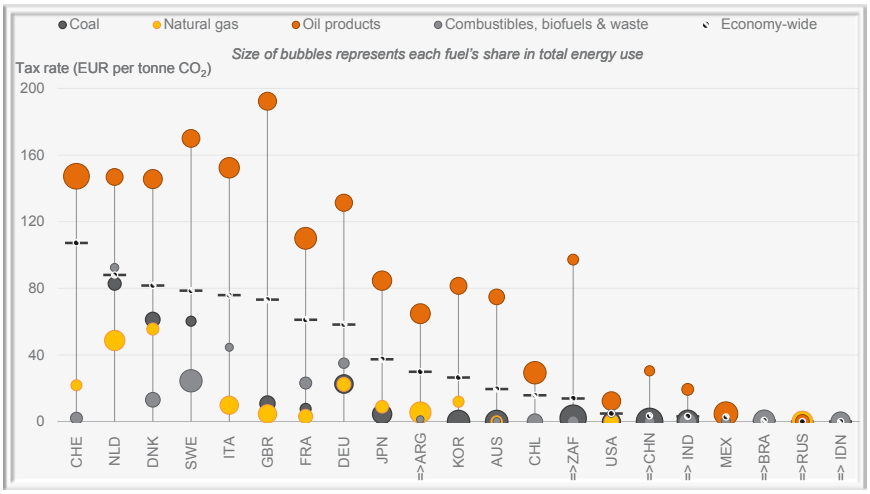
Source: OECD, 2015, Taxing Energy Use 2015 – OECD and Selected Partner Economies, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/9789264232334-en

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.

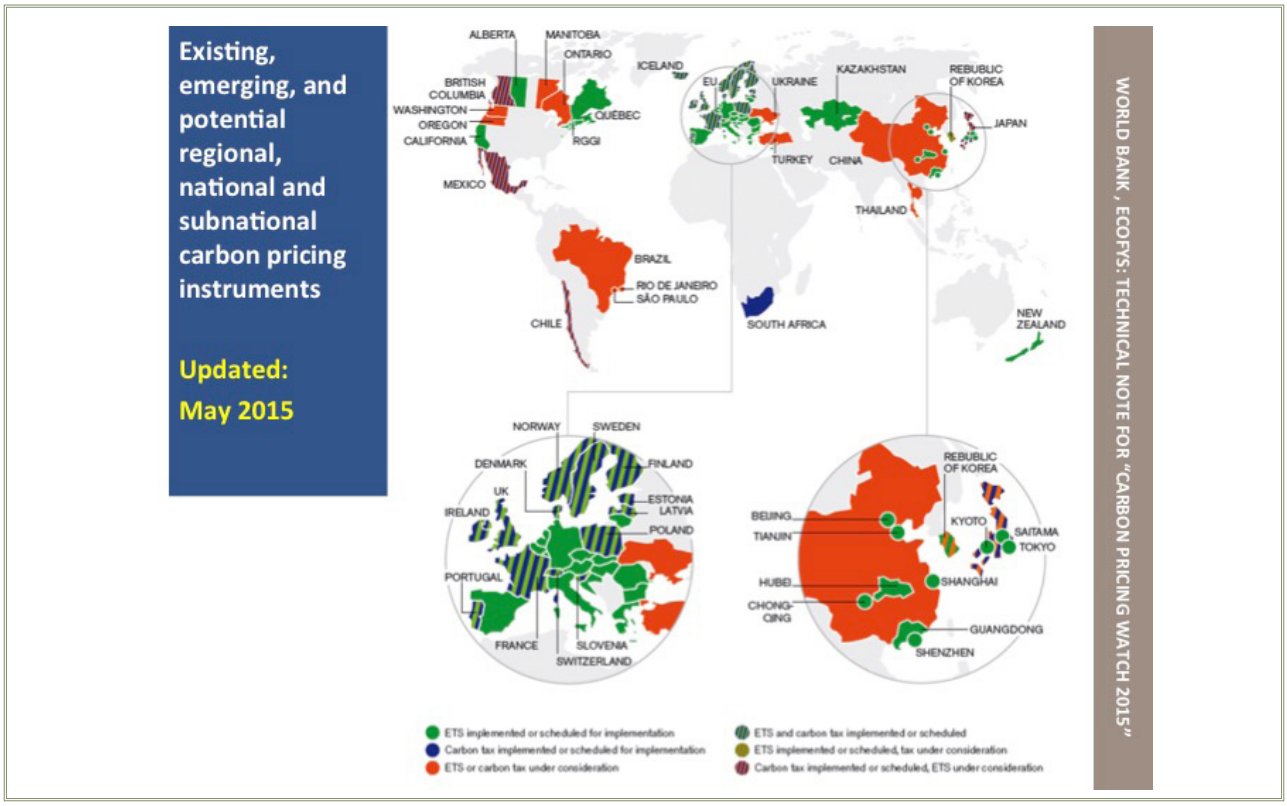
Grzegorz Peszko

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.

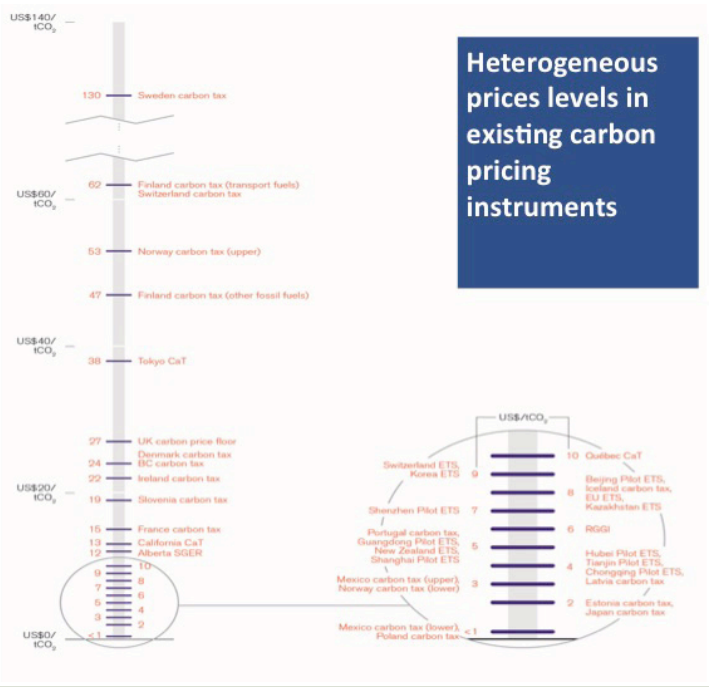


The countries in green are those that have implemented or are scheduled already for implementation: so, where there's a legal decision to implement cap and trade systems. The blue countries are those who either already have or are planning to have a carbon tax. And the red are those countries that are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