

Global Harmonized Carbon Pricing: Looking Beyond Paris

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

Session Two:

# The national interest argument for pricing carbon

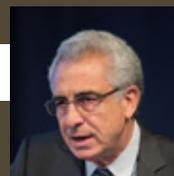
Presentations and Discussion

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MODERATOR

Ernesto Zedillo



## Session Two — The national interest argument for pricing carbon

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

### Presentations

#### **Ernesto Zedillo**

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

#### **Dale Jorgenson**

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

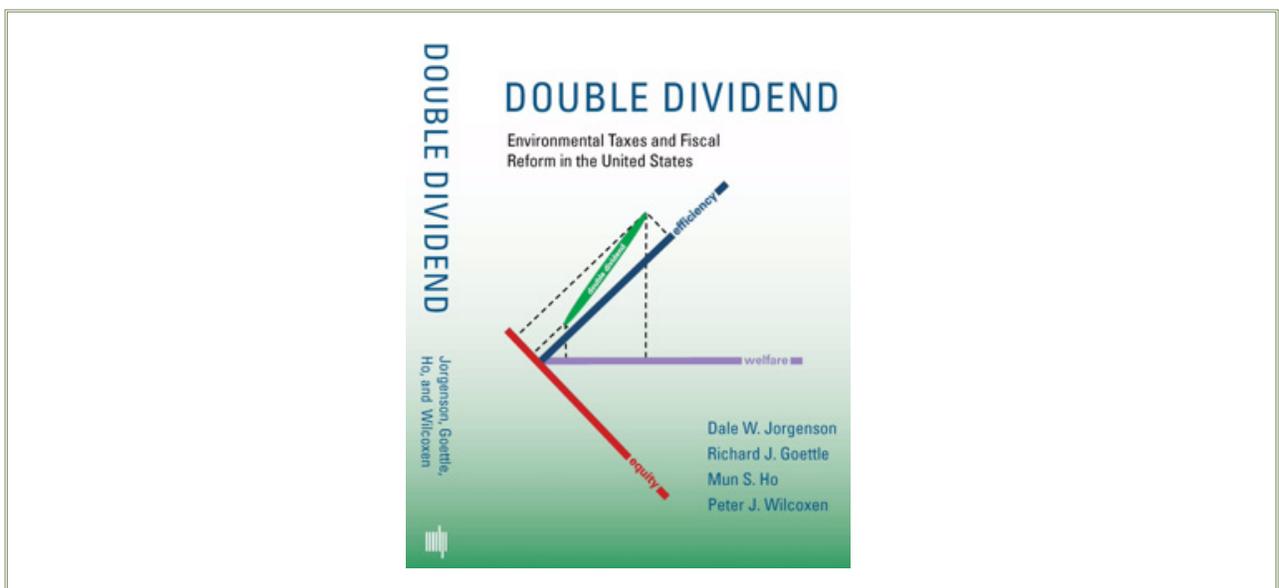
Now we have to confront the point that Marty raised, which is what is the consequence of considering the revenue that is raised? And obeying the rule that he proposed, which is that each country would dispose of the revenue itself. That's an alternative to some kind of system of transfers, which

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

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

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

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



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

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

But none of them meet the requisite that they include not only a discussion of environmental taxes, but also the entire fiscal system, along with a whole economy. And in this case, we have developed a model of the U.S. that essentially projects future economic growth over the indefinite history



going forward and does that with a multiplicity of consumers, and a multiplicity of producers which is necessary to capture the effects of the taxes. But all of this is linked by a price system that is incorporating the entire tax structure at the state and local, as well as the federal level in the U.S. So you can imagine what would be involved in constructing models like that for individual countries. But that is obviously what's going to be required to implement an idea like this.

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

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

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

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

### SOCIAL WELFARE

**Social Welfare Function:**

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

**Utilitarian Case:**

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

**Egalitarian Case:**

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

**where:**

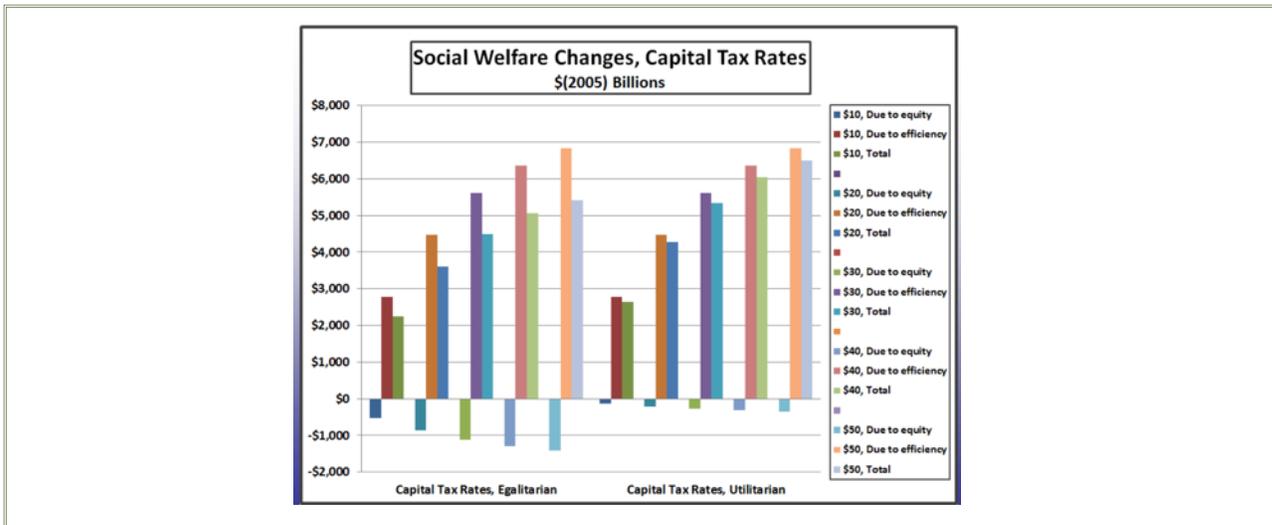
$$m_0(p, A_j) = \min_k m_0(p, A_k), \quad (k = 1, 2, \dots, K).$$

**Social Expenditure Function:**

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

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

So here is an example of double dividend.



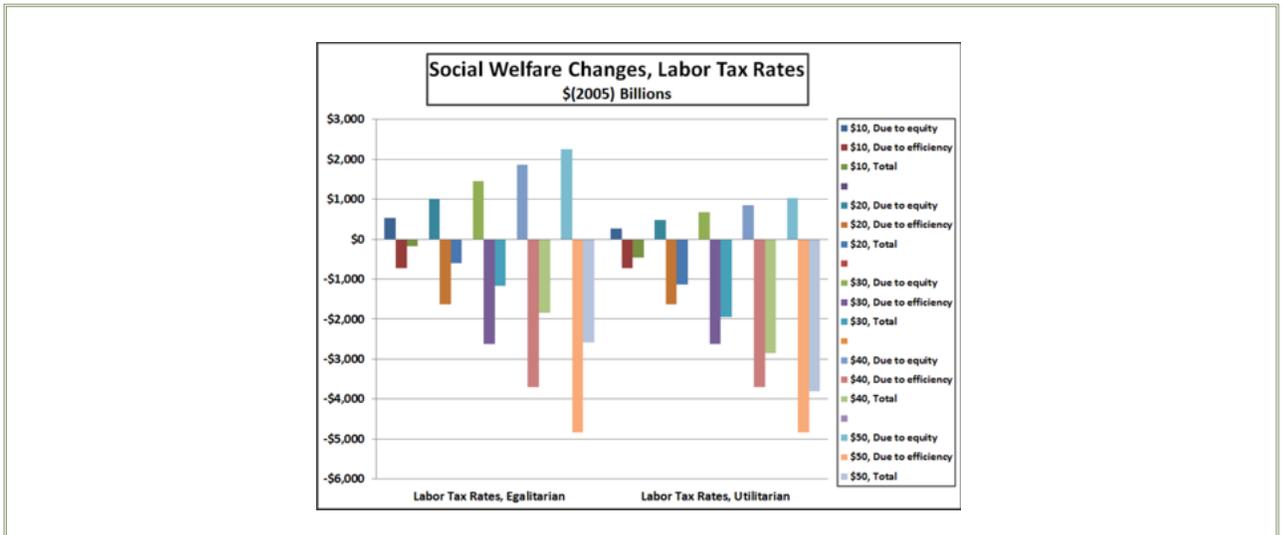
We're looking at the difference here between the base case, which is no tax change, no carbon tax, no participation tax in any international agreement, and a case in which the US joins a club that agrees on a uniform tax. So the taxes here that I consider are 10, 20, 30, 40, and \$50 in 2020. You can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

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

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

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

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



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

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

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

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

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

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

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

### **Zhongxiang Zhang**

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

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

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



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

#### **Why does China turn to market forces?**

Let me start with why China turns to market forces. The biggest change that I can see is that by the end of 2010 the country reflected on what had been the

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

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

**Carbon pricing makes sense for China as a public policy**

And so then if you turn to market forces, then the carbon pricing can be the one policy instrument, and there are a couple of arguments as to why it makes sense for China. One is you can complement existing energy-saving and pollution-cutting policies. Dale Jorgenson mentioned that because in China the energy mix is coal dominant, you want to cut carbon, and at the same time you also cut other pollutants like SO<sub>2</sub>. So altogether you can achieve an integrated collective benefit. Furthermore the government, particularly local governments, really do need the revenues, and for that reason it becomes more and more important to alleviate the financial burden to incentivize local governments not to keep their eye on economic growth alone.

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

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

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

And there was some calculation to show that particularly in the years 2006–2008, when the economy was booming and China was trying to reduce exports of these energy-intensive products, China itself levied export tariffs of 10-15%. There was a calculation done by the Institute for Sustainable Development and International Relations (IDDRI) in Paris to show that these export tariffs which China levied on itself in 2006–2008 actually are equivalent to the quota price of 30–43 €/tCO<sub>2</sub> for steel and 18–26 €/tCO<sub>2</sub> for aluminium. So this is comparable to what was the European Union allowance price at that time. That means if the US wants to do a carbon tariff, forget about the WTO legitimatization for a while and just charge the difference. But if it is already higher than your allowance price then there is no reason for you to do that.

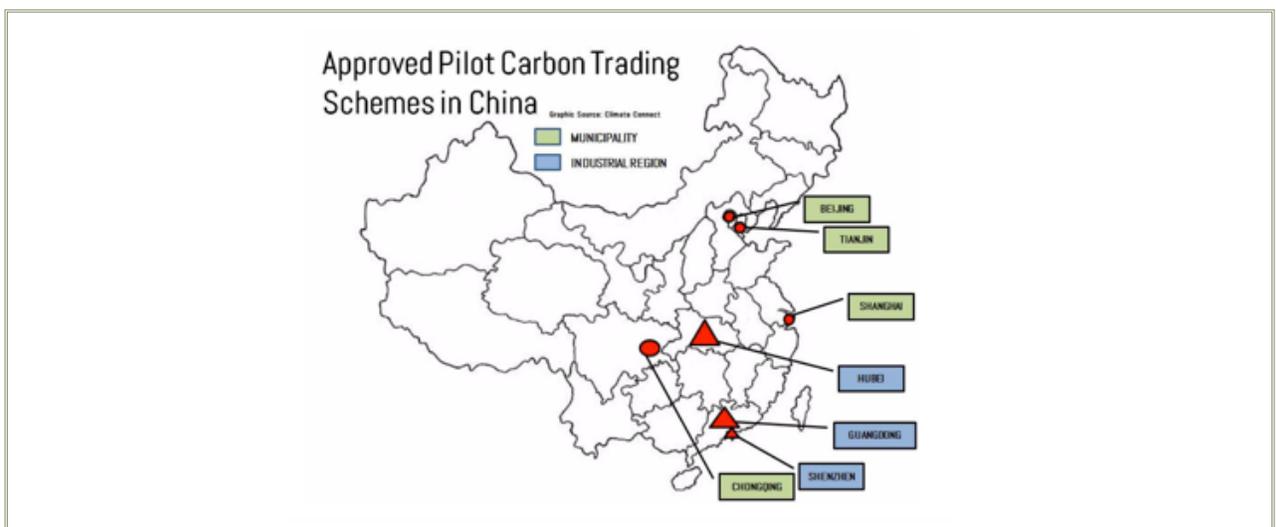
### **Carbon/environmental tax versus emissions trading**

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

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

### **Pilot carbon trading schemes**

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



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

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

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

### **China needs a carbon/environmental tax**

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

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

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

### **Why a harmonized carbon tax approach?**

So now let's move on to the wider harmonized carbon tax approach. Based on my observations, when it comes to international climate change negotiations, there are two approaches with which we are trying to break the Kyoto impasse. One is if negotiations continue along the Kyoto-style, quantity-based approach, the discussion should not be more or less focused on how everybody has a similar kind of commitment. Given the small number of major countries that contribute most of CO<sub>2</sub> emissions, what matters most is the commitments of these key players. Therefore we should just focus on the big players because basically the top 20 countries generate 80% of emissions. So this is one approach. Another one is a harmonized carbon tax. Basically this approach considers the Kyoto-type approach that has failed to deliver, at least from a long-term point of view. Of course there are also some other discussions, such as that you can combine environmental with other international treaty issues and these become much more complex. But anyhow, these are the major two approaches that are very often discussed.

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

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

### **Is China interested in a harmonized carbon tax?**

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

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

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

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

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

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

### **Thomas Sterner**

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

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

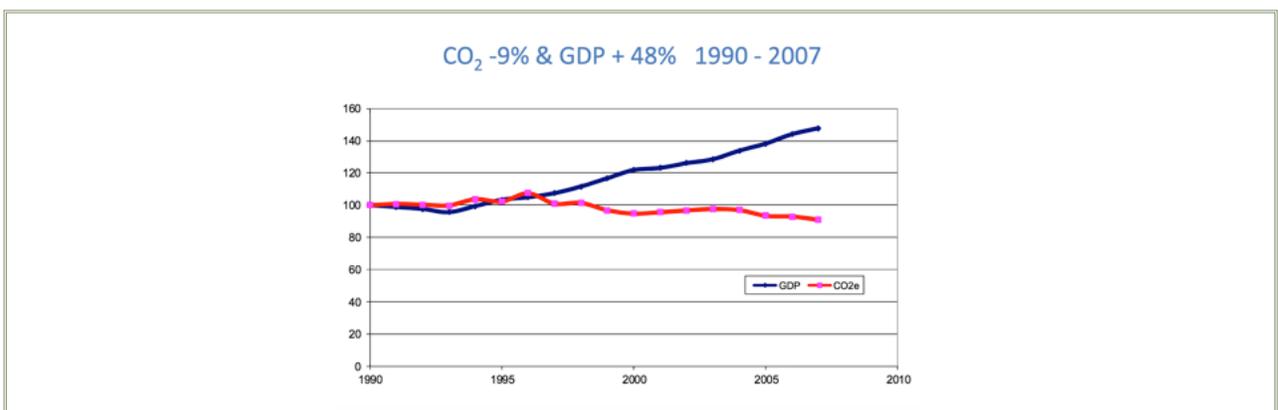
There's an issue of context of course. We like taxes in Sweden; it's a strange place. But in the end of the 1980s we were getting uncomfortable. Marginal tax rates were getting, according to rumor, above 100%. And that got to be a little bit much, even for the Swedes. And there was a big tax reform to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

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



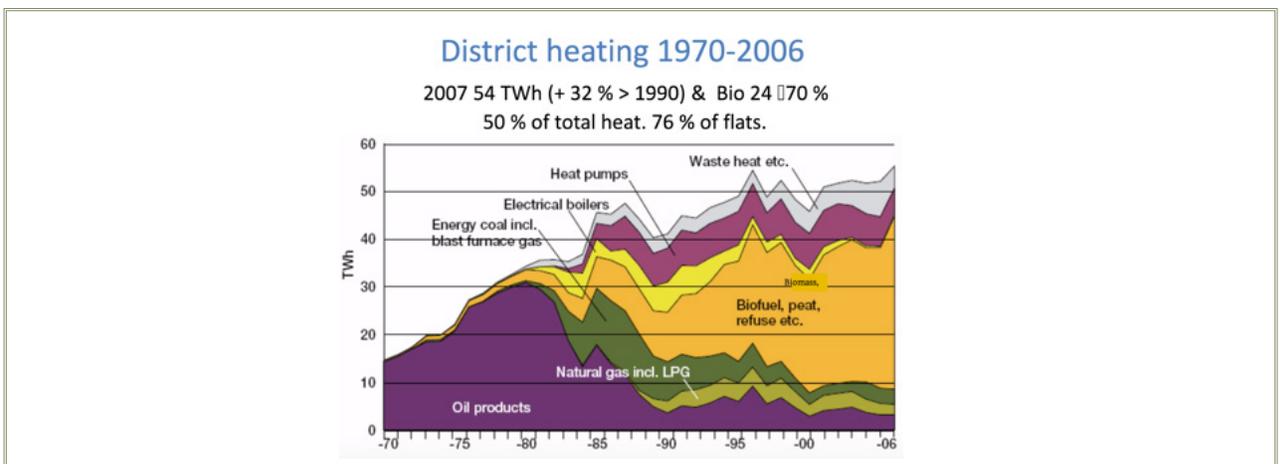
olas] Stern was speaking of \$20 to \$50. And most permit prices are below that currently. When I was working at the Environmental Defense Fund (EDF), we built a tax model, and I had the privilege of going to Capitol Hill and talking to Senators and Congressmen. We had \$5 or \$10, and they thought that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

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

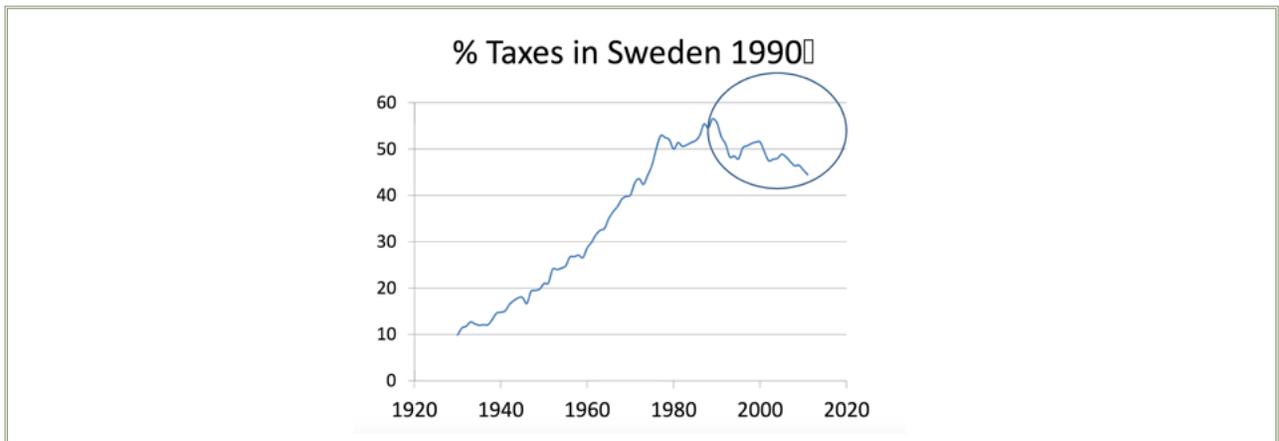




One of the important parts of this is the heating system. It's a cold country. We do a lot of heating. And we do something called district heating, which is an inherently efficient way of heating things. We do this not only in cities, but in really small towns. You see the size of this system has gone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



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



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

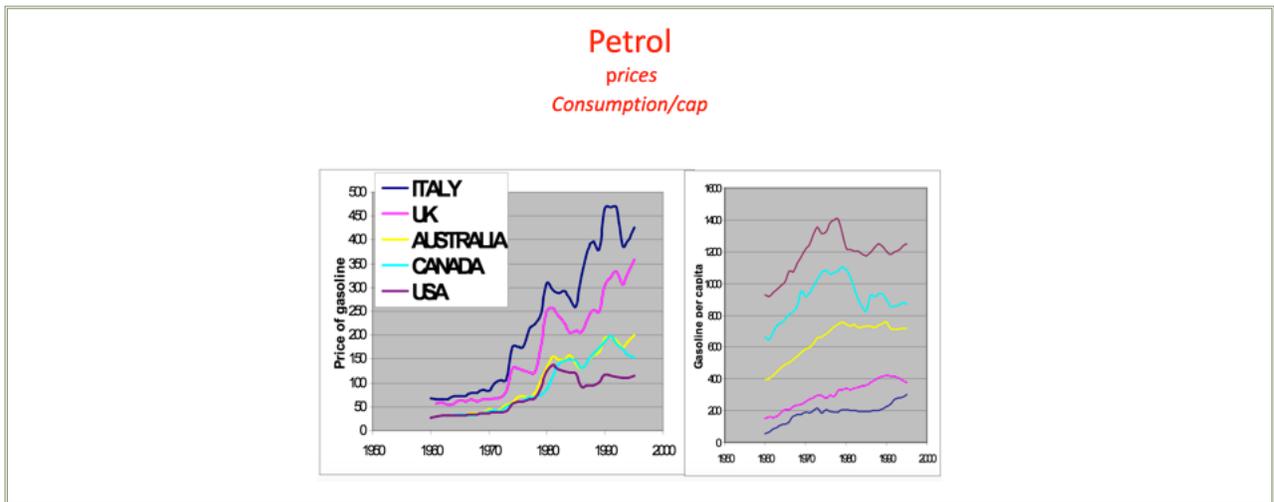
We don't have this carbon tax at the highest level on the trade-exposed sectors. So it's applied to transport and heating and all kinds of domestic use. There's a reduced level (of about 25% or just over 30 \$/ton) that is applied to industry, and then there's complications with the ETS, the companies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

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

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

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

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



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

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

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

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

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

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

- Population in country  $i$   $N_i$
- Income per cap  $y_i$
- Income  $Y_i = y_i N_i$
- Carbon price  $P$
- Carbon use  $E_i = Y_i^a (P T_i)^b \Psi_i = (y_i N_i)^a (P T_i)^b \Psi_i$
- 
- Carbon use ( $a=1; T_i=T$ )  $E_i = Y_i (P T)^b \Psi_i$
- Global Carbon Use  $E = Y (P T)^b$
- **Country share**  $E_i/E$

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

### Model of Carbon Emissions E

$$\bullet E_i = (y_i N_i)^a (PT_i)^b \Psi_i \text{ Per capita}$$

$$\text{allocation } \sigma_{in} = N_i/N$$

$$1. \text{ Proportion to income } \sigma_{iy} = Y_i/Y = \sigma_{in} * (y_i/y)$$

$$2. \text{ Grandfathering share us } \sigma_{ig} = E_{i,t-1}/E_{t-1}$$

$$=(y_i N_i)(PT_i)^b \Psi_i / Y(PT)^b = \sigma_{in} * (y_i/y) * (T_i/T)^b \Psi_i$$

This is prop to Y with extra benefit for those **who had low taxes** historically and **high  $\Psi$**

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

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

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

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

## Gilbert Metcalf

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

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

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

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

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

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



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

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

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

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

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

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

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

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

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

### Co-Benefits

➤ Power sector CO<sub>2</sub> emissions fall 25-30% below 2005 levels in 2025 – a reduction of 18-25% relative to business-as-usual baseline.

|                        | Climate Change Impacts |              | Co-Benefits of Correlated Pollutants plus ... |                        |
|------------------------|------------------------|--------------|---|------------------------|
|                        | Domestic               | Global       | Domestic Climate Impacts                      | Global Climate Impacts |
| <b>Benefits</b>        |                        |              |   |                        |
| Climate Change         | \$ 3                   | \$ 31        | \$ 3  | \$ 31                  |
| Health Co-Benefits     |                        |              | \$ 45   | \$ 45                  |
| <b>Total Benefits</b>  | \$ 3                   | \$ 31        | \$ 48   | \$ 76                  |
| Total Compliance Costs | \$ 9                   | \$ 9         | \$ 9  | \$ 9                   |
| <b>Net Benefits</b>    | <b>-\$ 6</b>           | <b>\$ 22</b> | <b>\$ 39</b>                                  | <b>\$ 67</b>           |

EPA (2014)

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

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

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

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

### **Adele Morris**

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

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

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

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



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

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

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

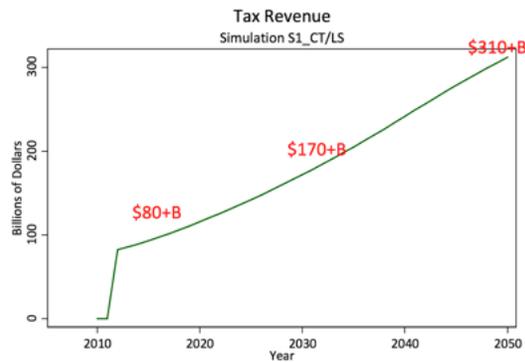
And then very importantly, what are you going to do about other federal environmental policies, not just the Clean Air Act, but subsidies and regulations of various other kinds. What do you do about state policies? Do you preempt them, or do you just let states do what they want to do? This came up in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

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

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

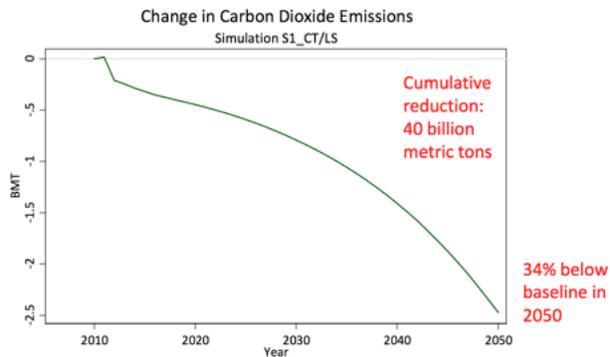
So as Gilbert said, the potential for revenue is very substantial. This is from the G-cubed modeling I described earlier that came out in the National Tax Journal. We only have fossil energy CO<sub>2</sub>, so our estimates are a little bit lower, and the carbon prices are a little bit lower. But at least \$80 billion a year, not counting the 25% offset or haircut that CBO would use to score the tax.

### Potential revenue is substantial (Fossil carbon tax @ \$16/ton, rising at 4% real)



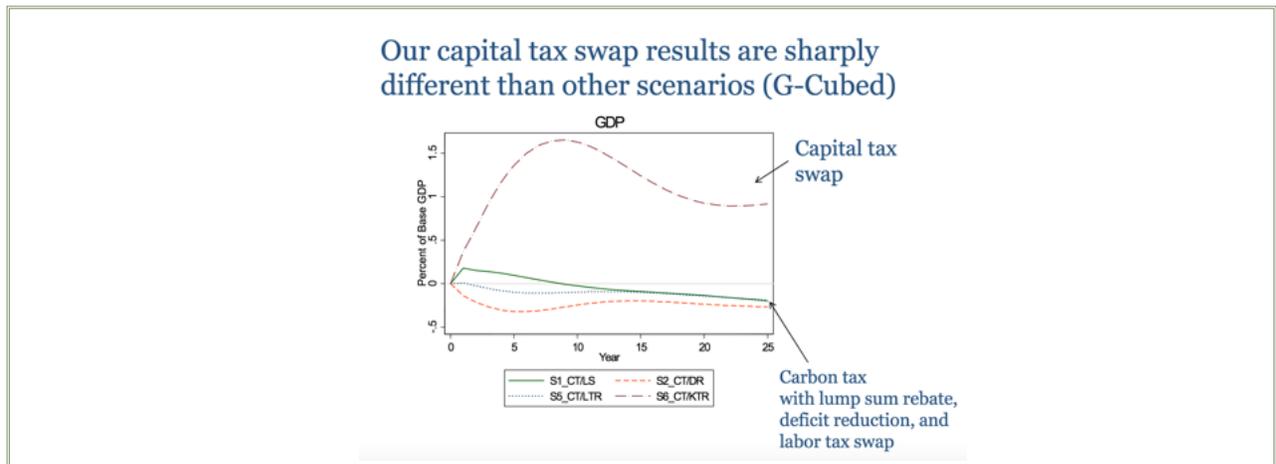
Emissions do decline significantly, and you see this pattern across the models when they do these kinds of scenarios.

### Emissions decline significantly



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

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

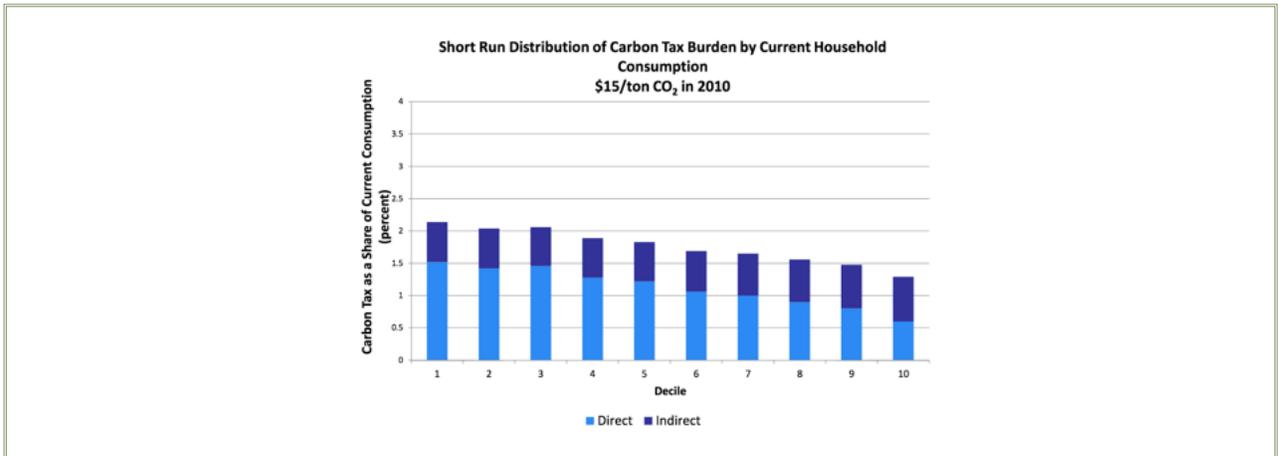


And you can see that the capital tax, represented by the dashed line, is substantially different in terms of GDP outcome than lump sum rebates, deficit reduction, and labor income tax swaps. Most of that GDP result is driven by increases in investment.

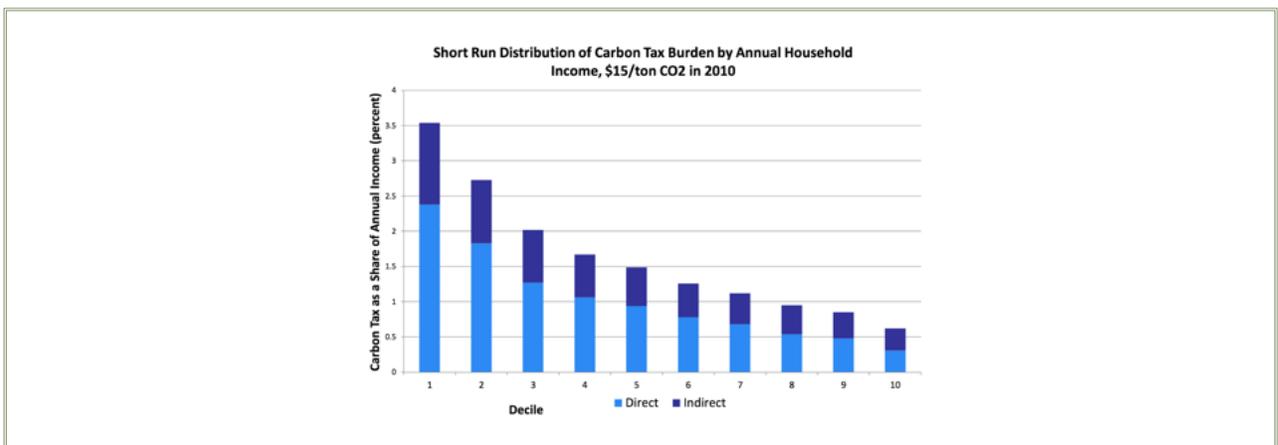
And we get similar results for wages and employment. So with these kinds of results, we can make a case to skeptics that it's not a job killing energy tax. One reason you get this result is on account of the US having relatively high statutory corporate tax rates compared to its trade partners. Now that's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

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

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



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



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

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

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

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

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

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

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

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

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

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

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

## Discussion

### Ernesto Zedillo

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

### Robert Repetto

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

### Dale Jorgenson

Marginal.

### Adele Morris

Yes, marginal.

### Robert Repetto

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

### Adele Morris

We haven't done it both ways.

### Dale Jorgenson

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

### Jason Bordoff

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

### **Adele Morris**

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

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

### **Jason Bordoff**

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

### **Adele Morris**

No.

### **Kenneth Gillingham**

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

### **Richard Cooper**

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

### **Thomas Sterner**

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

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

### **Ernesto Zedillo**

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

### **Thomas Sterner**

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

### **James Stock**

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

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

### **Adele Morris**

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

### **Gilbert Metcalf**

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

### **James Stock**

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

### **Gilbert Metcalf**

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

### **Adele Morris**

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

### **Ernesto Zedillo**

Let me take a few more questions.

### **Eric Toder**

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

### **Carolyn Fischer**

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

### Adele Morris

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

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

### Dale Jorgenson

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

### Thomas Sterner

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

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

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

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

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

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

### **Ernesto Zedillo**

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

### **Grzegorz Peszko**

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

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

### **Adele Morris**

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

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

### **Thomas Sterner**

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

### **Ernesto Zedillo**

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