



Conference Transcript

The macroeconomic implications of climate action

Session 3: Does decarbonization change the fiscal equation?

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Jason Furman: Okay. We are on to session 3, which is, does decarbonization change the fiscal equation? I'm Jason Furman from Harvard and PIIIE. I'll be moderating this session. We're going to start with Ruud de Mooij, who's the Division Chief for Tax Policy in the Fiscal Affairs Department at the IMF. And then we're going to have two comments, one from Luis Garicano, who's a Non-Resident Fellow at Bruegel and a Visiting Professor of Economics at Chicago Booth School. And the second, Selma Mahfouz, who's a member of the Inspector General, Des Finances of the French Ministry of Finance. So, Ruud, the clicker is yours.

Ruud de Mooij: Thank you, Jason. And good afternoon, everyone. So, this is joint work with colleagues in the Fiscal Affairs Department, including Vitor Gaspar. And it's about this question about the fiscal equation. And by fiscal equation, we mean, both the design of fiscal policies to address the decarbonization issue. But then also the more positive question on suppose we implement these policies, what does it mean for the revenue side, the spending side and the fiscal balance?

So, addressing both these issues. And we've heard this morning a lot of discussion about these considerations in advanced economies, the perspective we take in this paper is more a global one. And I am going to explain why, which seems obvious, but it's good to emphasize some of that. The value added of this paper, I guess, is primarily in terms of the quantification. So, we do a lot of applied analysis. And I think a number of interesting insights with respect to the different implications for different countries.

So, let's get started. And I'm starting with decarbonization in advanced economies in the past and what is already in the pipeline. And I think it's interesting to note that policies that are identified already in place or announced go a long way in reducing carbon emissions in a number of countries. So, if we compare it, for instance, to a scenario without these policies, we find that the emission reduction is between 20 and 50 percent for a number of advanced economies. Some advanced economies also overachieve their nationally determined contributions.

For instance, Germany, France, Canada. So, they reduce their emissions more than they had announced as pledges in Paris. But not all of them. And several countries still fall short of their NDCs, including the US, as we've seen this morning. Most emerging market economies fall short. And if we look at the aggregates countries achieve less than what they have pledged for with their NDCs. So, there is an implementation gap. But there is a larger gap, even if we consider the path towards the Paris Agreement with respect to the temperature increase.

So, if we want to achieve a path to well below two degrees zero as agreed, then a much larger ambition is needed. And that's reflected also in this picture on the right, which also was shown by Antonio this morning. So, this is one of the favorite pictures in the IMF. But clearly, much more is needed. And in fact, if we want to reach the path towards two degrees zero, what we need is a reduction in emissions by around 25 percent in 2030. Now, an important message is that advanced economies cannot achieve that alone. And that's reflected in this picture.

On the left is historical emissions in the different regions in the world and also some projections until 2030. But when we look at the right, this is the projections from our model for 2030 in terms of the emissions per country or region. So, what it shows is that China is responsible in 2030 for almost 30 percent of global emissions. US for 15 percent. The EU for about seven percent. So, EU and US together, the advanced economies, let's say, is a little less more than 20 percent. India 10 percent. If we include also other G20 countries. The G20 together is responsible for 80 percent of global emissions.

So, this really points to a global problem. And if we do not include the emerging market economies in the decarbonization strategy, we're not getting there. And a global approach is so important. If we don't go for a global approach, the efforts will be, first of all, insufficient because there will be insufficient policy ambition. Countries are fearing for competitiveness losses or simply do not have the priority for decarbonization. And it's also inefficient because we do not exploit international spillovers. We do not exploit low-cost opportunities for mitigating carbon. So, that's why the focus is on the global agreement and that's what we do in the paper.

So, we discuss the contours of a global deal scenario that we then going to analyze with some variations possible, but a lot of common aspects. So, of course, there's an infinite number of global deals that you can think of. So, we choose one. To make it concrete and to be able to analyze and quantify it. And global deal is characterized by four components. It's coordinated, it's equitable, it's flexible and comprehensive. So, it's coordinated in a way

that it achieves 25 percent emission reduction in 2030 relative to 2019. So, it achieves the path towards net zero and the path towards the two degrees' scenario.

Second, it has a carbon price as the centerpiece of the policy. A carbon price that initially started 75 dollars per ton in advanced economies, 50 dollars in emerging market economies and 25 dollars in low-income countries. And it's gradually arising over time. But that does not achieve the entire reductions in emissions. So, the additional effort has to come from other policies. And this also emphasizes the needs to combine the different policies, as also has been done in the past. We also think there should be a global deal, but a global deal might be initiated by a small group of countries.

And we think that at least the four large economies shown in the previous slide are important and should be part of that deal. And to make it also inclusive of the low-income countries and to link it to the development agenda, which is in the middle, embedded in the Sustainable Development Goals. We think it's also important to have a group representing the developing countries in the deal. And so, therefore, in the analysis we show the impact on the African Union countries, which could be a natural candidate to join the negotiations. It's equitable.

So, that's reflected in differentiated responsibilities. So, the reductions in emission is 50 percent in advanced economies, 25 percent in emerging markets economies. And the low-income countries relative to 2019 still have an increase in their emissions relative to baseline. It is a reduction in emission, of course. But there have still some scope for increasing their emissions as part of their development strategy over the next decades. Another part of the equitable is revenue-sharing and/or financial or technological transfers that we discuss.

The third component is flexibility. As we've seen, carbon pricing may not always be the easiest way. And what we see also for certain sectors that other policies might complement carbon pricing. And we analyze that in the paper that other measures are important part of the mitigation strategy. Another part of this is also the compensation for low-income households, which we will discuss and potentially also some relief for trade exposed sectors. Then the last part is the comprehensive. Recognizing that it's not just incentives for mitigation.

There's also a need for investment in green public infrastructure and to address market failures elsewhere. For instance, with respect to innovation and technology, as was discussed in the previous session. Now, what we do is we use this model. It's called The CPAT model, The Climate Policy Assessment Tool, that's jointly developed by the IMF and the World Bank.

And this is not a structural model. It's not a general equilibrium model or so. It is a reduced form model that focuses on projecting greenhouse gas emissions, fuel use, fiscal revenue from it.

And the strength of this model is primarily in its detail. So, it has information for 200 countries. It has several sectors, several fuels, several policies that can be analyzed. And that's what we do. But it's also interesting is that we can analyze the economic costs of moving towards greener technologies. So, that's reflected in these what we call the marginal abatement cost curves to the right. So, these are specified per sector different per country.

And it shows, for instance, that the marginal cost of abatement in a country like France are much higher than they are in a country like India or South Africa. So, a 30 dollars carbon tax reduces emissions in France by around five percent and in India by 28 percent. But the model also has and that's also a cool feature, is the environmental co-benefits. So, if you reduce emissions, it also reduces your local air pollution, which improves the health of citizens, it reduces mortality. It also has implications for congestion, externalities, and these are all quantified in the model, and included in the analysis.

And finally, we also do distributional analysis, which we will show in a second. So, then we simulate the global deal. And this is what comes out. I'm going to focus primarily on the picture here on the right, which is the total cost of mitigation. And the red bars are basically reflecting that. So, that's the additional cost of using cleaner technologies. So, the cleaner technologies reduce emissions but they are, in a sense, more expensive. So, this is the abatement costs.

And if we look at the five groups at the top, so China, India, US, African Union, and the EU 27, on average, the cost is about half a percent of GDP. But there's quite some variation across countries. It's much higher in the United States and Europe compared to China, India, and the African Union because they are lower opportunities for abatement. Interesting is also these green bars, which are the environmental co-benefits. And for China, for instance, we find huge co-benefits of reducing the emissions, especially from local air pollution. So, the net balance for China is a large positive impact on their welfare.

Now, let's focus on the revenue implications. So, the first part of the fiscal equation, looking at revenue, if we implement this package. So, these graphs show the revenue implications of the 75, 50, 25 dollars carbon tax in 2030, and then a gradual increase towards 2040. And the blue bars show the revenue from the carbon tax itself. And then distinguished by sectors. So,

you can also say, “Well, if we exclude a certain sector, we don’t get the revenue from that particular portion.”

There’s also the red bars. The red bars reflect the revenue foregone from taxes or excises on fuels that currently exist. Because on a path to net zero with more electric vehicles, and so on, there’s a reduction in the use of fossil fuels for -- or fuels for transportation. And that erodes the base of the tax on fuels. I think I need a few more minutes, by the way.

Jason Furman: Two minutes.

Ruud de Mooij: We have a precedent. On the left, we see that the revenue is positive. In China, it’s close to two percent total revenue, and there’s a small reduction as a result of the erosion of the base of the fuel taxes. For other countries, here it is less. And in particular for Europe, the revenue is much lower. It’s about half a percent for the carbon tax, but then a quarter percent of GDP is reduced from the erosion of the fuel tax base.

In 2040, when we go to the right, we see that revenue for the African Union, for instance, doubles because emissions remain more or less the same, and the tax rates double. In Europe, the net revenue that’s the diamond is actually around zero because the additional revenue from the carbon tax is offset by the erosion of the base of the fuel excises. And for other countries, we also see this latter effect to become more, and more important over time.

I think this is already an important message from the paper. We look a bit more deeply here into a current revenue from fuel excises. And also, an example here for the UK where you see a break-even point arising from the balance between the carbon tax, and the fuel excise. But I think this is one important lesson on the revenue side. So, let’s move to the spending side. And on the spending side, I’m shorter because we do not have in our model, any value added.

So, we rely here basically on existing studies on spending on first green public infrastructure, and then support for technology. So, on green public infrastructure, we have here reflection from a study by the International Energy Agency who specified the additional, the incremental investment -- public investment necessary on the path towards net zero. So, this is net of the investments currently taking place in carbon. So, the carbon is the purple part, which is going to be reduced on this path to net zero.

And the other categories like electricity, networks, renewables and so on are going to increase. I think three important messages. One is on average, the cost of public investment is about 0.3 percent of GDP on net. So, it’s about 0.4 percent of GDP -0.1 percent less for the investment in the fossil fuel

sectors. So, on net, it's an increase of 0.3 percent of GDP. It's higher in emerging market economies. And that's related to the ownership.

There's more state-owned enterprises in the electricity sector, and there is this hump shape. So, the investment is very much front loaded over the next decades. After that, there's actually a decrease in the investment necessary. On technology, I'm going to be brief. We don't have any value added just to acknowledge that there is this need for also for public expenditures with respect to technology, basic public research, R&D subsidies. Then the more contentious one on deployment subsidies. We do not quantify these. Either because they are pretty small.

On basic research, we have found that a paper that the global expenditures is about 30 billion. So, if this even doubles it does not even show up in our figures compared to other categories. So, R&D subsidies in the OECD is about 0.2 percent of GDP for all R&D, not just green. So, these are small categories. The potentially big one is the deployment subsidies, which is a more contentious one, as we have just seen. Then the final category of spending is related to, basically, what do we do with the revenue. So, the revenue sharing. Or using the revenue for compensation to developing countries.

On compensation, there's different approaches. Again, there's probably an infinite number of approaches to this. So, in the paper we illustrate two approaches to this. One is what if we compensate the low-income countries for the additional mitigation costs? So, in this picture, we do that for countries up to a certain level of their GDP per capita. So, if we set that level at 5.5 thousand dollars then the total cost to compensate countries for their additional abatement costs is about 30 billion USD. So, that's not a huge amount. And I think that's the insight if you do this approach here.

The other approach here on the right is very different one. It says, suppose we have a minimum carbon tax of 25 dollars per ton, and we say that the property rights of the global common are equally distributed among the population in the world. So, the revenue of this carbon tax should then be distributed on a per capita basis. Then we can analyze, well, what is the balance of the payments versus the receipts of different countries? And clearly countries that emit less per capita than the average receive, and vice versa.

So, based on that, the total sort of redistribution taking place is about 260 billion. African Union would receive four percent almost of their GDP. India 1.4 percent. And on that, this comes from countries that pay more than they receive. For instance, China will pay on average 0.6 percent of GDP. The US pays 0.3 percent of GDP. So, the other category of using the

revenue, in case of a carbon tax, is to compensate households. So, we know that in many countries the carbon taxes regressive.

There's probably a need for compensation in particular for low-income households, but cannot be done in a targeted way through the tax system. So, it requires maybe transfers. But it only requires, for instance, to compensate the bottom three deciles about 15 percent of the revenue from a carbon tax. So, there's still some space left for other purposes which can be reducing other taxes, distortionary taxes to obtain the prospect for this double dividend that was mentioned earlier.

Or in other countries, in particularly emerging markets and low-income countries, where there's a huge challenge with respect to revenue mobilization. This could be the source to necessary to finance development spending going forward. One slide on compensation for firms, which is probably more important if there is no global deal. If there is a global deal, there is more a level playing field. But otherwise, there may be a need for some compensation measures such as border carbon adjustment.

And here's a picture of the revenue impact of border carbon adjustments imposed by different groups of countries. In the EU, we find if it's only on import as according to the proposal, it would be around 0.1 percent of GDP. So, relatively small effects. If there would also be an export rebate to also level the playing field. In other countries, the revenue of course would be smaller. So, then we add them up to get the idea of the entire picture. And what we add up is we have this revenue effects. Based on the model, we have that some of the compensation.

So, we say, "Let's compensate the bottom 3D styles through transfers. Let's also include some transfers to low-income countries based on these abatement costs." And we include the estimates on the infrastructure spending, public infrastructure. And then we get these pictures for 2030 and 2040. I think the punchline here is that for EU countries, the fiscal balance is likely to be negative already in 2030. Not in the US if it imposes a carbon tax. Here it is 75 dollars, right? It would have the opportunity to raise revenue still.

But in 2040, the revenue would have disappeared because of this erosion of the fuel tax. For Japan, we find a small positive. The picture for emerging market is very different. For emerging markets, we typically find the diamonds here to be positive. So, the revenue is much more buoyant because of still higher carbon emissions, much less erosion of existing fuel tax bases because many countries do not have fuel taxes. Some have even subsidies. And also, they are potentially recipients of transfers from the advanced economies.

So, on balance, we find a positive picture for them. This also sort of summarizes the conclusions, and also adds on the right a picture based on a study done by the Office of Budget Responsibility in the UK, which basically illustrates the various components that I've just shown. But then, in the context of the dynamics of public debt. So, they find that initially public debt falls because the revenue from a carbon tax exceeds the erosion of the base for fuel taxes, and the necessary public expenditures.

But then gradually these bases start to erode and the balance becomes negative. And ultimately defined in 2050, an increase in the public debt of around 20 percent in their baseline scenario. Of course, this can be offset by other taxes, but that's subject to further discussion. Let me stop here and hand over to you, Jason.

Luis Garicano:

Thank you. So, thanks very much. So, it's my pleasure to be here. And thanks for the invitation to the [inaudible 0:26:09]. So, I was involved with some of this climate legislation in three years I spent in the European parliament between 2009, 2022. And I was quite interested, and I thought I learned a lot from this paper. I think that, in many ways, the message is very positive. It's actually very carefully done, and probably completely unknown to most people. The message that the climate deal with very significant impact on the evolution of the climate for the entire planet can be had with a pretty reasonable cost.

So, here's what the paper aims to do. The basic idea is okay. So, what can we do a politically, and -- I mean, politically, that's not a question that is asked. But if it's fiscally feasible, it will be more likely to be politically feasible climate deal. And the climate deal is going to involve holding the advanced economies emissions to 49 percent below 2019 levels, the emerging markets to 24 percent, and the less developed countries to let them raise a little bit.

And what the paper does is it goes through all the budgeting very carefully, through all the budgeting aspects, revenue costs from the investment costs, the innovation costs, and the distribution cost. And basically, at the end, it kind of tells you, I would conclude the analysis by it's not a fiscal free lunch but almost it's pretty good cost benefit. And I will talk about that. What I'm going to do is spend a little bit going through the main results, but just basically to tell you to highlight the point that I find most interesting in each one of those results. What is the welfare cost of more expensive? I will come back to this graph at the end.

But basically, what is the welfare cost when it's internalized when the authors internalize on the right, as you were told the co-benefit, it actually becomes significantly likely that some countries that you would be scared that wouldn't want to take action. They will want to take action such as

China. So, that's good news. Let's start from the revenue. So, is there a fiscal dividend? I will not repeat everything that was said. But I will just tell you that it's clear from the simulations that if full in revenue will take place regardless of that large increase in taxes.

The goal of this paper, from the mid-2000s, 2014, I think says, "Look, what you should do is keep the revenue constant, rather than just doubling, but just go ahead and go up all the way to keep it constant." Maybe that's another experiment to take. But the point is that even when you increase significantly the taxes, you're going to lose a lot from the motor fuel. So, that's the main finding there. So, not really a big revenue boost or not at all.

On the expenditure side, indeed, as they also said, "The infrastructure expenditures is very front-loaded." So, these are high fixed cost, low marginal cost technologies. So, we need to do them now. But again, not very large because we save the fossil fuel investments. We get the 0.4 for clean technologies, and then we save 0.1. So, again, pretty reasonable cost. Relative to what we are talking about in terms of potential benefits. In terms of R&D support, very promising low number for R&D. Globally, support for private R&D, and technology deployment, both relatively, again, reasonably low.

There is a description of the IRA, which basically gets back to that 0.2 percent. So, that's more or less the kind of explanation on R&D support. There are two distribution costs; one is international. Look at this number. It's basically getting a hundred percent of the total abatement cost to all the lessees are 30 billion. If you add up the EU and the US budgets, your GDP -- sorry, you're talking about around 30 trillion. So, it's basically a thousand of that GDP to get everybody to do this transition for free, basically to pay all the costs.

And then the internal redistribution, which basically with the scenario that's assumed, which is a targeted assistance to the two, three towards the south. If you see, you can see the redistribution by looking at the little white dot, which adds up everything. And you can see that everybody below the sixth or seventh decile gets a positive transfer, and only the last two really pay in most of the examples. And again, the cost is not very large fiscally.

So, the authors also talk about the protection for domestic firms, and defend the carbon border adjustment mechanism. I was working on the European one, and I'm very much in agreement that that's the right way. Instead of subsidizing left and right like we have been discussing all day. Again, a very limited fiscal cost. And overall, and I've raced through it. But it's the second time you saw most of those graphs. Overall, fiscally, it's actually pretty reasonable in terms of how much cost these countries are going to have to

incur to do all those four things, our research, finance, the redistribution, et cetera.

So, when I was reading this, I was pretty surprised. And I was trying to think what is missing. Okay. So, the first thing that is missing is, of course, GE effects. There is no general equilibrium effects. But as I'm going to argue, maybe that's not such a big bother given the levels that we're talking about. The second is talking about mitigation, and the third Canadian political economy. So, in terms of my first comment has to do with -- I'm making all dirty with these hands. I'm sorry. The general equilibrium effect is, as you can imagine, is missing from this. And there's a very recent paper.

So, in general, a lot of the work we've seen today, and the work in the literature talks about relatively small general equilibrium effects since that class of 2014 paper. In some countries for which it could be larger, there is a very recent paper for a small open economy, which is Chile in this case, which does get much more significant for a 40 percent increase in grain relative. To Brown gets 88 percent output fall in the last year, which would be much more significant, and would put very much in question whether we can achieve that kind of relaunch.

But I think that most of the findings in the literature that actually do take a look at these general equilibrium effects find a much more than -- I would be very interested to hear Jon about that. Thank you. I will be on time. Second, in terms of winners and losers, I mean, there's the convenient fiction that all of these countries just care about implementing these fiscal for whatever reason, and this fiscal changes, and all the benefits.

But the truth of the matter is that there is a huge amount of heterogeneity. I think we've been generally hiding that under the under the carpet. And I think now it's much more clearly been addressed by the literature, the recent review of economic studies from Rossi-Hansberg, for example, does that, look at the distribution of welfare relative to no warming. And what you see is that welfare -- red is good. Okay? So, blue is bad. So, that's a 15 percent drop in welfare to a 15 percent gain.

Obviously, Canada, and Russia are better off all the extreme northern better off. And here, if you think in terms of the social cost of carbon, by the way, I think it is right that in this paper, even though there are efficiency losses, the carbon cost is different. It's at 15, 50, 75, or 50, 100, 150, because indeed the social, the local social cost of carbon are very different, apart from the other countries, Australia, et cetera, the cost is much lower.

And my main issue here is, I mean, when we are thinking about this assumption that they do want to make these changes, we got to have to think. And of the political economy, we have to think of this map, and really

think hard about who is winning, and who is losing from the carbon -- from the potential warming benefits, their potential warming benefits in, let's say, Russia, Canada, et cetera, particularly Russia I think seems clear.

And in terms of that political economy, I want to point out that the carbon pricing is very different across locations. The OECD has these actual calculations, a carbon pricing score. But you see, for example, Brazil is not even close to starting on carbon pricing. These are equivalent carbon pricing. And you think clearly when you try Brazil to push this up, then you can imagine the politics are much harder. And indeed, when you see, for example, Latin America, look at Brazil, and Chile, et cetera, they haven't really invested in green relative to Norway or Sweden in green technologies.

So, let me just conclude by saying this is very useful. It appears entirely doable, and surprisingly cheap. And it prompted two reflections from me that I want to share with you. And one, as somebody who has been on the other side, not on the policy, but on the politics side of this debate. One is, if it's small and it's doable, shouldn't this message be one of the messages that we're sending? Okay. There is something which is very uncertain, potentially very large, and potentially very destabilizing for the world that we could actually deal with relatively low fiscal costs.

I don't think this is a message I've ever heard, to be honest. And if this is the message of the paper, then maybe we should start seeing it because it's really something that can change the political equation. The second thing that changed the political equation is because we are assuming or because we think or because the politicians think due to what we tell them, that this is a gigantic taxes, and it costly changes fiscally, et cetera. We go to all these policies that are really intrusive and annoying.

We were talking during lunch about them in some of the papers we're discussing this morning. Right? People have to refurbish their house, but there is no supply to refurbish the house. They can't sell the house because, as the governor said, because there's no mortgages. All of these things are at zero, I know. All of these things are a pain in the neck, and they are going to create a coalition against climate change. So, we are thinking, "We are getting right the political economy by doing all these other things."

And in fact, maybe we are getting them wrong. And maybe the actual thing that economists believe in, which is carbon taxes, is the actual one that from a political economy perspective might be the easiest. I think that GE effects might be taken into account. As I argued, this is not a big deal. Asymmetries maybe take a little bit more into account. And of course, the politics, I realized the IMF is not able to do that. But the heterogeneity is very important in thinking about the feasibility of all this. Overall, a very good effort and a very encouraging one, at least to me. Thank you.

Selma Mahfouz:

Can you see it? I can see it here, but not here. It's not on here. Okay. It's coming. Yes. Hi, everybody. And thank you for this opportunity to discuss this very interesting paper as well. So, first, what the paper does, I'll be very short because it has been very clearly presented in the first two presentations. It estimates the fiscal impact of a global deal that aims at reducing emissions quite significantly by 2030 through a mix of carbon prices, and other policies. So, you have the details here.

And I just go directly to the two main results of this paper because there are two different results. One is on the overall economic costs, which are estimated to be very small, 0.5 percent of GDP in 2030, slightly higher in advanced economies but less than one percent of GDP in all the countries. And the second result is the fiscal impact. In 2030, which are slightly positive for the US, zero for Japan, zero for Germany, negative for France and the UK, and very positive for all emerging countries, and low-income countries. Still positive in 2040. This has been shown.

So, this is really nice and comprehensive approach. And I think it's nice for various reasons. First, it's a comprehensive approach, and it's right to have a comprehensive global approach for a global problem that impacts all countries, all sectors, and both revenues and spending. Of course, it comes at a cost. It has some drawbacks to have a very comprehensive approach, which is that you have to rely on reduced form for energy demands.

You have to rely on aggregate marginal abatement curves that have been shown in the presentation for economic costs. And it's less transparent than when you're focusing on a couple of countries. And, for example, it wasn't very clear to me the extent to which the first result, the economic costs were related or were feeding into the fiscal equation. I think they are not. But you'll tell us more about that.

The second nice thing is that they do not rely exclusively on carbon prices, which make it more realistic. Part of the is achieved through other policies which are modelled through shadow prices still. So, we're still going through an implicit price, and even though the carbon tax revenues made quite a large part of the fiscal story in the end. And the third specificity that it takes into account the need for transfers, transfers to low-income households, transfers to negatively affected firms and to low-income countries.

And that's really a nice feature of this paper although, of course, the way these transfers are calibrated may be discussed. And I'll come to that. So, all this is very nice. But there is a puzzle. This global deal has a very small total cost, and it's increasing fiscal space for most countries. And at the same time, what we're seeing is that the US are putting so much money on

IRA. Most countries in the world are very reluctant to do carbon prices. And so, are we missing something here? Because if it's such an easy deal and a costless deal, why aren't we there still?

So, I'll put in the discussion a number of possible explanations. And one is that maybe the estimated costs are somewhat underestimated for a number of reasons. So, first is overall investment costs, 0.5 percent of GDP. They are quite low compared to other estimates. For example, the EU impact assessment of 55 comes up with an investment cost. So, it's hump shaped as in your study. But we are coming up to some 1.5 percent of GDP. It's not huge, but it's more than 0.5 percent of GDP.

If you take into account that part of the reduction in the emissions are in the baseline, actually, and maybe that's one reason why we have such a low cost, that some investment is already happening in your baseline. It's not very clear in the paper. It's also not very clear how much the reduction in emissions is relative to the baseline. In some countries, it seems low. So, it's always very important to be very clear about the baseline.

So, in the in the EU it's higher. In the UK, you've shown some results from the OBR fiscal report 2021. They come up with a 1.8 percent of GDP at the peak, and some 1.5 percent. So, always hump shaped. You have the investment needs in various sectors. It's quite large in the building sector, which is in yellow here. And you only come up with reduction in operating costs later than 2030. So, these are the net costs as in your paper.

And so, one way to make sure that we're not missing something would be for a couple of countries, at least, to confront this with more granular approaches, what we call bottom-up approaches sometimes where you really take calculate the cost of doing the required investments. For example, what we've done in France is how much does it cost to replace oil or gas boilers with heat pumps, which are more expensive than boilers to replace ICE cars with electric vehicles, which are more expensive.

And when you do this, you replace three million oil boilers and et cetera with heat pumps. You calculate how much it costs based on these price differentials where we're coming up to some two percent of GDP investment needs, additional investment in 2030. So, that's not huge. But it's more than one than 0.5 percent of GDP. I was always also wondering if the marginal abatement cost that you show in the first few slides, which go up very steeply, are truncated at 150. That's something unclear about that.

And, yeah, the second reason we might be underestimating the cost is the compensation of households. You compute the compensation needed to offset the effect of regressive carbon taxes. But maybe we should calculate the compensation needed to help households invest in decarbonized

solutions. And it's not exactly the same because a heat pump, plus renovation, plus electric vehicle is more than two years income for middle class households in France, for example.

And it's not only for political reasons, and second best reasons, probably there's a need for these investments to happen if households are liquidity constrained to not only offset the impact of carbon taxes, but to help overcome the liquidity constraints of these investments. And that needs to go further than the first three designs. So, the three bottom designs of households of income distribution to help even middle-class households. Same for the compensation of firms.

I understand you're excluding technology and deployment subsidies. So, I understand it's a difficult question. We've been discussing it. And that's most of the IRA cost. So, maybe it's a downward bias also. And in general. Yeah, and I'm finished. But from a broader economic perspective, the reason why we're underestimating some of the cost is due to the fact that we're overlooking financing, and supply side effects. So, Luis Garicano mentioned the general equilibrium effects.

But basically, for investment that do not increase potential output, and may even reduce potential output if they crowd out some productive investments, of course, it depends on the profitability of these investments. But if we factor in these effects, the fact that we may have negative productivity effects of the transition, and higher spending needs -- of higher public spending needs because higher investment costs, and higher share of these investment costs that have to be taken into by the public sector, then we might have an impact on the debt ratio on the fiscal that is less benign.

That's what we did in France. And, for example, in France, so we've offset the impact of the decrease in the erosion of the tax base on fossil fuel taxes, assuming that they're compensating. So, even without having this effect due to the impact of higher spending, and impact on lower growth on revenue, you could end up with an impact on the debt ratio that is close to ten points of GDP, 10 percent of GDP by 2030. So, slightly less benign.

I'm finished. Thank you.

Jason Furman:

Okay. We have a short window for discussion. Ruud, I'd love to just hear you start out with any thoughts you had on what we just heard. In particular, if you had any ideas, the gap between your couple tenths of a percent of GDP for infrastructure, and the 1.5. And I was also wondering whether you're taking into account if you switched to a carbon tax, you can get rid of some of your subsidies. If you're not raising money from a gas tax, can you have a vehicle miles traveled that serves some of the functions that a

gas tax is currently serving? Do those show up in your numbers? But that, plus any response, and then we'll go straight to questions.

Ruud de Mooij:

Thanks, Jason, and thanks a lot for all the comments. I think this is really useful. And also, really, the purpose of the paper to set the stage on sort of these equations for individual countries, ultimately, I think this can be augmented by much more granular information for individual countries. But we've tried to sort of sketch the overall picture. Actually, my initial presumption was, "Well, we're going to do this primarily through a carbon tax." So, this is going to raise revenue. So, this strategy could be a plus for the fiscal.

And actually, I thought it's really interesting that it's not so positive as I anticipated because we have this erosion of the fuel tax base, which is in effect, I think which is largely overlooked, and which is dominating the equation. It's also dominating the equation. For instance, in the analysis of the UK, which I think is really an important insight that it's not so positive, and there's no scope for using the revenue for all kinds of purposes that we had anticipated.

Although the picture is slightly different for emerging market economies where I think this is an important issue in the context of the discussion on revenue mobilization. So, my perspective was slightly different. I think it's really interesting to look more deeply into the fiscal equation on investment. So, what is right? Is it 0.3 or is it 1.5? That's a huge difference.

We've seen a lot of studies with very different numbers. And these studies often have different perspective. What do they exactly measure? What do you measure when it comes to investment in public transportation? Do you include the entire sort of all the public busses? Or do you only include the increment of the green public busses relative to the brown ones? So, what is public? What is private? I think on average, I think the studies we cite assume that about 20 percent of total investment is public investment. Public infrastructure, 80 percent is private investment.

For emerging market, it's often very different because of the state-owned enterprises. Is it only mitigation? Or do we also include in the investment equation the adaptation cost? So, there's many differences that can explain the difference. But I think we need to be clear. Our focus has been entirely on the decarbonization. So, we exclude adaptation, investment. We exclude the private investment, or we -- I basically cite a study by the International Energy Agency. But I think part of the difference can be reconciled.

I also looked at the UK numbers, actually much lower numbers for the UK equation is also a very small portion of the final picture, but something to look into. So, that's an important one. When it comes to other aspects, it's

not just carbon tax, and the other -- all other taxes can be influenced. And, of course, if you have a full-scale general equilibrium model, you want to include all those interactions with the existing tax system.

So, we have this reduced form model where we do not automatically have all that. But I think it's good to think through what could be other relatively important interactions. And I think also in that context, other policies like a vehicle per mile charge, we have an appendix in the paper that discusses this. And I think this is a natural substitute for the existing fuel excises as a source of revenue to deal with the congestion externalities, which are still there, and need to be addressed.

And so, we discuss also a potential reform that can actually raise the same amount of revenue. You see, that's also in the UK, OBR study an alternative scenario for the debt trajectory, which in the baseline is plus 20 percent. If they offset the loss in revenue for the fuel excise by a vehicle per mile charge, they actually arrive at a plus of 10 percent for the departure trajectory. So, really, this kind of sensitivity analysis really changes the fiscal equation. But I think this is basically why we do this, to have this discussion on the different components, and have an idea of what matters more and what matters less.

Jason Furman: Great. Thank you. Questions. And you should identify yourself for everyone else's sake, if not for mine.

Kim Clausing: Okay. So, I'm Kim Clausing. I'm an affiliate with PIIE and I'm also at UCLA. And I think this paper that you presented. And the global focus is highly welcome and clearly needed, even if you got the US and the EU to be perfect. That's still 19 percent of world emissions, and there's a lot left to do. I wonder if you can comment a little bit on how we get there. So, when we think about models for International Global Collective Action Resolution, one that comes to mind is the WTO where you rely on export interests across countries and reciprocity.

Not so much the gains of consumers, even though those are large, but you trade off what Boeing gets from being able to export with what somebody else gets from being able to export. Or if we think about the international tax agreement where it's not so much the firms that gain, they're the ones who had to pay, but the countries come together, and there's an enforcement mechanism, which is if you don't adopt, someone else is going to tax you, right?

So, looking for enforcement mechanisms or reciprocity, here is a little bit harder, particularly given the moral problem associated with the fact that the rich countries have created the problem. But the poor countries are the

ones who are forecast to do the emissions. So, I'm just curious if you all at the IMF have thought creatively about that.

Jason Furman: Great. And we're going to take two more questions, then go down with everyone answering what they want.

Caroline Fisher: Hi, I'm Caroline Fisher from the World Bank. Well, one point and a question. So, I guess, any decarbonization strategy is going to erode the fuel tax base. But the carbon tax still raises more revenues than alternatives that do that. So, the other question -- I guess, I'll second Louis' point about the interest in doing more general equilibrium analysis. There's a long literature on tax interactions. And I think it would be very interesting to think more deeply about how those interact in a variety of different countries with very different institutional settings, very different tax frameworks, and developing economies.

You may have more informality, and other kinds of market frictions and failures that actually open up the larger possibility of a double dividend, and even positive GDP effects. So, better understanding the conditions of the revenues and how you use them, and the implications for fiscal policy, and a variety of countries. Thanks.

Jason Furman: Great. Thank you. Marissa, your -- and Jon gets to ask whatever he wants. So, after you.

Mauricio Cardenas: Well, thanks. Fascinating paper.

Jason Furman: Tell everyone else who you are.

Mauricio Cardenas: I am Mauricio Cardenas. So, very good paper. I was just wondering, what are the assumptions regarding the fuel subsidies? Because the IMF's own work has much bigger numbers in terms of the cost of the fuel subsidies for the emerging and developing countries. I come from Colombia. We have a carbon tax, but then we have a fuel subsidy that is about two percent of GDP. So, simply getting rid of the fuel subsidy will generate a much bigger net effect, fiscal effect. So, I wonder what was the assumption.

And once you correct for that, you have two types of transfers; between countries and within countries. The within country transfer becomes a lot more problematic because it has to be much bigger. So, I wonder how you dealt with this.

Jason Furman: And later, you can tell us about what the politics of that might be like in Colombia. Jon?

Mauricio Cardenas: That's for tomorrow.

Jon (audience question): Yeah. It's really a sort of follow-up question. I'm struck by the fact that the time dimension may be perhaps underestimated because the very basis for the decarbonization is that it is to substitute capital for fossil fuels. That means you have to pay upfront. And that means that when you look over a longer time period, you may minimize the fiscal cost of it.

Jason Furman: Okay. I'm going to go in reverse order. So, Ruud, you'll get the last word. Selma.

Selma Mahfouz: Yes. But maybe I'll start with the last question. I'd like to say it's very important to look at the fiscal impact. But at the basis, it's not a fiscal question we are addressing. We should first figure out what the economic impact will be in the short term, 2030, because your paper is focused on 2030 mostly. And in the short term, as Jon just said, we're going to invest to replace fossil fuel by capital. And this investment is not productive in the short term. It's not increasing productivity, potential growth or anything. And we still have to finance it.

So, if it's not create -- another way to put it, we're putting a price with carbon price on a free resources polluting our emissions. And the way this can create fiscal space in the short term is a bit magical in a sense, if you follow me. So, the whole the global result that in the short term by just putting carbon taxes, if it doesn't make the economy more efficient, richer, more productive. And we're creating fiscal space somewhere. It's something that still is quite puzzling to me. That's the point. I'd like to come back.

Jason Furman: Yes.

Luis Garicano: So, one comment about costs, and it's something related to what Selma said before, and I think is important to note is that that part of the reason -- the costs are reasonable is because we don't do stupid stuff. I mean, if we force everybody to refurbish their houses, then the cost is going to be much higher. So, I think that that's the advantage of the carbon tax approach over the current one. The current one is for sure much more expensive. I think that's fair to say.

On Kim's question on getting agreement, so I would say what is new? I think we have two tools, right? We have the CBAM, which we already knew, the Border Adjustment Mechanism type issues, which is to say to the countries, "Look," this is a somewhat coercive approach that says, "Look, if you want to trade with me, you're going to have to pay. If you don't have a carbon tax, you're going to have to pay the difference." But here, I think what Ruud quoted to is they add a second. You have the stick.

Now we're going to have a carrot, which is going to -- we're going to have a transfer that actually allows, and that goes to the question of Mr. Cardenas, that he was pointing out is, "Okay. We're going to lose some of those political economy constraints inside the countries because, in fact, on those developing countries, and less developed countries, and intermediate economies, there is actually a positive redistribution to everybody, basically."

So, in that sense, the political economy is better if we could communicate this, which is a big question. So, those two. And then just simply on the way the GE, and the tax, I would have actually -- I don't know if there's time, but for Jon or for Philippe to discuss that the extent to which it's going to change the picture. But it doesn't seem, at the level of taxes we're talking about, where that is going to contradict to what we found, what the IMF team found.

Jason Furman: Ruud.

Ruud de Mooij: Thanks. I love my discussions today. How do we get there? That's a huge question, of course. I'm not a climate negotiator. But I think -- I mean, various studies have shown that there is opportunity for reform that benefits all. There are all these model simulations by Kotlikoff. You can make all generations better off. You can make all countries better off. Why don't we get there? It's still very difficult how to do that. And I think our approach to this is, ultimately, we want a global deal. What people say, "Well, you should not have too many parties." G20 is already too big. So, let's start with a small group of countries, the big emitters, to find an agreement.

And even getting four countries at the table is difficult. But let's suppose that's possible. Then our thought was also -- it's important to link this to the development agenda because if we want to have the developing countries on board, we have to involve them from the start, and not at the end. So, linking it to the SDGs, and including the African Union was part of our attempt to say, "Well, this is maybe the strategy to follow. But I think analyzing, contributing to the discussions in the way we do, is important." And ultimately, it's up to countries to find a way in which they find an agreement.

On the text interactions, Caroline, very good point. Of course, there are many general equilibrium models around in the literature on the double dividend. I wrote my PhD thesis on the double dividend in the late 1990s. Since then, there have been zillions of general equilibrium models with tweaks and all that. And I think that has really evolved into general insights on what are the important interactions that matter for ultimately the fiscal equation. And I think we should utilize that and build on those insights. It's

not all captured in our model. Our model is strong in certain aspects, but not in others. So, it does not include all these general equilibrium effects.

The last point also on the timing, I think it can be very important. But it's not something we capture in our framework. So, something to think about. And maybe also for us to caveat more what is not included in the analysis. And then on the subsidies, yeah, that's of course a very important and obvious thing to do to get rid of subsidies. We do discuss a little bit fossil fuel subsidies in the paper. Also, in the context of how do you define subsidies. And the fund has various studies on fossil fuel subsidies, distinguishing the explicit and implicit subsidies.

The explicit subsidies is the two percent of GDP for Colombia, and for several other countries, obviously very distortionary costly. And there must be ways to reform those. But there's also the implicit subsidy, the not pricing of the externalities, which we usually include, which is a methodology that is more being discussed. But I think also gives an important message that we still massively underprice the externalities related to energy use.

Jason Furman:

Great. Well, thanks for this terrific discussion. And people are allowed a short break even though we went over. Okay.