From COP21 pledges to a fair 2°C pathway

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Executive summary

At the 21st Conference of the Parties held in Paris in 2015, about 160 countries proposed the so-called intended nationally determined contributions (INDCs) that define greenhouse gases abatement objectives by 2030. While encouraging, these commitments are not ambitious enough to achieve the 2°C threshold by 2100, and, as requested by UNFCCC, additional discussions and efforts are very much needed. There is therefore a necessity to assess the economic consequence of a pathway to 2°C and the fair sharing of this burden. The need for this exploration is made even more important by the recent decision of the American administration to withdraw from the Paris agreement.

Contribution and methodology

The contributions of this paper are twofold. First, it proposes a methodology to synthesize the INDC pledges for the 11 groups of countries considered in the paper. In our analysis, we distinguish four categories of countries depending on the approach used for their INDC definition and we compute conditional and unconditional emission targets for 2030. Second the paper explores the future of Paris negotiations and, in particular, it assesses the economic impacts of both the INDCs and the USA withdrawal decision, on the design of fair burden sharing agreements on the period 2015-2050 compatible with the 1.5°C and 2°C targets. The economic analysis is based on a simple two-level game theoretic model that can be summarized as follows. In a first step we translate the warming target into a safety cumulative emissions budget, in the time span 2015-2050. We then assume that this cumulative emissions budget will be shared among different groups (coalitions) of countries that we consider. The proportion of the budget given to each country becomes a design variable for the agreement. To assess the value of the budget given to all coalitions we compute a Nash-equilibrium in a game where the strategies are the profiles of supply of emission permits on a world emissions trading market and the payoffs are the welfare gains (losses). Through statistical emulation of the computable general equilibrium model GEMINI-E3, we derive abatement cost and gains in terms of trade functions that enter in the definition of the players payoffs. With this two-level game structure (at the higher level one chooses the budget allocation by regions and at the lower level one defines the permit supply profiles), we obtain an economically coherent assessment of different rules for the

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design of a fair agreement. In particular this approach permits the use of a Rawls criterion of justice, where one would tend to minimize the worst relative welfare variation among all the coalitions considered.

Main conclusions and policy implications

First, we use our model to evaluate the economic cost of INDC pledges. We confirm the weakness of these commitments in the attainment of the 2°C target. Only four groups of countries have a binding target, and especially USA, European countries and other industrialized countries. The other regions have submitted INDCs that are close or above our business as usual emissions scenario, in particular India and China. USA is the most affected country, with 0.37% welfare loss and a CO_2 tax of 71$/t in 2030. At some point, this could help to explain "partly" the decision of the American administration to withdraw from the Paris.

In a second part, we perform numerical simulations with this model to analyze "equitable" international climate agreements, which are compatible with the 2°C goal on the period 2015-2050. We provide two examples of possible international agreements.

The first scenario consists in finding the budget allocation, such that one minimizes the largest additional welfare loss among the countries. In other words, the welfare losses are equalized among all countries and groups of countries. We show that this target could be achieved at a reasonable global welfare loss, i.e., only 0.8% of total discounted household consumption.

In a second scenario, we assume that it should lead to a zero welfare loss for least developed countries and a maximum of 0.5% contribution for emerging economies. The remaining effort is shared among OECD countries. This rule of fairness stems from recognition of historic responsibility on emissions and limited economic capacities of developing countries. It is related to the Greenhouse Development Right framework. Welfare loss for developed countries is now around 0.9% of discounted household consumption, which constitutes a very limited increase compared to the first agreement. We observe that in both scenarios, China, India, Russia, and OPEC are the main contributors in terms of abatement costs, partly compensated by permit trading.

We then explore climate change agreements with partial cooperation when countries decide not to participate in the climate agreement and thus do not implement any climate policies. We assume that the minimum coalition agreeing to implement stringent climate policies corresponds to G20 countries. Limiting the participation of countries to a global climate change agreement increases the cost of the 2°C target. We also compute different variants around the G20 coalition and find that without China, the G20 would not be able to reach the 2°C goal.

Finally, we study a more ambitious goal aiming at limiting global warming to 1.5°C. Global cost is multiplied by a factor of four revealing the stringency of such an objective. But the main result is that the 1.5°C objective seems to be not reachable without USA participation.

In conclusion, our numerical results show that the implementation of an international carbon market and participation of all countries in the game are crucial elements for reaching equitable burden-sharing among countries. For example, considering a reduced G20 coalition, welfare losses are multiplied by a factor of three for coalition members. Our simulations permit also a first evaluation of the possible impacts of the recently announced USA withdrawal from the Paris agreement.