

[SUMMARY]

## On the Macroeconomic Effects of Unilateral Decarbonization

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## I. Motivation

At the heart of the economics of climate change is the global emission externality. A growing body of literature has focused on estimating the effect of carbon emissions on global welfare, often referred to as the *social cost of carbon*, as a benchmark for carbon pricing. While some regions have started to adopt carbon pricing via e.g. cap-and-trade systems, it is now widely acknowledged that international coordination will be crucial to further decentralize the social or global cost of carbon by providing sufficient *private* or regional incentives. Yet evidence has piled up that climate agreements and “muddled” carbon pricing fail to curb global emissions due to the free-riding problem in abatement, which implies that the cooperative solution consistent with the stabilization of global temperatures has not materialized (Nordhaus, 2020).

More hands-on approaches of regional climate policies now compare the regional costs and benefits of climate policy in a global environment characterized by incomplete carbon taxation (see e.g., Hassler et al., 2020). The first attempts of unilateral climate abatement have accentuated the misalignment of regional cost and global benefits. A country decreasing its emissions domestically is often found to (i) increase emissions in another region, i.e. induces *carbon leakage*, (ii) diminishes fossil fuel rents and encourages faster extraction and ultimately global emissions, i.e. contributes to the *green paradox* and (iii) erodes national competitiveness and prosperity, giving rise to the *free-riding problem* of climate change mitigation. According to more optimistic narratives, climate policy will (i) unfold learning-by-doing and potentially large *spillover effects* which increase the competitiveness of green energies, (ii) induce employment and international competitiveness in clean energy (iii) reduce exposure to the *carbon bubble* while potentially absorbing financial/capital flows freed up by dismantling carbon-intensive power plants (iv) diminish the curse of *dutch disease* in fossil fuel extracting countries. In what follows,

we review our paper’s research question and main findings that has been conceptually developed along the narratives listed above.

## II. Research Question and Audience

Starting from the goal to illustrate crucial building blocks for a macroeconomic model of regional and global effects of climate policy, we developed an outlook for macroeconomists and policymakers about the state-of-the-art of climate economics. The paper is an attempt to draw a research frontier by recapitulating data on emission patterns and on the challenges ahead in the macroeconomics of unilateral climate policy. In order to do so, we want to identify some of the crucial channels through which regional climate policy can determine global climate outcomes. The paper is also concerned with illustrating the theoretical starting point of modern macroeconomic analysis regarding climate change mitigation. Along our way, we also try to answer the question how political narratives have been shaped by macroeconomic research.

## III. Content

The paper proceeds as follows: we first present a few moments of descriptive statistics including regional emission patterns, energy mixes and fossil fuel extraction rents to illustrate the need for climate policy and to obviate the regional incentives to enforce or oppose climate policies.

We then discuss the following blocks of the macroeconomic literature: firstly, we revisit the social cost of carbon debate pioneered by the integrated *assessment models* of William Nordhaus, which have been crucial devices to illustrate the need of substantial and globally uniform carbon pricing.

Next, we dig into the literature concerned with (the) green paradox, which has incorporated the feedback of climate policy on ultimate emission patterns, either through the presence of existing climate change abatement systems or due to crowding-out and out-sourcing, known as carbon

leakage. We contrast this body of research with the findings on the optimal timing of climate policy.

The third branch of our literature review investigates the findings on the two schools of regional general equilibrium models of climate economics.

#### IV. Findings

A major observation shared among climate economists is the ineffectiveness of climate agreements to curb global greenhouse gas emissions uniformly and substantially. While many developed regions (EU, Japan, US) are on their way to decarbonization, the observed reductions have been more than compensated by developing countries' emissions. These countries seize growing shares of global emissions, despite improvements in the local production- per-emission ratios. Less surprisingly, some fossil-fuel extracting regions like Russia and the Arab World have not yet used the economic power generated by appropriating fuel rents to push for less carbon-intensive production. One reading of this observation is that incentives to decarbonize have been somewhat symmetric around the fossil fuel trade balance, while a second reading suggests substantial carbon leakage from developed to developing countries. The first reading is consistent with the view of at least mild forms of dutch disease, which vindicate an assessment of transfer payments necessary to lift these regions out of fossil-fuel business models. The second reading reinforces the need to address the global free-riding problem.

Since decarbonization attempts in accordance with the Kyoto Protocol have taken place mostly across Annex-I countries, which are not only economically and financially developed but also somewhat politically and culturally integrated, the climate policy demarcation line now runs both along geographical borders (Europe and North-America vis-a-vis the southern hemisphere and Asia incl. Russia and the Arab World), but also along the lines of fossil fuel abundance and political integration, a gargantuan task for climate diplomacy

to resolve.

The first finding of our literature review is that estimates of the social cost of carbon have reached maturity. Yet, the huge uncertainty around damage elasticities and the appropriate choice of social discount factors as well as the international free-riding problem in carbon-taxation have dead-ended much of the academic effort on this frontier. Our second finding regards the green paradox that arises when clean energy innovation accelerates fossil fuel extraction. The considered macroeconomic literature suggests that green paradox is a serious concern with regard to the speed of oil extraction, not its ultimate volume. However, the limited size of oil reservoirs (which engender scarcity returns and thus the management of extraction schedules) make this type of green paradox quantitatively less relevant in comparison to the extraction of coal, which is traded on deep global markets. Carbon leakage as another source of green paradox thus has climbed up in the list of concerns of climate economists.

A related and important finding has emerged as a result of the incorporation of endogenous growth theory into climate economics. Early endogenous growth theory stressed the learning-by-doing effect for the international diffusion of technology (Young, 1991) and the demand-pull forces in R&D efforts (Romer, 1994). These indirect effects of developing abatement technologies do not only provide a strong case for more front-loaded innovation efforts in the presence of climate damages but can also justify both demand and supply-sided macroeconomic policies. Quantitative studies relying on calibrated endogenous growth models provide support for a distinct role of "global industrial policy" and less myopic regional planning. Nevertheless, whether regional subsidies can contribute to achieving more front-loaded global research efforts does not only depend on innovation spillovers but also on whether domestic climate policy avoids high-carbon energy innovation globally due to carbon-leakage (Van den Bijgaart, 2017). This rather recent qualification suggests that technological effects of carbon taxation and green

subsidies are still contentious, with many open questions in the sphere of international patent markets.

As these findings illustrate, carbon leakage is crucial for the effectiveness of unilateral climate policy. A branch of macroeconomics has already studied the impact of climate policies on global emissions and how leakage can be reduced effectively. Computable general equilibrium models so far find (and work with) coefficients of carbon leakage substantially below the green paradox threshold (cf. Kuik and Hofkes, 2010; Böhringer et al., 2017). However, their results depend on behavioral parameters subject to Lucas-critique and vary violently with the precise furnishing of other climate policy systems (e.g., Gerlagh et al. (2020) finds that the EU ETS enables green paradox and multiple equilibria due to the threshold banking-cancellation). Surprisingly, early dynamic stochastic general equilibrium models confirmed the low estimates of carbon leakage (see e.g., Felder and Rutherford, 1993) from Annex-I countries but the recent exercises in this field are pessimistic about the significance of e.g., OECD countries to determine the global innovation and emission trajectory (Van den Bijgaart, 2017).

## V. Conclusion

Our review has led us to conclude that the frontier of climate economics is aware of the numerous effects and the potential repercussions of unilateral climate abatement. Macroeconomic models treat trade and diffusion of knowledge and even existing climate policy frameworks seriously when assessing the role played by unilateral climate policy advances. Particular questions up in the agenda of macroeconomic climate modeling concern the necessary economic size of a region to induce global adoption of decarbonization strategies and the regional cost of making the transition to fossil-free production happen, both in developing countries and in countries that have started to actively move towards a carbon-free economy. The implications of unilateral climate policy on the

strategic stakes and bargaining positions in global climate diplomacy is a delicate field that benefits from macroeconomic research clarifying regional costs of climate policy.

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