Resource extraction and the Green Paradox: Accounting for political economy issues and climate policies in a heterogeneous world

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Chapter 5

Summary

The thesis presents work on the intersection of two fields: climate change economics and resource economics. Chapters 2 and 3 make a contribution to the Green Paradox literature. The "Green Paradox" is a term coined by Sinn (2008) and denotes adverse effects of climate policies. The literature on the Green Paradox has been ample since Sinn's seminal paper. A commonly made assumption in most models is, however, that economies employ *unified* climate policies. In contrast, Chapter 2 introduces regional heterogeneity at different levels and analyzes the resulting Green Paradox effects of *unilateral* climate policies. Chapter 3 goes a step further and incorporates a monopolistic market structure into the model: it unravels the effects of unilateral climate policies in a two-region setting and in the presence of limit pricing.
Chapters 2 and 3 share a *global* view on resource extraction and resulting climate damages, whereas, in Chapter 4, the focus lies on *national* determinants of resource extraction. The second part of the thesis relates to the resource curse literature insofar as it highlights the impact of a country's political and institutional context on resource extraction and the social welfare of a resource-rich country. A key finding is that the presence of self-interested politicians results in over-extraction of the resource. This is in line with a small branch of literature that places models of resource extraction in a political economy framework.

In Chapter 2, based on Ryszka and Withagen (2014), I investigate the Green Paradox phenomenon in a two-region setting, where both regions possess non-renewable resource pools, which differ in their extraction costs. The analysis draws upon Hoel (2011) who examines potential Green Paradox outcomes of unilateral climate policies in a two-region model. This contrasts with much of the literature which is mainly focused on homogenous

policies. Given Hoel's two-region setting with diverging policies, I add extra layers of heterogeneity by introducing different regional resource extraction costs, differing emission factors of the non-renewable resources, and differences in the regions' abilities to produce a backstop resource. The questions I seek to answer are: What are the effects of climate policy changes on the resource extraction path, given the heterogeneity of policies and of extraction costs? Under which circumstances do we observe a Green Paradox? Do the regions have incentives to introduce climate policies in the first place?

To answer these questions I obtain analytical results regarding the direction of change of the Green Paradox variables of interest, and numerical results for a full solution of the model. The findings suggest that a backstop subsidy in one region always results in a Green Paradox outcome, whereas a carbon tax typically does not. I conduct a numerical study of the welfare effects of policy changes for both regions and find examples of optimal climate policies for specific parameter values. The analysis implies that the regions have incentives to use climate policies for non-climate purposes due to the terms of trade effects of their policy measures, which vary between regions. I calibrate the model to assess potential benefits from adapting climate policies and possible Green Paradox effects in the real world. I find that forming a 'climate coalition' and introducing carbon taxation is beneficial for the largest fossil-fuel using regions, such as the OECD together with India and China, even in the absence of real climate concerns due to favorable terms of trade effects for the coalition.

The study highlights the incentives stemming from energy market changes induced by unilateral climate policies, which result in welfare changes in both regions due to terms of trade effects. It reveals which policies are 'desirable', i.e., compatible with the regions' self-interest, and thus have a chance of being implemented in the first place. A calibration exercise sheds some light on what could be the optimal climate policy instrument for the 'climate coalition': unilateral carbon taxation is the optimal policy choice for the climate coalition, both in view of the coalition's non-green welfare and regarding climate costs. This finding at least partly refutes some countries' preconception that climate policies are economically disadvantageous. The argument of potential terms of trade gains of climate policies could help to overcome some countries' reluctance to engage in (international) climate action.

Also in Chapter 3 I deal with heterogeneous climate policies combined with monopolistic resource production and limit pricing. The resource monopolist produces at constant unit

extraction costs and supplies to a global market consisting of demand from two regions. The regulated region employs both a carbon tax and a backstop subsidy, whereas the unregulated region does not have any climate policies in place. I analyze the Green Paradox and welfare effects of changes in the climate policy parameters such as backstop production costs, a backstop subsidy and a carbon tax.

In the first part of the chapter I show that there is always a final phase of limit pricing in a single market supplied by a resource monopolist. The analysis illustrates that climate policy tightening can have adverse climate effects implying a Strong Green Paradox, despite the occurrence of a Weak Green Orthodox. Lower backstop costs and a higher backstop subsidy result in a shorter time horizon for resource extraction, making an increase in climate damages likely and affecting overall welfare in a negative way. In the numerical example, carbon taxation improves both green and non-green welfare by extending the resource extraction phase and by enabling the resource consumer to acquire a part of the monopolist's resource rent.

In the second part of the chapter I analyze a two-region model, distinguishing between two frameworks characterized by price continuity and discontinuity, respectively. The difference lies in the assumptions made regarding the storability of the resource and the presence of speculators in the market. In both cases the supply and demand patterns can be divided in two phases: first, both regions are supplied with fossil fuel, until the regulated region switches to using the backstop. Next, only the unregulated region demands the non-renewable resource until its exhaustion. A first finding is that, in the absence of speculators, it is optimal for the monopolist to let the price jump upwards when demand from the regulated region drops to zero. Second, I find that in the cases with and without speculators on the market, the resource extraction paths may contain two limit-pricing phases: one just before the demand from the regulated region vanishes due to climate policies, and one just before the depletion of the resource. Third, I show that the presence of speculators is beneficial for the climate: initial extraction is lower and the overall resource extraction phase is longer than in the case without speculators, reducing the present value of climate costs. Fourth, a tightening of climate policies does not result in a Weak Green Paradox: initial resource consumption falls in both regimes. Climate costs might still rise as intermediate extraction goes up and, in the absence of speculators, as the overall resource extraction phase is shortened. Finally, the numerical welfare analysis shows that the different climate policy changes have varying effects on the regulated region's non-green welfare. In the presence of speculators, however, the regulated region is consistently worse

off regarding its non-green welfare because the resource producer sells more resources to the unregulated region than in the absence of speculators. Furthermore, climate policy tightening decreases the unregulated region's non-green welfare as the monopolist shifts more of its resource supply to the unregulated region.

A large share of the world's non-renewable resource deposits are state-owned, i.e., controlled by politicians. Politicians, however, maximize not only society's welfare, but most likely also their own private utility. Consequently, the resource extraction path in such a country is likely to differ from the Social Planner's optimum. In Chapter 4 I develop a political economy model of resource extraction to examine the resulting non-renewable resource extraction pattern and social welfare losses. In my model the politician accroaches a part of the resource for himself. I analyze qualitatively and quantitatively how the politician's rapacity and the pace of resource extraction are ultimately determined by the political economy features such as the weight the politician attaches to society's welfare, his discount rate and time horizon.

I find that a lower social weight decreases the resource stock available to society, whereas the politician's higher discount rate and a shorter time horizon do not imply less socially used resources. Yet, they do have an adverse effect on the resource extraction paths, and especially on the initial extraction rates: the politician behaves more extractive the higher his discount rate and the shorter his time horizon. Higher initial resource extraction entails negative climate consequences.

The choice of the exogenous political economy features is justified in another model in the second part of the chapter by demonstrating how the politician's discount rate and social weight endogenously result from the politician's probability of staying in power, which increases in the amount of social welfare in the preceding period. This provides the purely self-interested politician with an incentive to account for social welfare. The size of this incentive depends on the functional form of his staying in power probability. Furthermore, the politician decides every period anew on the resource allocation in the endogenous setting as his electorate is not forward-looking. He is not required to commit to a certain extraction path, which results in a further worsening of the resource extraction profile.

The endogenous model reveals the importance of political commitment and adequate commitment devices, which can curb the power of politicians and force them to take longer-term decisions. Many resource-rich countries do not possess strong institutions such

as binding laws, a constitution and politically independent courts limiting the power of politicians and their decision-making. Therefore, their prospect of attaining a second best outcome seems somber. The results imply furthermore that a country's welfare outlook also depends on its electorate's ability and willingness to hold the politician responsible for the dynamic (welfare) consequences of his extraction decisions. Lastly, the significance of the model's findings extends to the global climate change issue: when thinking about strategies to curb global resource usage we do not only deal with market forces of supply and demand, but we also need to account for the incentives of selfish politicians and dictators.

The key message of my thesis is that, when designing climate policies, we cannot act on the assumption that the entire world will put these policies in place and that those policies will be implemented by a benevolent Social Planner. Unified climate policies, regulations and measures spanning the entire world will most probably stay an utopian concept forever. The effectivity of present-day climate policies needs to be assessed against this background. The thesis also stresses the importance of the supply side of the resource market: whether resource producers are modelled as competitive, monopolistic suppliers or self-interested politicians or dictators, their incentives need to be accounted for as their resource extraction decisions have major implications for carbon emissions and the climate.
With my focus on climate policy heterogeneity and my study of political economy issues in resource-rich countries, I hope to have contributed to a better understanding of real-world climate policy and resource extraction mechanisms.