

Multi-problem challenges for a renewable future

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Summary

The economic textbook solution to climate change mitigation is to use environmental policies towards all greenhouse gas point sources and to direct support for innovation in low-carbon technologies. Yet, in the absence of a single global carbon price, climate policy relies on unilateral efforts by national governments and on low-carbon technology innovation strategies by individual businesses. In this spirit, the new climate change mitigation framework adopted in Paris in 2015, aims at assuring that the efforts to address the problem of climate change take place on a global scale. The latter is set to be achieved through a combined top-down and bottom-up architecture, which foresees a globally binding treaty under international law, governing the commitments by individual countries to decrease their carbon emissions through nationally determined pledges. Though assuring wide participation by both developed and developing countries, such decentralised approach leaves it to the responsibility of participating countries to design climate change policies in line with their respective country contexts. However, in a world of nation states which are competing with each other economically and which have developed heterogeneous policy approaches reflecting their national priorities, ideologies, interests and legal and cultural traditions, an uncoordinated transition to low-carbon energy systems might not only inhibit reaching the global pledge to limit the temperature increase to well below 2°C, it might also bring about new problems in terms of increasing the economic burden of emission reduction in countries with more stringent environmental policies.

In this respect, the aim of this dissertation is to shed light on how the co-ordination of bottom-up processes within the broader context of climate change should be managed, in order to assure a sustainable and equitable transition to a renewable future. In particular, this dissertation analyses the challenges for a transition to low-carbon energy systems, whereby climate change mitigation is interpreted within a wider socio-economic, technological and geopolitical context, as opposed to the narrow view of emission reduction targets. Such approach allows to examine the interconnections between climate change mitigation, energy and mineral resources, and to ultimately draw conclusions on the coordination challenges in a world with interconnected systems, heterogeneous national policies and priorities, and distorted markets. The analytical framework has been informed by theories of public goods and collective action, as well as by the nexus approach to resource governance and by the national system of innovation considerations. The

dissertation is a collection of three empirical studies, each of which sheds light on the coordination challenges from a different perspective. The latter are analysed using various methodologies, ranging from quantitative analysis of dynamic panel data model, through market analysis and technological landscape assessment, to a comparative political economy analysis of policies and policy styles. Such mixed method approach enables examining the problem of coordination from a more holistic perspective. At the same time, the scope of the dissertation being multidisciplinary, each chapter also makes a scholarly contribution to its respective field.

Chapter 2 examines the economic costs of uncoordinated implementation of environmental policies across countries. In particular, it investigates on to what extent electricity prices for industrial consumers lead to a loss of international competitiveness on country level in terms of attracting foreign direct investment (FDI). The results of the quantitative analysis for the European Union (EU) confirm that besides tax rates, unit labour costs and competitive disadvantage in secondary education, also electricity prices contribute to eroding net FDI inflows of the EU countries. While this is true for both sub-regions, south-western countries tend to be more adversely affected than north-eastern both in the short and the long run. These results have implications on a larger scale too. Should electricity price differentials continue to persist internationally, they might lead to alteration of the global pattern of investment, production and trade.

Chapter 3 analyses the implications of inadequate coordination of policies beyond sectoral stovepipes on global supply chains. This is done by investigating the interconnections between low-carbon technologies and mineral resources. In particular, the chapter investigates the far reaching consequences of rare earth demand-supply imbalances on the deployment and innovation of offshore wind turbines and advanced technology vehicles. On the supply side, the chapter confirms the existence of rare earth supply risk which arises from institutional inefficiency within the market. On the demand side, the results disprove the widespread allegation that supply risk of rare earths impedes the deployment of offshore wind turbines per se. In contrast, the automotive industry and its electrification have been found substantially dependent on the undistorted access to rare earths. The potential supply shortage of the latter would thus largely disrupt the further development of the market altogether. Ultimately, evidence shows that the uncertainty about volatile prices and the threat of supply shortages induce manufacturers to optimise the designs of their products by innovating in less rare earth-intensive topologies, which are however often inferior in terms of their performance.

Chapter 4 investigates on the importance of coordinating collective actions

at multiple scales within countries, in order to accommodate national interests and domestic circumstances in face of global market distortions. In particular, it examines within a comparative political economy framework how national interest considerations, resource endowment circumstances, countries' historical experience in tackling supply risk and their respective policy styles influenced the development of policy choices regarding rare earths. The overall findings show that despite their similar objectives, the foci of strategies differ across regions. While Europe's efforts target policy dialogue with resource-rich countries, Japan and the United States have a more hands-on approach in research and development initiatives. Australia's and China's policies instead, focus on development of domestic mining activities and on resource protection.

Taken together, the results of the three chapters convey the message that uncoordinated transition to new energy systems might create bottlenecks to socio-economic, technological and geopolitical systems globally. The dissertation therefore argues for a three-dimensional coordination within a bottom-up climate change policy architecture: within national policies, across national policies and beyond sectoral policies. In fact, in order for climate change policies to be beneficial at country level both environmentally and economically, coordination across countries is required to prevent leakage from countries with more stringent to those with less stringent policies. On top of this, each country should also develop its own multilevel and possibly polycentric system of governance by involving stakeholders at all levels, in order to accommodate the particular domestic contexts and national interests. Finally, besides coordination within sectoral policies, this also needs to occur beyond the sector in order to reflect the interconnections between climate change mitigation, energy and minerals, and potentially other resources. Therefore, from the policy perspective the main contribution of this dissertation is to provide evidence of the need for devising sustainable and equitable climate change mitigation policies, by taking into consideration the distinct and often competing sub-national, national and sectoral collective action mechanisms.