Environment and Development Economics 20: 425–433 © Cambridge University Press 2015
doi:10.1017/S1355770X15000145

Climate change mitigation and adaptation in developing and transition countries: introduction to the special issue

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Submitted 13 April 2015; accepted 15 April 2015

ABSTRACT. While mitigation efforts in developed and emerging economies are necessary in order to meet ambitious climate targets, the international community strives to explore strategies to help the most vulnerable populations to cope with the short-term and long-term impacts of climate change. In the perspective of the 21st COP of the UNFCCC (Paris, December 2015), this Special Issue on 'Climate change mitigation and adaptation in developing and transition countries' addresses two complementary topical

This special issue is partly constituted of contributed papers from the 2nd international conference 'Environment and Natural Resources Management in Developing and Transition Economies', hosted by CERDI (Center for Studies and Research on International Development, http://www.cerdi.org), University of Auvergne, Clermont-Ferrand (France) in October 2012. All papers underwent the usual refereeing process of *Environment and Development Economics*. Guest editors are indebted to Anastasios Xepapadeas and to anonymous referees who greatly helped in improving the papers. They thank the FERDI (Fondation pour les Etudes et Recherches sur le Développement International) which supported the preconference on 'Migration and the Environment', and the ANR (Agence Nationale de la Recherche) for its financial support through the 'Grand Emprunt' and the LABEX IDGM+ (ANR-10-LABX-14-01) mechanism. The usual disclaimers apply.

https://doi.org/10.1017/S1355770X15000145 Published online by Cambridge University Press

issues. On the one hand, migration – international and internal – and remittances are analyzed as adaptation strategies for vulnerable households and individuals. On the other hand, climate policies in emerging economies are examined in light of their distributional impacts for households and of the strategic issues they may raise. This special issue introduces five papers with a diversity of approaches, e.g., game theory, econometric modeling and computable general equilibrium (CGE) modeling.

In the late 1990s, several developed and transition countries agreed to commit themselves to climate change mitigation. This agreement created the hope of achieving effective international climate governance. The recent synthesis report of the Intergovernmental Panel on Climate Change (IPCC), however, provides evidence that this is all but the case: current greenhouse gas emissions are 'the highest in history' (IPCC, 2014a). Widespread effects on human and natural systems are therefore to be expected. This is all the more true for developing and emerging economies which strive to achieve three broad objectives: better environment, good economic performances, and poverty reduction as targeted by the Millennium Development Goals.

Paraphrasing Friedman (1968), there is largely agreement on these major sustainable development goals but less agreement that they are mutually compatible. They might, for instance, collapse into the so-called environment development dilemma (see, for example, Combes Motel *et al.*, 2014). Solving the latter is increasingly important in light of recent studies which show evidence of accelerated rates of changes: decennial temperature changes are increasing (Smith *et al.*, 2015). The time needed for adaptation is therefore shrinking and effective climate policies need to be urgently implemented, especially in developing and transition economies which are deemed to be global major emitters but at the same time will be more vulnerable to climate change than developed countries (Mendelsohn *et al.*, 2006).

This special issue is dedicated to exemplifying these two related issues while providing a selective sample of papers. The first set of papers addresses the issue of adaptation focusing on migration. The second set of papers concentrates on the consequences of the implementation of climate policies in developing countries.

1. Migration, remittances and climate change adaptation

The first set of papers in this special issue on 'Climate change mitigation and adaptation in developing and transition countries' is devoted to exploring migration and remittances in the context of climate change. As noted in the *Fifth Assessment Report of the IPCC*, migration can be seen as one adaptation strategy among others (IPCC, 2014b). It is therefore important to increase our knowledge of how migration responds to climate change and what role migrants' remittances can play in the adaptation to climate change in the origin countries. The paper by Nicola D. Coniglio and Giovanni Pesce (2015) studies international migration flows, whereas the paper by Brinda Viswanathan and K.S. Kavi Kumar

https://doi.org/10.1017/S1355770X15000145 Published online by Cambridge University Press

(2015) studies internal migration in a major emerging economy, India. Finally, the paper by Cécile Couharde and Rémi Generoso (2015) is entirely devoted to remittances and their impact on the macroeconomic performance of West African countries conditional on the prevailing rainfall conditions.

1.1. International migration

Climate-induced out-migration raises concerns in the international community and public opinion. Indeed, international migration is seen as one adaptation strategy among others. It is therefore essential to understand under which settings it is the preferred strategy of households to cope with climatic shocks. Coniglio and Pesce's analysis draws upon previous studies dedicated to the climate–international migration relationship. While a growing number of studies explore this nexus, most are micro-level studies at the level of individuals or households (see Piguet, 2010). Coniglio and Pesce add to this strand of literature by employing a macro approach in order to capture aggregate net effects. In this respect, their analysis is complementary to the macro-level study by Beine and Parsons (2015). Indeed, the latter examine the impact of long-run climatic factors on international migration and find evidence of indirect effects through wages.

Climate variability may lead to international migration though two channels (see Coniglio and Pesce, 2015, figure 1). Direct effects refer to situations where livelihoods reduce the possibilities for human survival (push factor) and where individuals' future expectations are modified (current and expected push and pull factors). Indirect effects refer to environmentally induced social conflicts and to changes in market prices such as wage differentials between origin and destination countries. Obviously, the climate–international migration nexus is dependent on the degree of resilience of households and on other conditioning factors. More resilient households may rely on alternative coping strategies such as internal migration and remittances.

Given the complexity of these interactions, Coniglio and Pesce start by presenting a theoretical framework on which they build their empirical model. The authors conduct their analysis using annual data from the OECD International Migration Database, which include bilateral migration flows toward OECD countries. The analysis covers the period 1990–2001 for 128 origin countries and 29 destination countries. One of the contributions of this paper is the use of different measures of climatic shocks and anomalies. Using the TYN CY 1.1 data set (Mitchell *et al.*, 2003), the authors compute measures for absolute levels of precipitation and temperature, surplus (or deficit) of precipitation and temperature, climatic anomalies, intra-annual rainfall variability, and seasonal effects of climatic shocks. This rich set of variables allows for capturing the fact that climate shocks are multi-faceted.

In their results, Coniglio and Pesce highlight differentiated effects according to the types of climatic variables. Globally they find evidence of both direct and indirect effects of climate shocks in origin countries on out-migration from poor to rich countries. The results are robust to

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the use of an alternative source of data for the dependent variable, i.e., the international bilateral migration flows of the UN Population Division (2011).

1.2. Internal migration

Turning to internal migration, the paper by Brinda Viswanathan and Kavi Kumar (2015) follows Feng *et al*. (2010, 2012) in estimating the sensitivity of migration with respect to crop yields. The identification strategy relies on yield shocks due to exogenous variation in weather. The authors use census data from 1981, 1991 and 2001 for 15 major Indian states and data on rice and wheat yields, as well as net state domestic agricultural product per capita. The definition of migrants is based on the stock of the population in a state that originated from a rural area in another state one to four years from the census date, and between five and nine years from the census date. The dependent variable is the out-migration rate from a state, calculated as total migrants according to these two definitions over the average of the total rural population in the origin state. The analysis is thus based on five-year averages of migrants, crop yields, net state domestic agricultural product and rainfall and temperature levels. The weather data are from a database of the Indian Meteorological Department with a resolution of 1.0×1.0 degree grid. The estimations are done using two-stage least-squares and fixed-effects limited-information maximum-likelihood estimators.

The results imply that the elasticity of the inter-state out-migration rate with respect to per capita net state domestic agricultural product is -0.775, indicating that a 1 per cent decline in the value of agricultural output related to weather variations results in a 0.7 per cent increase in the out-migration rate. The crop-wise analysis shows that a 1 per cent decline in rice (wheat) yield leads to a nearly 2 per cent (1 per cent) increase in the rate of out-migration from a state, but the effects of the specific crop yields are statistically significant only at the 10 per cent level.

Viswanathan and Kumar also analyze the district data from the 2001 census, but since no data are available on the exact origin of the migrants, only in-migration can be studied at this level. District migrant origin can only be separated according to whether they come from another area of the district they are currently enumerated in, another district in the same state, or from a district in another state. The estimations at the district level for these three categories of migrants indicate that in-migration into a district varies positively with wheat yield shocks and negatively with rice yield shocks. However, since the district-level analysis uses two-period panel data constructed from a single Census, it provides relatively less robust results compared to the state-level analysis because of the inherent data limitations. The study's results at the state level, however, show a robust effect of weather variables on the net state domestic agricultural product and that it influences out-migration rates, in its turn. The results show that migration may well be one likely adaptation option in India, at least from the rural areas.

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1.3. The role of migrants' remittances in the macroeconomic performance of West African countries facing climate variability

When analyzing migration as a possible adaptation strategy, its impact on the agricultural sector and the economy in the origin countries is one important subject. One of the major implications of migration is the flow of remittances from migrants abroad to the origin countries and their use in helping adaptation to climate change. This is the topic of the paper by Couharde and Generoso (2015), which investigates the consequences of remittances inflows on the macroeconomic performance of West African countries over the 1985–2007 period. The West African countries are among the most vulnerable to climate change and remittances also play an important role for their economies. As Ebeke and Combes (2013) show, remittances can dampen the negative effects of natural disasters. The paper by Couharde and Generoso contributes to the analysis of the macroeconomic impacts of remittances by estimating a panel conditional homogenous vector autoregressive (PCHVAR) model that has the advantage of exploiting the panel nature of the data and allowing for heterogeneity in the countries' dynamics in response to an exogenous shock. In particular, the authors control for rainfall shocks in the countries studied, and they also analyze how the state of the financial sector affects the impact of remittances. Couharde and Generoso study the following variables: real GDP per capita, agricultural value added per capita, and agricultural imports per capita. The measure of financial development is private credit by deposit money banks and other financial institutions as a percentage of GDP.

The results by Couharde and Generoso show that the impact of remittances on macroeconomic performance is highly sensitive to the nature of the weather shock. On the one hand, the authors find no evidence of an indirect effect from the consumption of remittances on GDP, since remittances only explain less than 6 per cent of the variance in GDP during normal weather conditions. On the other hand, agricultural value added per capita responds strongly to remittances during both positive and negative rainfall shocks. Under humid conditions, a positive shock on remittances leads to an immediate increase in agricultural value added followed by a decrease in agricultural imports in the next period. Remittances are also found to have a positive impact on financial development.

When drought conditions prevail, however, remittances no longer exert any short-term spillover effects on growth and may increase a situation of economic dependence, by spurring agricultural imports. Couharde and Generoso also find that the link between remittances and the state of financial development in the countries studied is non-linear and dependent on the weather conditions. Adverse weather conditions seem to act as a constraint on the complementary link between remittances and financial development. Households in drought-struck countries in Western Africa may therefore prefer to rely more on informal financial services when they face adverse weather events.

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2. Climate policies and developing countries: distributional and strategic issues

Whereas the first set of papers in this special issue focuses on the role of migration and remittances as a form of adaptation to climate change, the second set of papers is devoted to climate policy directly. They explore one key issue of the current debate on climate policies since they pay particular attention to emerging countries that are (or are on the way to becoming) major greenhouse gas emitters. Matthias Weitzel, Joydeep Ghosh, Sonja Peterson and Basanta K. Pradhan (2015) evaluate the distributional impacts related to the implementation of climate policies in India, and Charles F. Mason, Edward B. Barbier and Victoria I. Umanskaya (2015) examine how far unilateral trade policy from a developed country changes the emissions profile and trade flows from an exporting transition economy. Both papers use complementary approaches: while Weitzel *et al*. rely on general equilibrium modeling and simulations, Mason *et al*. develop a game theoretic approach and focus on the design of second-best climate policies.

2.1. The distributional impact of climate policies

Despite substantial progress in reducing poverty rates, India remains a developing country with a per capita GDP of US$5,411.6 in 2013 (in PPP) (World Bank, World Development Indicators). At the same time, India is an emerging economy with rapid economic growth. Not surprisingly, CO_2 emissions are increasing, India being third in terms of absolute emissions (World Bank, 2012).[1] While economic growth and poverty alleviation remain at the heart of the country's strategy, India has pledged to reduce carbon emissions in the Copenhagen Accord. What is more, mitigation efforts in emerging countries are necessary in order to meet ambitious international climate targets.

Within this context, Weitzel *et al.* (2015) explore welfare and income gap changes for Indian households due to international climate policy. The purpose is twofold. First, they wish to understand how a climate policy would affect poor households – that is, to highlight distributional effects of international climate policy. Secondly, they wish to outline the impact of the different channels of a climate policy.

To address these questions, Weitzel *et al*. rely on scenarios, by using a CGE model. Existing articles tend to be very aggregated or to ignore international effects. Here, the authors overcome such shortcomings by combining – soft-linking – the multi-regional CGE model DART (entire world economy) and the IEG[2]-CGE model for India. This approach allows for capturing the distribution and allocation effects of international climate policy regimes for the specific Indian context while accounting for the impact of international transfer payments and price repercussions on international markets. In addition, Weitzel *et al*. can address additional questions such as the robustness of the results from the national model when there are changes in the outside world. Both models share common

[1] This ranking holds if Europe is not taken as one entity.
[2] Institute of Economic Growth.

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characteristics, yet DART is more aggregated. IEG-CGE allows for disaggregating sectors in a finer way (notably for the electricity sector). Another difference is that there is one representative agent in DART in each region (given that there are 13 regions including India), whereas in IEG-CGE households are classified into five rural and four urban categories. Soft-linking the two models is thus an interesting way to address the research objectives of this paper.

Taking 2050 as a time horizon, Weitzel *et al*. consider various scenarios that provide important insights on the repercussions of climate mitigation policies. They look at the welfare impacts of a domestic carbon tax and simulate different allocations of the tax revenue. Then they conduct similar analysis by adding international financial transfers (i.e., India selling allowances on a carbon market) to the model. They continue by addressing welfare variations induced by changes in international fossil fuel markets. On the whole, these scenarios highlight the different distributional effects of climate policies; the different groups of households are affected very differently according to the policy and redistribution schemes.

2.2. Trade policy and climate mitigation

Global negotiations on climate (The Conference of the Parties, COP, to the UNFCCC) and trade (e.g., Doha Round) have yet not achieved agreements leading to effective mitigation of environmental degradation. As regards climate mitigation, de Melo and Mathys (2012) point out that global climate and trade policy regimes are on a collision path. Moreover, Peters *et al.* (2011) show evidence that the stabilization of emissions in developed countries coincided with a rise in imported CO_2 from developing and emerging countries. Reconciling trade and climate policies is therefore on the agenda. One option might be to consider some kind of polycentric action as suggested by Ostrom (2010) or initiatives from small groups of countries. Several authors, e.g., Keen and Kotsogiannis (2014), explored this issue with border trade adjustments (BTAs) and discussed the circumstances under which BTAs could help achieve efficient climate policies. The contribution of Mason *et al.* (2015) illustrates further how trade policy can be harnessed as a climate mitigation policy. The originality of their study is to adopt a game theoretic setting rather than a general equilibrium framework and especially to explicitly address the very dynamic nature of climate change.

Mason *et al*. consider two different countries. One is a transition exporting country and the other is a developed importing country. They produce the same single good with CO_2 emitted as a byproduct. Trade flows are unidirectional and the transition country puts less emphasis on damages generated by CO_2 emissions. In the absence of an international agency, the developed country implements a (unilateral) BTA against imports from the transition country in order to control the intensity of CO_2 emissions. Mason *et al*. derive the second-best border tax using a differential game model, i.e., a dynamic non-cooperative game between two asymmetric countries. They explore the effects of BTA on trade and pollution, which are conditional on the transition country's preferences towards the environment. While conventional wisdom suggests that BTA on exports from emerging countries

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would increase leakage, Mason *et al*. establish more contrasted results. For instance, in the case of an exporting country that cares about carbon stock externalities, the imposition of a border tax in the developed country gives incentives to the exporting country to implement a climate policy. This result is of the highest importance in the perspective of the 21st COP of the UNFCCC to be held in Paris in December 2015. It does not, however, preclude closer international cooperation towards linking top-down and bottom-up approaches in climate policies (Green *et al*., 2014).

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