Energy Policy 63 (2013) 951–961

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Monetary compensations in climate policy through the lens of a general equilibrium assessment: The case of oil-exporting countries

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HIGHLIGHTS

- We endogenize the interplay between climate policy, oil markets and the macroeconomy.
- We quantify the transfers to compensate climate policy losses in oil-exporting countries.
- We assess the general equilibrium effect of monetary transfers in opened economies.
- The macroeconomic efficiency of transfers is altered by general equilibrium effects.
- Monetary compensation schemes are not efficient for oil exporters in climate policy.

ARTICLE INFO

Article history:
Received 18 February 2013
Accepted 9 August 2013
Available online 13 September 2013

Keywords:
Monetary transfers
Oil exporters
Climate policy

ABSTRACT

This paper investigates the compensations that major oil producers have claimed for since the Kyoto Protocol in order to alleviate the adverse impacts of climate policy on their economies. The amount of these adverse impacts is assessed through a general equilibrium model which endogenizes both the reduction of oil exportation revenues under international climate policy and the macroeconomic effect of carbon pricing on Middle-East's economy. We show that compensating the drop of exportation revenues does not offset GDP and welfare losses because of the time profile of the general equilibrium effects. When considering instead compensation based on GDP losses, the effectiveness of monetary transfers proves to be drastically limited by general equilibrium effects in opened economies. The main channels of this efficiency gap are investigated and its magnitude proves to be conditional upon strategic and policy choices of the Middle-East. This leads us to suggest that other means than direct monetary compensating transfers should be discussed to engage the Middle-East in climate policies.

1. Introduction

The compensation of developing countries for the adverse impacts of climate change and climate policies is one of the constant stumbling blocks of international climate negotiations. These adverse impacts encompass three distinct issues: climate change damages, higher energy prices affecting households' purchase power and firms' production costs and the reduction of exportation revenues in fossil fuel producing economies. Historically, it is under pressure of Middle-East countries and the Organization of the Petroleum-Exporting Countries (OPEC) that these concerns have been officially acknowledged at different stages of international negotiations, since article 4.8 of the UNFCCC[1] and article 3.14 of the Kyoto protocol[2] (Barnett and Dessai, 2002) until, more recently, Article 1 of the 2009 Copenhagen Agreement.[3]

This repetition is the sign that no tangible progress could be made about this sticking point of climate negotiations in the past

DOI of original article: http://dx.doi.org/10.1016/j.enpol.2012.06.005
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0301-4215/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.enpol.2013.08.055

[1] It commits parties to give: "full consideration to […] to the specific needs and concerns of developing country parties arising from the adverse effects of climate change and/or the impact of the implementation of response measures, especially on […] countries whose economies are highly dependent on income generated from the production, processing and export of fossil fuels and associated energy-intensive products".

[2] It requires developed countries to implement their Kyoto commitments "in such a way so as to minimize adverse social, environmental and economic impacts on developing country parties", particularly those identifiedin Articles 4.8 and 4.9 of the Convention.

[3] , which recognizes "the potential impacts of response measures on countries particularly vulnerable to its adverse effects".

decades. This impasse has obvious political roots, i.e. the reluctance of developed countries to grant large transfers towards countries perceived as rent seekers, especially in a context of public budget constraint. But, beyond this political dimension, compensations based on monetary transfers raise questions about both their amount and their efficiency for sustaining economic activity in a general equilibrium vision. This paper tries and frames these two sides of the compensation problem.

The first question relates to the evaluation of climate policy losses in oil-exporting countries, which defines the compensations but remains a controversial topic in the literature. General equilibrium energy-economy models predict significant costs[4] whereas dynamic partial equilibrium models find moderate losses.[5] These opposite conclusions are related to the assumptions underlying the two approaches. The former conventionally assumes optimized trajectories under perfect foresight and flexible technical and market adjustments, which comes down to overlooking the potential co-benefits of climate policies permitted by the correction of baseline sub-optimalities. The latter do not consider the feedback effects of the oil sector on macroeconomic indicators and hence do not account for the reduction of world oil demand under climate policy, a potentially major adverse impact on oil-exporting economies. One ambition of this paper is thus to provide a comprehensive assessment of the cost of climate policy in oil-exporting countries through a combination of these two approaches, i.e. in a hybrid top-down/bottom-up framework (Hourcade et al., 2006).

The second question relates to the effect of monetary transfers on economic activity and welfare in the recipient country, which has been investigated in a large body of literature on the empirics of “development aid and growth”. A recent survey by (Doucouliagos and Paldam, 2011) shows however that no univocal message can be derived from existing assessments. Some support the idea that development aid promotes growth,[6] whereas others find it growth-neutral[7] or even contributing to depress activity through indirect mechanisms undermining aid effectiveness (Rajan and Subramanian, 2005). Among these, (Rajan and Subramanian, 2011) typically demonstrate the role of real exchange rate overvaluation when trade effects and structural lock-ins are accounted for. This mechanism is a source of the ‘natural resource curse’ through its negative effect on local competitiveness and socio-economic development (e.g., Sachs and Warner, 2001; Frankel, 2010; Ross, 2012). It is a particularly important dimension for the evaluation of monetary compensations in Middle-East countries and it calls for endogenizing terms-of-trade adjustments.

We try and respond these two methodological challenges through a hybrid Computable General Equilibrium (CGE) energy-economy model that captures the limited flexibility of technical and economic adjustments under imperfect foresight, describes the domestic effects of adjustments on the terms-of-trade and endogenizes long-run structural change in response to price signals and geopolitical strategies (Section 1). This model is used to estimate the socio-economic consequences of an international climate policy on oil markets and its adverse impacts on Middle-East countries in terms of exportation revenues and macroeconomic activity (Section 2). This assessment serves as a basis for estimating the monetary transfers Middle-East countries may claim for in a climate policy context under two options depending whether they compensate losses of oil revenue or of economic activity (Section 3). An analytical study demonstrates that general equilibrium effects in a second-best setting create the risk of an efficiency gap, i.e. that the *ex-post* benefit of transfers is lower than predicted with an *ex-ante* calculation, and isolates its crucial determinants (Section 4). Finally, numerical assessments confirm the relatively poor efficiency of monetary transfers to actually sustain economic activity in Middle-East economies (Section 5). Section 6 concludes on the implications of this analysis for international negotiations and, in particular, on the trap of reducing the compensation problem in climate negotiations to a question of monetary transfers.

2. Modeling long-term oil markets in a globalized economy

This paper adopts the Imaclim-R model, which has been developed for the analysis of energy and climate issues at a long-term horizon, and this section summarizes its specificities that are of particular importance for the topics of this paper.[8]

2.1. General structure of the Imaclim-R model

Imaclim-R is a recursive CGE model of the world economy, which endogenizes the interplay between the dynamics of oil markets and the macroeconomy over the 2001–2050 period through the recursive succession of annual static equilibria and dynamic modules (Fig. 1).

The *static equilibrium* represents short-run macroeconomic interactions at each date t under technology and capacity constraints. It is calculated assuming Leontief production functions with fixed intermediate consumption, labor inputs and mark-up in non-energy sectors.[9] Households maximize their utility through a tradeoff between consumption goods, mobility services and residential energy uses considering fixed end-use equipment. Market clearing conditions lead to a partial utilization of production capacities, given the fixed mark-up pricing and the stickiness of labor markets. This equilibrium provides a snapshot of the economy at date t in terms of relative prices, wages, employment, production levels and trade flows.

The *dynamic modules* are reduced forms of bottom-up models, which describe the evolution of structural and technical parameters between t and $t+1$ in response to past and current economic signals. At each year, regional capital accumulation is given by firms' investment, households' savings, and international capital flows. On that basis, the across-sector distribution of investments is governed by expectations on sector profitability and technical conditions as described in sector-specific reduced forms of technology-rich models (referred to as Nexus modules and described in details in the Supplementary Material of (Waisman et al., 2012)). The Nexus modules represent the evolution of technical coefficients resulting from agents' microeconomic decisions on technological choices, given the limits imposed by the

[4] In a survey of modeling exercises, (Barnett et al., 2004) estimate that the implementation of the Kyoto Protocol would reduce oil exportation revenues by 9.8% to 13%, and decrease real income by up to 3% in 2010. At a longer term horizon, (van Vuuren et al., 2003) estimate that a 550ppm target would induce a 35% decrease of oil revenues in OPEC countries in 2050 and (WBGU, 2003) obtains that the total abatement cost can reach approximately 2 per cent of GDP in Middle East at the same horizon.

[5] Some studies even obtain that a climate policy can be beneficial to the producers of conventional oil by affecting more the cost of their substitutes (unconventional oil, coal) (Persson et al., 2007) or by fostering an increase of conventional oil rents in OPEC if they can exert their market power (Johansson et al., 2009).

[6] See, among others, (Burnside and Dollar, 2000; Guillaumont and Chauvet, 2001; Collier and Dollar, 2001; Dalgaard et al., 2004; Minoiu and Reddy, 2010).

[7] e.g., (Boone, 1996; Easterly et al., 2004; Easterly, 2005).

[8] The Imaclim-R model has been used in several publications about oil markets (Rozenberg et al., 2010; Waisman et al., 2012b) and the comprehensive description of its analytical structure and numerical assumptions is given in (Waisman et al., 2012a).

[9] For an extensive discussion about production/cost functions in the energy field, see (Saunders, 2008).