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Technology transfers and the clean development mechanism in a North–South general equilibrium model

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ABSTRACT

This paper analyses the potential welfare gains of introducing a technology transfer from Annex I to non-Annex I in order to mitigate greenhouse gas emissions. Our analysis is based on a numerical general equilibrium model for a world-economy comprising two regions; North (Annex I) and South (non-Annex I). In a cooperative equilibrium, a technology transfer from the North to the South is clearly desirable from the perspective of a 'global social planner', since the welfare gain for the South outweighs the welfare loss for the North. However, if the regions do not cooperate, then the incentives to introduce the technology transfer appear to be relatively weak from the perspective of the North; at least if we allow for Southern abatement in the pre-transfer Nash equilibrium. Finally, by adding the emission reductions associated with the Kyoto agreement, our results show that the technology transfer leads to higher welfare in both regions.

1. Introduction

The importance of international cooperation in order to address the climate problem is widely recognised. This is often exemplified by the Kyoto Conference in 1997, which resulted in a protocol with legally binding emission targets. The protocol sets binding targets for the industrialised countries (Annex I), while there are no such commitments for the developing countries (non-Annex I). A relevant question is how the climate policy can be implemented in a cost-efficient way

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in a world where only part of the countries faces explicit emission targets. The importance of cost-efficient implementation has been recognised by the UN Framework Convention on Climate Change (UNFCCC), Art. 3.3, which states that the climate policy should ''ensure global benefits at the lowest possible cost''. In practice, this means that, although the emission targets are imposed on a limited number of countries, there is some flexibility in the implementation of these targets, allowing for a more cost-efficient outcome than would otherwise be accomplished. One way of increasing the cost-efficiency is to introduce technology transfers from Annex I to non-Annex I.[1] Among the countries that have ratified the UN Climate Change Convention, the industrialised countries commit themselves to ''promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other parties, particularly to developing countries, to enable them to implement the provisions of the Convention'' (see Article 4.5 of the UNFCCC). In addition, a technology transfer needs not (necessarily) only be a means of lowering the abatement cost; it may also contribute to economic growth in the host country.[2] However, despite that the idea of technology transfers has received attention in the academic as well as policy discussion, it has so far only played a minor role in practice. In the light of these observations, the purpose of this paper is to examine the likely welfare effects of technology transfers in terms of a numerical general equilibrium model. Our approach will be explained more thoroughly below.

In the Kyoto protocol, the idea of technology transfers is formalised via the 'Clean Development Mechanism' (CDM), allowing Annex I countries to invest in projects aimed at reducing the emissions in non-Annex I countries and, at the same time, relax their own emission targets in exchange for the emission reduction induced by these projects.[3] The purpose of the CDM is ''to assist parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the convention and to assist Annex I countries in reaching their targets''.[4] Previous numerical equilibrium studies typically model the CDM in a way similar to emission trading.[5] However, this approach fails to recognise the first part of the purpose of the CDM (to assist non-Annex I in achieving sustainable development). Another aspect of relevance for our analysis is that the 'non-carbon welfare effects' associated with the CDM are potentially very important for the non-Annex I countries, when they decide on whether or not to participate in projects aiming at lower emissions. In case studies focusing on Brazil, China and India, it is shown that these countries could benefit substantially from many viable abatement projects. The non-carbon benefits include, for instance, improved air and water quality, electrification of rural and remote areas, and increased employment.[6]

In this paper, we simulate the welfare effects of introducing a technology transfer in a stylised world-economy comprising two regions; the North (Annex I) and the South (non-Annex I). Our analysis is based on a numerical general equilibrium, in which agents make intertemporal choices. The data and parameters for the regions are, to a large extent, based on the RICE- and DICE-models.[7] Clearly, the welfare effects of a technology transfer depend on the pre-transfer resource allocation. We consider four different regimes; (i) the regions behave as uncontrolled market economies (which is our reference case), (ii) the regions are imperfectly controlled market economies, which means implementing the emission reductions associated with the Kyoto Protocol in an otherwise uncontrolled market economy, (iii) the pre-transfer resource allocation is a conditional cooperative equilibrium, where 'conditional' means that the resource allocation is

1 See e.g. Forsyth (1999) and Grubb (2000).

2 For a discussion of additional benefits typically provided by projects that include technology transfers, see e.g. UNFCCC (2007). For details about the relationship between foreign direct investments in technology and economic growth, see e.g. Borensztein et al. (1998). See also Ambec and Barla (2006), Wagner (2004) and Roediger-Schluga (2004) for surveys of the literature on investments in environmental capital.

3 There are some recent studies showing that many CDM projects actually involve technology transfers. See e.g. Haites et al. (2006), Youngman et al. (2007) and Coninck de and Haake (2007).

4 See Article 12 in the Kyoto Protocol.

5 See e.g. Ellerman and Jacoby (1998), Zhang (2004) and Anger et al. (2007).

6 See e.g. Austin and Faeth (1999) and Banuri and Gupta (2000).

7 See Nordhaus and Yang (1996).