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Analysis of the partnership network in the clean development mechanism

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HIGHLIGHTS

- We investigate dynamics of the international partnership networks of CDM projects.
- The density of CDM networks tends to decrease by time.
- The partnership networks' leading groups tend to shift into host countries.
- A host country with more partnerships better utilizes global knowledge resources.

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ABSTRACT

The clean development mechanism (CDM) is a global collaborative action proposed at the Kyoto Protocol in response to climate change issues. The CDM contributes to cost-efficient reduction of greenhouse gas emissions in industrialized countries and promotes sustainable development in developing countries. Its fundamental framework is based on partnerships between industrialized and developing countries. This study employs social network analysis to investigate the dynamics of the partnership networks observed in 3816 CDM projects registered in the database of the United Nations Framework Convention on Climate Change over the period of 2005 to 2011. Our three main findings can be summarized as follows. First, the CDM partnership network is a small world; however, its density tends to decrease as the number of participants for a CDM project decreases. Second, the partnership networks' leading groups tend to shift from partner countries into host countries. Third, a host country that pursues more partnership-based projects takes better control of resources and knowledge-flow in the ego-network formed around that country, and can thus better utilize global resources for its CDM projects.

1. Introduction

The clean development mechanism (CDM) is a coordinated response to climate change by industrialized and developing countries. This scheme was proposed by the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC). Under the Kyoto Protocol, 42 ANNEX I countries, most of which are industrialized, have legally binding targets for the reduction of greenhouse gas (GHG) emissions. Non-ANNEX countries, by contrast, have no such obligations. The CDM has two central goals: (1) to facilitate the domestic efforts of ANNEX I countries in meeting their emission reduction targets in cost-efficient ways, and (2) to enable developing countries to participate in global action toward climate issues while encouraging them to achieve sustainable development (UNFCCC, 1997).

CDM involves an intricate procedure to fulfill the dual goals. Initially, a Project Design Document (PDD) describing the proposed activity is submitted to the Designated National Authority (DNA) of the host country to ensure the projects' contribution to the sustainable development priorities of the host country. The approved PDD is validated by a Designated Operational Entity (DOE). DOEs are firms that validate, verify, and certify the activities of CDM projects along the project cycle (UNFCCC, 2001). In the next step, validated PDDs are sent to the Executive Board (EB), which carries out daily supervision of the CDM, to request for registration. Once the project is executed, emission reductions accomplished through CDM projects are verified and certified by the DOE. Finally, the reductions are issued by the EB to participants in ANNEX I countries as Certified Emission Reduction (CER) units. These CER units can be traded in carbon markets where the price is determined by sellers and buyers. Hence, the CDM is considered as a market-based mechanism.

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The CDM can be regarded as a tool that facilitates global network initiatives because a CDM project generally involves a non-ANNEX host country collaborating with an ANNEX I partner country (Streck, 2004). Having more than one host country per project is rare. Not all CDM projects rely on partnerships; occasionally, host countries are allowed to perform emission reduction activities by themselves in unilateral CDM projects.

The impact of international collaboration on climate protection is a topic of debate for politicians, industrial actors, and researchers. Several reasons have been provided with regard to the necessity of global action on CO_2 reduction. First, the problems brought by climate change are not confined to the local level; environmental issues such as carbon emission are transboundary in nature and have global consequences (Lueth et al., 1997). Therefore, countries must cooperate to address these issues effectively. Second, research indicates that collaboration between industrialized and developing countries can considerably lower the costs of mitigating climate change on both national and international levels (Barker et al., 2009; Fichtner et al., 2001), because developing countries have enormous potential to decrease their emissions by applying less-expensive and intuitive technologies. In comparison, developed countries have nearly reached the limit of their domestic capacities for emission reduction. Finally, international collaboration on climate protection is expected to contribute to innovation in developing countries by distributing technologies and creating social benefits (Forsyth, 2005; Haites et al., 2006).

However, concerns have been raised regarding unevenly distributed CDM partnerships, with more than 84% of projects being concentrated in Asia-Pacific countries. Decision 17/CP.7 of the Marrakech Accords highlights the "need to promote equitable geographic distribution of CDM project activities at regional and sub-regional levels (UNFCCC, 2001)." Nevertheless, minority countries benefit from the emission reductions and profits from the CER trade, whereas least developed countries, which are more vulnerable to climate change and regard external aid with more importance, have far less opportunities to take advantage of their participation in CDM projects. As a result, conflicts between countries have emerged. In recent meetings on climate change, confrontations between the biggest carbon emitters (China, the United States, and India) and the least developed or small-island developing countries have been observed. In 2011, the 17th Conference of the Parties (COP) in Durban decided on extending the current system, where developed countries adopt binding targets while developing ones only commit to voluntary action, until the new commitment is implemented by 2020. As the CDM is also expected to continue the current format with several methodological improvements, suggestions are sought to minimize the drawbacks in existing CDM partnerships.

This study employs social network analysis (SNA) to evaluate whether partnership activities under the current CDM scheme have fulfilled the fundamental goals of the CDM. The SNA demonstrates the development of partnerships and the collaboration dependency between CDM participants, as well as which side has the greatest influence in the CDM network. This study also compares the egocentric networks of major host countries in CDM projects, and analyzes the effects of their various collaboration tendencies on their social network properties.

The SNA of the CDM is carried out at the country level to observe the collaboration dependency among countries, as well as their roles and positioning within the CDM network. Unlike purely descriptive statistics, the SNA provides valuable data for evaluating qualitative aspects of partnership between countries. For example, a country can be an active CDM recipient country in quantitative terms, but may exert considerably less influence on the entire network in terms of technology transfer and global initiative when a country has an ineffective partnership structure. The anticipated effects of this analysis are twofold. On one hand, the study results are relevant to country-specific factors that influence the attractiveness of counterpart organizations applying for a CDM project. On the other hand, an SNA at the country level can derive richer implications for developing policies that target a better distribution of CDM benefits worldwide and aid participating countries to effectively deal with inter-governmental discourses and negotiations.

The rest of the study is organized as follows. Section 2 reviews previous studies on the effects of partnership on innovation and climate change, country-specific collaboration characteristics, and frameworks for selecting counterpart countries. Section 3 presents a general introduction to social network analysis and other selected methodologies for this study. Section 4 describes the data applied to investigate CDM networks. Section 5 analyzes three aspects of CDM networks: the dynamics of these networks over the last seven years, the changes in the network position of participating countries, and a comparison of host countries' ego-networks. Finally, Section 6 concludes by discussing the strategic direction and policy for international collaboration actions to develop the CDM scheme more successfully.

2. Literature review

Over the last decade, much research has emphasized the importance of collaboration in innovation. Faced with growing global competition, shortened time-to-market, and increasing R&D costs, innovation has become increasingly open, achieving an efficient integration of internal and external resources (Chesbrough, 2003). Collaboration has many positive effects on innovation. First, it enhances the complementarity of resources and capabilities required for the development of complex technologies, in which a number of different disciplines and thematic fields are involved. Collaborations enable researchers to incorporate different sets of knowledge (Stephan, 1996). Second, collaborations help synergize knowledge creation by enhancing the division of tasks and scale economies in innovation activities (Adams et al., 2005; Katz and Martin, 1997). Finally, innovation-minded collaboration is an effective tool for internalizing asymmetric knowledge spillovers: it supports the diffusion of technologies, particularly the collaborators' tacit knowledge (Dyer and Nobeoka, 2000).

Climate change mitigation can also be viewed from an innovation standpoint. This view highlights the importance of a collaborative approach to the development of innovation in CO_2 reduction activities. Innovations in environmental fields, such as climate change, have inherent multidimensional characteristics and should therefore be addressed using an interdisciplinary approach (Del Rio, 2008). This condition puts stress on the integration of different sectors' resources and capabilities. Participating in international collaboration for climate change mitigation may provide developing countries with opportunities to uplift their local economies, environments, and technological foundations to levels at par with those of developed countries.

The impact of global partnerships on CDM recipient countries' innovation capacities has been analyzed by empirical research evaluating CDM performance. Dechezleprêtre et al. (2008) confirmed that CDM projects promote technology transfer and knowledge spillover to developing countries. Schneider et al. (2008) defined the main determinants of technology transfer and investigated CDM's contribution to them. For CER, 64% of CDM projects were found to be related to technology transfers. As for CDM, the resulting technology transfer could be classified into transfer of knowledge through training by, and involvement of, foreign experts, the transfer of equipment through