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International low carbon technology transfer: Do intellectual property regimes matter?

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ABSTRACT

Transfer of low carbon technologies to developing countries has been recognized as important in global efforts to limit climate change. Yet the mechanics of international technology transfer, especially around intellectual property rights, have remained a controversial issue in international negotiations. Using a new dataset on international partnerships in China and India in three key low carbon technologies—solar photovoltaics, electric vehicles, and coal gasification/integrated gasification combined cycle—and complementary expert interviews we study the dynamics of the transfer of intellectual property and the underlying drivers that guide the development of business strategies and partnerships in the context of transitioning intellectual property regimes in emerging markets. We find that weak intellectual property regimes are indeed a hindrance to the diffusion of certain classes of low carbon technologies: (i) for cutting-edge technologies, (ii) for fully-embodied (explicitly codified) technologies, and (iii) for small firms. However, we also find that intellectual property issues do not represent a barrier to the diffusion of the relatively mature and low to medium cost low carbon technologies that are materially (at scale) most important for carbon dioxide emissions reduction in the short to medium term. Competitive technology supply, shifting market dynamics, and increasingly vigorous domestic innovation coupled with mechanisms and opportunities to structure credible intellectual property deals allow for the diffusion of key low carbon technologies to occur within the context of existing business, political, and institutional structures.

1. Introduction

With their large and burgeoning economies and emissions of greenhouse gases, the group of developing countries, especially China and India, are important participants for helping address the climate change problem (Hufbauer et al., 2009; IEA, 2012b; Ockwell et al., 2008; Ockwell and Mallett, 2012; Victor, 2011). Indeed, increasing international pressure as well as creaking domestic energy supply chains are forcing both these countries to rethink their energy strategy, including the implications for greenhouse gas emissions (Hufbauer et al., 2009; Liu and Liang, 2013; Rai and Victor, 2010; Victor, 2011).

Policies for innovation and diffusion of low carbon technologies take the center stage in global efforts to limit the impacts of climate change (Gallagher et al., 2012; IPCC, 2012; Ockwell and Mallett, 2012; Williams et al., 2012). The massive emissions reductions that nearly all models deem necessary to limit climate change can only be possible through the large-scale diffusion of low carbon technologies such as energy-efficient appliances, solar and wind for power generation, smart grids, advanced transmission networks, and carbon capture and storage (de Conink et al., 2008; Dechezleprêtre et al., 2011; IPCC, 2000, 2012; Ockwell et al., 2008; Sanden and Azar, 2005). As the spread of low carbon technologies is characterized by market failures and externalities, policy intervention is often necessary (Barton, 2007a; Clarke et al., 2006; de Conink et al., 2008; Dechezleprêtre et al., 2012; IPCC, 2000, 2012; Jaffe et al., 2003; Popp, 2010). Partly because of concerns about climate change and largely for other reasons, both China and India have embraced a slew of low carbon technology friendly policies over the last few years (APCO, 2010; Dechezleprêtre et al., 2012; Hufbauer et al., 2009; Lewis, 2007; Ockwell et al., 2008).

At the same time, in international diplomatic negotiations under the United Nations Framework Convention on Climate Change (UNFCCC), developing countries have consistently demanded an active international push for "technology transfer" of low carbon technologies (Cazorla and Toman, 2000; Khor, 2011; Lema and Lema, 2013; Maskus, 2010; Ockwell et al., 2010). In

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general, intellectual property (IP) rights have been a point of huge contention in international negotiations surrounding climate change mitigation and in the transfer of low carbon technologies to developing nations (Dechezleprêtre et al., 2011; IPCC, 2012; Khor, 2011; Lee and Mansfield, 1996; Lema and Lema, 2013; Maskus, 2004, 2010; Ockwell et al., 2010; Ockwell and Mallett, 2012). The developing nations have argued that increasing demands for them to reduce their emissions must be accompanied with greater technology transfer, without which they would be incapable of doing much on mitigation of greenhouse gas emissions (Altenburg et al., 2008; Cazorla and Toman, 2000; Khor, 2011). A specific proposal that has gathered support among developing nations argues that low-carbon technologies are public goods and, as such, intellectual property rights for these technologies should be pooled in a collective global pool; an international fund could then purchase the intellectual property rights in this pool and make them available to developing countries or could help developing countries access these intellectual property rights at a low cost, possibly with the support of international funds (Khor, 2011; TWN, 2008). Implicitly tied to the same discussions have been the desire and need to maintain selective and flexible levels of stringency of intellectual property rights in developing countries (Dechezleprêtre et al., 2011; Maskus, 2010; Reichman, 2009; Oliva, 2008). On the contrary, businesses, who own most of the intellectual property surrounding low carbon technologies internationally, and developed nations have opposed such calls (Barton, 2007a; Dechezleprêtre et al., 2011; Harvey, 2008; Lee and Mansfield, 1996; Maskus, 2010; Ockwell et al., 2010; Oliva, 2008), arguing that technologies diffuse through natural marketplace dynamics, and that in the context of low carbon technologies stronger intellectual property regimes would make it easier for them to transfer more low carbon technologies to developing countries (Harvey, 2008; IPCC, 2000; Lee and Mansfield, 1996; Maskus, 2010; Reichman, 2009; World Bank, 2010).

The aim of this study is to understand how the structure of intellectual property regimes conditions the drivers, mechanisms, and level of international technology transfer in low carbon technologies. Specifically, we examine the following questions:

(1) How much is weak intellectual property protection a hindrance to the international flow of low carbon technologies? What other factors (such as market access) than just the strength of the intellectual property regime drive international technology flows?
(2) In addition to securing best possible intellectual property protection where necessary and possible, what are the emerging sets of business strategies (such as joint ventures, etc.) that innovative firms are employing to maintain a competitive advantage in the face of new market and technological realities?
(3) How the coupled technological, market, and, intellectual property-related institutional dynamics shape further innovation and diffusion of low carbon technologies?

2. Background and literature survey

2.1. Technology transfer

There is significant variation in the broader literature on how technology transfer is defined (see Bell and Figueiredo (2012) for a comprehensive review). In recent years, though, there has been an increasing convergence of how technology transfer is viewed, especially in the context of low carbon technology transfer (Bell and Figueiredo, 2012; Lema and Lema, 2013; Ockwell et al., 2010; Ockwell and Mallett, 2012). Two critical pieces of this emerging view are: (i) technology transfer not only includes the physical transfer of technology codified (or embodied) in equipment and machinery, but also the transfer of associated know-how of the operations and perhaps even deeper knowledge about design and production principles that may allow receiving firms to engage in fresh innovation (Altenburg et al., 2008; Bell and Figueiredo, 2012; Lema and Lema, 2013; Ockwell and Mallett, 2012), and (ii) the level and impact of technology transfer both depend in important ways on the recipient firm and country's technological capabilities to absorb and adapt new technologies (Bell, 1990; Bell and Figueiredo, 2012; Bell and Pavitt, 1997; Ockwell and Mallett, 2012).

Bell's three-flow model of technology transfer from supplier to recipient firms provides a useful categorization of the nature of knowledge transfer associated with different types of technology transfer (Bell, 1990; Bell and Figueiredo, 2012; Ockwell et al., 2008, 2010). Specifically, Bell's model distinguishes between capital and knowledge flows that impact different aspects of the recipient firm's (or country's) capabilities. In Bell's model, there are flows of capital goods and services (Flow A) and of associated know-how (Flow B) for the creation, operation, and maintenance of production facilities in recipient countries. And there are flows of knowledge and skills that enable creation and management of technological change (Flow C).

2.2. Strength of intellectual property regimes

It is widely recognized that technology transfer to developing countries is a necessary component for the widespread deployment of low carbon technologies that can help reduce emissions, limit climate change, and potentially even improve energy security (Dechezleprêtre et al., 2012; Dimitrov, 2010; Ockwell et al., 2008; Sanden and Azar, 2005; Watson et al., 2010). Indeed, commitments of both technological and financial assistance to developing countries for facilitating the transfer of low carbon technologies have been formally made by developed countries at part of international negotiations (UNFCCC, 2010; Ockwell and Mallett, 2012). One factor commonly identified when discussing international low carbon technology transfer is the *strength of the intellectual property regime* in the recipient country, as it has important implications for when and how innovative firms choose to transfer technology (Abdel Latif et al., 2011; Barton, 2007a,b; Hall and Helmers, 2010; Kumar, 2003; Lee and Mansfield, 1996; Maskus, 2004, 2010; Ockwell et al., 2010; Park and Lippoldt, 2008; Srinivas, 2009).

However, there are dissenting views regarding the "ideal strength" of intellectual property regimes to incentivize international technology transfer, especially technology transfer to developing countries. Arguments in favor of weak intellectual property regimes in recipient countries argue that developing countries will be better able to replicate and disperse more advanced technology with weaker intellectual property regimes (Altenburg et al., 2008; Khor, 2011; Kumar, 2003; Srinivas, 2009; TWN, 2008), and that strong intellectual property regimes make it prohibitively expensive for developing countries to acquire advanced technology (Hall and Helmers, 2010; Hoekman et al., 2005; Khor, 2011; Yang and Maskus, 2009). Some also argue that strong intellectual property regimes may reduce the spread of technology if firms prioritize a stronghold on the technology value chain for fear of increasing market competition. If firms wish to retain sole market power, they are better able to do so under strong intellectual property regimes (Lewis, 2007; Maskus, 2000; World Bank, 2010). Although these points are in favor of weak intellectual property regimes, the majority of research suggests that stronger intellectual property regimes will increase the level of innovation and technology transfer to developing and emerging countries.