International linkages for green innovation

The international dimension of green innovation

Green growth and green innovation have global as well as national dimensions. The fact that innovation takes place in a globalised economy (along global value chains) on the one hand and the fact that there are global negative externalities due to climate change and environmental degradation on the other means that the generation and diffusion of green innovations is not a matter for a single country or region.

The development and diffusion of green innovations at world level requires international co-operation in a range of policy areas, not least environmental regulation. While much discussion has focused on issues such as global emissions reductions, and market and policy measures to achieve this, it should be recalled that for many emerging and developing countries the policy focus is on economic development issues, such as poverty, energy, food security and access to water. In many cases this makes them more dependent on exports of natural resources. Green technologies can help these countries achieve development goals while preserving the stocks and flows of natural resources.

Closer to the market for green technologies, international co-operation is necessary for setting global standards on environmental and energy technologies, environmental regulations on industrial production, trade policy and technology deployment mandates. Today, for example, producers of energy-efficient light bulbs face different performance standards in different markets. The result is price effects and impacts on the uptake and diffusion of such energy-saving products. On the supply side, co-operation strategies include: integrated and co-operative R&D in international networks and funding commitments; co-ordination and harmonisation of priorities and research agendas; technology transfer initiatives; and international exchange of scientific and technical information, including mobility of researchers (OECD, 2012a). Among the many perceived benefits are: cost-effectiveness through cost sharing and reduced duplication of efforts; development of absorptive capacity; and accumulation of complementary knowledge by combining the comparative strengths of different countries.

However, difficulties may also arise for international co-operation: lack of continuity of funding at times of constrained budgets; asymmetric benefits and burdens; lack of participation due to insufficient incentives for individual countries, such as unclear technology transfer mechanisms; overall lack of co-ordination and strategic vision; overlap of agreements and programmes.

Given the complexity of the challenges, additional strategies involve greater implication of the private sector, non-governmental organisations, philanthropic organisations, and other stakeholders in the prioritisation and delivery of science and innovation and the use of new financing mechanisms (e.g. securitisation, risk sharing) to provide incentives for global and local innovations (OECD, 2011).

Green technology transfer at the international level

Ensuring a wide diffusion of green technologies will be as important as their invention, in particular in addressing global environmental issues. The speed of deployment of, for example, existing low-carbon technologies will partly determine the global costs of climate-change mitigation and adaptation.

International transfers of green technology still occur primarily between developed countries. Recent data, however, indicate that transfers in green technologies from OECD to non-OECD countries have been increasing over the past years. China alone accounts for three-quarters of the climate-mitigation transfers from OECD to non-OECD countries. There is also significant potential for greater exchange among non-OECD economies, particularly since technologies from emerging economies may be better tailored to the needs of developing countries (Dechezleprêtre et al., 2011).

Adoption of sound environmental policy plays an important role in driving international technology diffusion, as it contributes to the creation of markets for eco-innovations and provides firms with the incentives to acquire new technologies. Indeed, industrialised countries with more advanced environmental regulations have attracted more technology transfers.

However, the lack of strict environmental policy in developing countries is not the only explanation for the lower rates of environmental technology transfer to these countries as there is a similar pattern of low diffusion for all technologies. More general factors such as openness to trade and foreign direct investment, the quality of the IPR system, and local absorptive capacities (e.g. human capital) also help to explain why technology diffusion is concentrated in developed countries.

Technological development, adoption and transfer are at the core of current discussions surrounding the post-Kyoto agreement. Indeed, the 2007 Bali Road Map cites technology development and diffusion as strategic objectives, thereby inciting a debate on appropriate policies and the role of facilitating mechanisms, such as the Clean Development Mechanism (CDM). On-going work (Hascic and Johnstone, 2009) finds that host country involvement in the CDM has encouraged the transfer of climate change mitigation technologies. However, and not surprisingly, the role of CDM in encouraging such transfers is relatively small in relation to other factors. In particular, domestic absorptive capacity appears to play a predominant role – those countries with high domestic technological capacity are more likely to import technologies from overseas.

Since technology transfers take place through market channels such as trade, FDI or licensing, they occur more frequently between open economies. Numerous tariff and non-tariff barriers to trade in green technologies remain in place, however, which inhibit their free flow (Steenblik and Kim, 2009). In some developing and emerging economies, high import tariffs on energy-consuming goods, like air conditioners and refrigerators, combine with subsidized electricity prices to encourage consumers to favour appliances that are cheap to buy but relatively inefficient to operate.

Lowering barriers to trade in services is also important. Deployment of climate-change mitigation and adaptation technologies often depends on the availability of specialised services, including those imported from other countries, notably business services, construction, environmental and energy services. Foreign investment is also important and responds to a healthy business environment that includes adequate governance and economic institutions.

Tension can arise between technology diffusion and maintaining appropriate incentives for investment in innovation which is aggravated by the desirability of transferring clean technologies to emerging countries before they proceed to invest massively in potentially dirty technologies. IPRs provide an important incentive to invest in innovation by allowing firms to recover their investment costs.

Empirical evidence suggests that effective IPR protection is a means to promote technology transfer towards developing countries when foreign technology providers face the threat of imitation by local competitors (Maskus, 2000). Along the same lines, stronger IPR protection encourages FDI and licensing, which induces technology transfer that goes beyond the mere export of equipment or goods.

More generally, there is strong evidence that countries need absorptive capacities in order to successfully adopt foreign technology (Hascic and Johnstone, 2011). The higher the level of domestic human capital the higher the level of foreign technology transfer, as well as the local spillovers from trade and FDI. This highlights the importance of long term education and capacity building policies in promoting technology transfer.

To diffuse green technologies to the least-developed countries, multilateral action might also be considered to reduce the cost of green technologies for these countries, e.g. by covering licensing fees, or even buying out patents on key technologies. Experience in other areas, such as health, shows this can work if well designed and involving the private sector from the beginning. Enabling all countries and firms to build more systematically on the knowledge resulting from basic research undertaken by public institutes would also help.

Almost no South-South collaboration to-date

The benefits of green technologies spill across national boundaries, so a higher level of international collaboration in green innovation would be the expected norm. But as indicated by the incidence of patents with co-inventors from both developing ('South') and high income ('North') countries, the extent of North-South collaboration is almost identical for green patents as for all patents, with both having increased over time. Across all technology areas, 42% of patents with an inventor from the South also had a co-inventor from the North in 2010. Just for green patents, an almost identical 43% had North collaborators. The corresponding figures for 1996 were 35% South-North collaborations across all patents, and 17% collaborations for green patents. Interestingly, these data indicate almost no South-South collaboration: among all green patents granted between 1995 and 2010, there is only one instance of South-South collaboration. Thus, there may be scope for policy to increase international collaboration in green technologies, particularly among developing countries. And even if the benefits from South-South collaboration on frontier innovations are limited, there is a strong case for more collaboration on catch-up innovations when adapted to relatively similar local environments.

Potential for expanding green production and trade

The patent data suggest that there is little capacity for frontier green innovation in most developing countries. However, there could be enormous capacity for *catch-up* green-up innovation through new-to-the-firm adoption and adaptation of existing green technologies, and through indigenous base-of-pyramid innovation. While these are unlikely to be captured in international patent data, they are reflected in the production and trade of 'green' goods and services, to the extent that green technologies are embodied in a good or service.

Environmental goods constitute a non-trivial and rising share of high-income country exports. The share of green exports is slightly lower in most developing regions - but the gap is nowhere near as large as with frontier innovations. However, with the exception of EAP, the share of green exports has not been rising, suggesting that new firms are not entering these sectors. The policy implication of this observation depends on the extent to which this reflects some under-exploited comparative advantages in specific developing countries accounting for lower levels of home production and export of green goods and services. Any policy intervention should be predicated on better information on the sources of this under-exploitation, whether driven by specific market or policy failures. For instance, information on the extent to which the relatively less developed state of environmental regulations in many developing countries may be accounting for these differences could suggest appropriate policies.

Green imports are as important (as a share of all imports) in developing regions as they are in high-income countries. This indicates the international transfer of green technology as embodied in green consumption goods. Further, inasmuch as some of these green goods are used as inputs, this also indicates the 'greening' of the input mix, which may reflect adoption and adaptation of existing technologies by local firms. In addition, the import of green goods may be a response to domestic demand-side green policies in developing countries. However, there is no significant upward trend in any region in particular.

Even if developing countries are not increasing their exports of green products, they could be increasingly capable of moving into green sectors to the extent that they are producing non-green goods and services that enable them to produce green products because of similarities in the required inputs or technologies. To examine this broader 'capability' for green exports, we utilize the concept of 'proximity' between products. For example, a country with the ability to export apples will probably have most of the conditions suitable to export pears, but not necessarily those for producing electronics. In general, the trade in green and ‗close-to-green' products is about three to five times that in green products alone. Moreover, some developing regions like EAP and LAC are

even comparable to high-income countries in this respect.

References

- Dechezlepretre A., M. Glachant, I. Hascic, N. Johnstone and Y. Ménière (2011), “Invention and Transfer of Climate Change Mitigation Technologies: A Global Analysis” in Review of Environmental Economics and Policy, Vol. 5 (1): pp. 109-130.
- Hascic, I. and N. Johnstone (2009), “The Clean Development Mechanism and International Technology Transfer: Empirical Evidence on Wind Power Using Patent Data”, www.oecd.org/environment/innovation [1].
- Hascic, I. and N. Johnstone (2011), “The Clean Development Mechanism and International Technology Transfer: Empirical Evidence on Wind Power”, Climate Policy.
- Dutz, M.A. and S. Sharma (2012), "Green Growth, Technology and Innovation", Policy Research Working Paper 5932, World Bank, Washington.
- Maskus, K. (2010), “Differentiated Intellectual Property Regimes for Environmental and Climate Technologies”, OECD Environment Working Papers No. 17, OECD, Paris.
- OECD (2011), Fostering Innovation for Green Growth, OECD Green Growth Studies, OECD Publishing. http://dx.doi.org/10.1787/9789264119925-en [2].
- OECD (2012a), International Co-operation in Science, Technology and Innovation: Meeting Global Challenges through Better Governance, OECD, Paris.
- OECD (2012b), “Transitioning to green innovation and technology”, in OECD Science, Technology and Industry Outlook 2012, OECD Publishing. http://dx.doi.org/10.1787/sti_outlook-2012-5-en [3].
- Steenblik, R. and J.A. Kim (2009), “Facilitating Trade in Selected Climate Change Mitigation Technologies in the Energy Supply, Buildings, and Industry Sectors”, OECD Trade and Environment Working Papers, No. 2009/2, OECD, Paris.

Links
[1] http://www.oecd.org/environment/innovation
[2] http://dx.doi.org/10.1787/9789264119925-en
[3] http://dx.doi.org/10.1787/sti_outlook-2012-5-en