

The diffusion of innovation in low-income countries

In this Research in Context, innovation theme lead Dirk Willem te Velde and innovation grant holder Xiaolan Fu provide context and analysis for DEGRP-funded project [The Diffusion of Innovation in Low-Income Countries](#) (“DILIC” project).

Beginning in 2012, the DILIC project was led by Xiaolan Fu, Professor of Technology and International Development at Oxford University. Combining broader cross-country analysis and a narrower focus on Ghana - until recently a low-income country (LIC) - it explored the determinants and transmission channels for effective innovation creation, diffusion and adoption in LICs under institutional, financial, and human resources constraints.

WHAT IS INNOVATION?

Innovation is critical for economic transformation and sustained increases in jobs and incomes in LICs. It can improve health, social and environmental outcomes, and is relevant to many dimensions of development goals.

There are various definitions of innovation. The Oslo Manual (OECD, 2005) - international source of guidelines for the collection and use of data on innovation activities in industry - defines innovation as the implementation of:

- a new or significantly improved product (good or service) or process;
- a new marketing method; or
- a new organisational method in business practices, workplace organisation or external relations.

In the context of LICs however, most researchers use a broader definition of innovation, which encompasses not only new-to-the-world invention but also the spread, adaptation and adoption of pre-existing know-how and techniques, services, processes and ways of working.

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The DILIC project takes this broader approach. It considers both technological and managerial innovation, exploring not only brand new-to-the-world products, processes, and practices, but also those that are new to a country, or new to a firm.

Measuring innovation

There are a number of ways to measure whether innovation has taken place. Signs of innovation implementation can be largescale or relatively subtle, and might include:

- Total factor productivity change at firm or sector level
- The presence or introduction of new technology such as computers, mobile phones or other equipment
- A firm receiving internationally-respected quality certificates
- Sales of new or significantly improved products
- Adoption of new management or marketing practices

THE RESEARCH

Aims & methods

The objectives of the DILIC project were to:

- understand the barriers to the creation of innovation in low income countries (LICs);
- analyse the determinants of knowledge diffusion in LICs; and
- examine the effect of external knowledge diffusion to LICs.

To meet these objectives, PI Xiaolan Fu collaborated with a number of innovation specialists, including Professor Pierre Mohnen (Maastricht University), as well as investigators and advisors from: Oxford University; United Nations University – Maastricht Economic and Social Research Institute on Innovation and Technology (UNU-MERIT); the Ghanaian Science and Technology Policy Research Institute (STEPRI); University of Cape Town; Tshwane University of Technology; and the United Nations Conference on Trade and Development (UNCTAD).

Mixed methods were employed, including:

- Literature review
- Cross-country economic study
- New firm-level survey of 500 Ghanaian businesses
- In-depth case studies of 32 firms in the textile/apparel, food processing, mineral processing, wood/furniture, and construction sectors in Ghana
- Statistical analysis of secondary longitudinal firm-level data

Findings

The project yielded a number of findings relating to the nature, impact, and sources (both national and international) of innovation in LICs.

The nature of innovation

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- Innovation takes place everywhere; in developed countries and in LICs, in formal and informal sectors. During 2011-2013, 80% of firms surveyed in Ghana had introduced some form of innovation.
- But, not all innovation is measured using conventional indicators such as patents or research and development. It is often “under the radar” (Zanello et al., 2013).

The impact of innovation

- In LICs, innovation often takes the form of transfer, adoption and adaptation of existing technology, rather than a new invention. This is one reason why patent activity and research and development (R&D) measures are often low in LICs. R&D expenditure to GDP ratios also vary considerably among country groups, from close to zero expenditure in LICs and 0.61 in lower-middle-income countries (LMICs) to 0.96 in upper-middle-income countries (UMICs) and 2.32 in higher-income countries (HICs) in 2011. The share of R&D spending from foreign sources is larger at lower per capita income levels.
- Diffusion and learning-based innovation has enabled firms in LICs to survive and grow. The DILIC survey of 500 firms in Ghana suggests that innovation raises labour productivity of firms through learning (Fu et al., 2014). However the low level of investment in technology-intensive innovations results in a slow process of structural change and industry upgrading.

The sources of innovation in LICs are often external

- Innovative export upgrading (increased product sophistication) in LICs depends on capital deepening, engagement in knowledge creation, knowledge transfer via investment in education and R&D, and foreign direct investment and imports. Cross-country analysis for 171 countries over 1992-2006 shows that the effect of a country’s domestic R&D on export sophistication is insignificant for low and low-middle income countries, while the effects of imports, foreign direct investment and education are positive and significant (Zhu & Fu, 2013).

Analysis of region-specific firm and industry data for Ghana suggests that import of Chinese products has a significant positive impact on total factor productivity at the firm level, which in turn suggests that Ghana is learning useful lessons from its interaction with China (Fu et al., 2015).

Innovation depends on participation in value chains and the formation of national/regional (if not global) production networks

- Forming national or cross-African vertical production networks allows firms to produce more sophisticated products, whereas single firms typically don’t have the capacity to do so (Fu et al., 2014).

Support systems are often inadequate or unknown to investors

- The survey in Ghana suggests that whilst firms are often innovative, and the Ghanaian government well-regarded as an innovation partner, most firms do not benefit from extension services such as loans or training. On the one hand, firms have little knowledge of the policy

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instruments available to them. On the other, innovation is not always recognised and/or measured by government, who therefore do not sufficiently support innovation efforts within the firms (Fu et al., 2014).

Interpretation

Some of these findings confirm existing knowledge on innovation that emerged in the 1970s, 1980s and 1990s. For example, the project's econometric findings confirm that technology diffusion and adoption depends on targeted technological efforts, sufficient human and financial resources and absorptive capacity and competitiveness achieved through international integration and competition (Lall, 1992, 2001; Cohen & Levinthal, 1989).

A number of other findings, however, represent new contributions to this existing body of knowledge. The finding that Chinese imports have actually led to firm upgrading in Ghana, for example, goes contrary to the traditional concept that exports are good and imports are bad. In highlighting the positive yet indirect effects of Chinese imports, it shines a different light on Sino-African trade relations, and is therefore a valuable addition to the increasing amount of research being conducted on the impact of Chinese trade with LICs.

The originality of this study also lies in the collection and use of new data and applications in specific empirical contexts. The survey used for DILIC's firm-level analysis of Ghanaian businesses, and resultant dataset of up-to-date information, provide new opportunities for the study of innovation behaviour and creation of new initiatives and improved innovation policies.

Wider relevance

In highlighting the crucial role of innovation as a means of firm survival, the DILIC research is relevant on a national, regional and global level.

National

It is anticipated that the findings will inform national policy decisions, and in fact this is already occurring. The survey data on Ghanaian innovation activity suggested a lack of significant linkages between innovators and universities in Ghana. Having learned of this, the government of Ghana is now using the findings of the research programme to inform future programmes that link universities and innovators.

Additionally, the DILIC survey instrument can be used to conduct similar research in other countries. The resulting enhanced dataset can then be used to analyse innovation behaviour, forming the basis for new initiatives and improved innovation policies.

Regional

As underlined by the African Union 2063 agenda, structural transformation is crucial for Africa, and innovation and industrialisation are key tools for achieving it. Yet there is often a temptation for LICs to take a mercantilist approach and develop their industries behind closed doors. Nigeria's drive for industrialisation, for instance, has often come with more restrictions on foreign exchange and imports. Similarly the Rwandan government has recently reacted to increased Chinese imports by raising import barriers, a move likely to damage Rwandan industrial development in the long term. DILIC project findings on the benefits to Ghana of free flows of trade and information are valuable evidence to the contrary, as they indicate that upgrading can be achieved without erecting barriers.

Global

Until last year, global development debates had largely ignored the importance of innovation. Now, under the leadership of a range of developing countries, and supported by international organisations such as UNIDO, the Sustainable Development Goals include a goal on innovation (SDG9). The research team interacted with these debates, with findings playing an important role in shaping high-level decision-making about the new SDG innovation goal.

CONCLUSIONS

This research project has major implications for practically-oriented research into the nature and scope of innovation activity and the determinants of its creation and diffusion.

It finds that learning-based and low cost technological and managerial innovations *do* take place across a wide spectrum in the Ghanaian economy, but that they have yet to spur the structural change previously achieved in many East Asian countries. A key question, therefore, is how can this be done?

Lack of finance and skills are found to be the major constraints to innovation in low-income countries. Specifically, the research reveals that collaboration in general, and business-university collaboration in particular, is limited in LICs. Further research will be helpful for understanding the factors (structural, policy and institutional) that could strengthen such linkages.

The research also confirms that collaboration along the value chain at the national/regional level brings significant benefits, enabling LIC firms to produce more sophisticated products. This helps product diversification and structural change. More research is also needed, therefore, into the development and impact of regional value chains.

Finally, the project has begun to examine differences in innovation between firms managed by women and men. Findings suggest that firms managed by women are less likely to introduce technology based innovation, but are more active in adopting other types of innovation. Understanding the major constraints to women entrepreneurs and how policies can help foster more innovation and empower women in LICs would be a valuable contribution to innovation knowledge.

REFERENCES

African Union Commission (2015) Agenda 2063. AU Commission. Available online at: <http://www.un.org/en/africa/osaa/pdf/au/agenda2063.pdf>

Cohen, W. and Levinthal, D. (1989) Innovation and learning: The two faces of R&D. *The Economic Journal*. 99 (397): 569 - 596

Fu, X., Hou, J., Mohnen, P. (2015) The impact of China-Africa trade on the productivity of African firms: Evidence from Ghana. Working paper. Oxford: Oxford Department of International Development.

Fu, X., Zanello, G., Essebey, G., Hou, J., Mohnen, P. (2014) Innovation in low-income countries: A survey report. London: DEGRP.

OECD/Eurostat (2005) Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data. 3rd Edition. Paris: The Measurement of Scientific and Technological Activities, OECD Publishing.

Lall, S. (1992) Technological capabilities and industrialization. *World Development*. 20 (2): 165-186.

Lall, S. (2001) Competitiveness indices and developing countries: An economic evaluation of the global competitiveness report. *World Development*. 29 (9): 1501-1525.

Zanello, G., Fu, X., Essebey, G. (2013) Innovation under the radar in low-income countries: Evidence from Ghana. PowerPoint presentation from UNU-WIDER Conference, Helsinki, Finland. Oxford: Oxford Department of International Development.

Zhu, S. and Fu, X. (2013) Drives of Export Upgrading. *World Development*. 51: 221-233.